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(Editors)

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"Internet and Modern Society"  
IMS-2021**

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**Proceedings**

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# 24th International Conference “Internet and Modern Society”

## IMS 2021 Editorial

The proceedings consist of the papers which were selected by the Program Committee for the International Conference “Internet and Modern Society” (IMS-2021). Due to the spread of COVID-19, the conference was held during 23-26 June 2021 in the hybrid format which let to mix online and offline participation that enriched the discussion. The IMS-2021 brought together scholars from Belarus, China, India, Russia, Singapore, Slovakia, Spain, and the USA. The conference was organized by the ITMO University during the Information Society Week in St. Petersburg, Russia. The events of IMS-2021, which focused on specific aspects of information society and digital transformation, were **International Workshop “Information Systems for Science and Education”, International Workshop “Internet Psychology” (IntPsy-2021), International Workshop “Computational Linguistics” (CompLing-2021) and International Workshop «E-Governance2021»**, as well as **Young Scientists Symposium**.

Prior to the conference the Program Committee comprising of the recognized researchers from 14 countries had conducted a rigorous peer review, with 41 papers accepted for the publication.

The goal of the **International Workshop “Internet Psychology” (IntPsy-2021)** was to create a platform for experts and researchers’ collaboration and discussion of the issues related to the transformations of human behavior and communication in the network society, the influence of ICTs on cognitive development of children and adults and their personality, as well as issues related to the methodology of psychological research on the Internet. The workshop IntPsy 2021 was focused on the following topics: Online Cognition, Digital Socialization, Identity & Self-Presentation Online, Psychology of Gaming & Cybersport, The Use of Immersive and Augmented Reality in Psychology, Problematic & Pathological Online Behavior, Psychology of Social Networking & Mobile Interactions, Big Data in Cyberpsychology Studies, Psychological Aspects of Cybersecurity.

The goal of the **E-Governance2021** workshop was to discuss the problems of new forms of interaction between citizens and the state in the digital environment, to develop the idea of digital citizenship, to identify the challenges and risks of digitalization of the public sphere, to determine the role of trust in digital technologies on the part of citizens and public servants. The participants of the workshop discussed the following topics: E-participation, Digital Public Sphere, Digital Citizenship, Trust in Digital Technologies, Participatory Governability, Crowdsourcing, Citizen Sciences in Digital Environment, Big Data, Policy Processes and E-participation.

The goal of the **CompLing-2021** workshop was to discuss the actual issues of interaction of linguistics and information technologies – regarding the development of technology solutions based on the natural language processing, and the influence of information technologies on the language. Target audience are linguists of all profiles, the staff of organizations developing information systems that involve natural language processing, specialists in knowledge representation, higher education teachers, translators. The workshop was focused on the following key topics: Computer Modeling of Language, Computer Analysis of Natural Language, Corpus Linguistics, Digital Linguistic Resources, Computational and Linguistic Ontologies, Information Extraction, Document Analysis, Information Retrieval, Machine Translation, Computational Lexicography, Speech Technologies, Linguistic Analysis of Social Networks.

The goal of the **International Workshop “Information Systems for Science and Education”** was focused on the following topics: e-learning, online education, digital libraries, electronic multimedia collections, and tools for extracting and analyzing contextual knowledge.

The conference traditionally pays great attention to and encourages research by young scientists. The **Young Scientists Symposium** has brought together researchers who are just starting their scientific careers with recognized scientists whose scientific interests include special aspects of information society and digital transformation. All papers were peer-reviewed in accordance with the requirements of IMS-2021.

As previously, the research part of IMS-2021 was structured around paper sessions within the workshops and Young Scientists Symposium giving the floor for presenting the results of studies. Accordingly, the proceedings of IMS-2021 consist of two parts: 1) papers presented within the international workshops; and 2) papers presented within the Young Scientists Symposium.

We would like to thank those who made this event possible and successful. Our gratitude is especially expressed to the Program Committee members for their contribution to the event. We thank the authors for presenting their papers and the session chairs that led fruitful discussions. We are grateful to all organizers and representatives of institutions, who contributed to the success of this conference; and we are proud to attract a great team of scholars from different countries and disciplines. We will work further to sustain and expand the IMS community through joint research and collaboration. There are the beliefs that the IMS has the good potential to turn into a new important forum for further academic discussion.

The international conference was held in cooperation with the Russian Association of Political Science and with the support of the Committee on Science and Higher Education of the St. Petersburg Government, Russia.

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## **PART 1.**

### **Internet and Modern Society**

## **Information Systems for Science and Education**



# Software for Modeling Deliberative Argumentation: Requirements and Criteria

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## Abstract

Methods of deliberative argumentation are widely employed for solving applied tasks in various fields of practical activities, where choosing of a line of behavior in a certain situation or making decisions is at stake. These methods enjoy permanent attention in the contemporary education with respect to teaching argumentation and training the critical thinking skills. In the last three decades, the progress in the information and communication technologies has led to the development of software designed for visualization and modeling of deliberative intellectual activity for solving various kinds of practical tasks and for supporting the relevant education. We propose the five (groups of) criteria for developing the software designed to model and represent deliberative argumentation, which have to be observed both in the development software and in its classification. We suggest four ontologies for such software, which will enhance implementing functions for evaluating arguments and finding solutions in such software.

## Keywords

deliberative reasoning, conceptual bases, software, modeling, representation

## 1. Introduction

In contemporary society, deliberative argumentation is widely used in various areas of human activity, where the results are achieved in the process or with the help of substantiating actions and justifying decisions. Such areas include law and jurisprudence, politics, public administration, social interaction, science, etc. The deliberative, or practical, argumentation, is distinct from the theoretical, or discursive, argumentation. The former focuses on justifying claims about the line of behavior in different circumstances – how to act in certain situation or what should we do with respect to certain goals and intentions. The latter pursues the justification of claims' truthfulness, and the discursive arguments are put forward to support or criticize the claims. The discursive arguments as well as the claims themselves are descriptive propositions which can be true or false. The deliberative arguments consist of descriptive and non-descriptive sentences expressing norms, values or intentions playing key role in justifying or refuting their conclusions expressing intentions to act [1]. These formal and semantic differences of discursive and deliberative arguments is connected to the properties of intellectual agents participating in the argumentation of those two kinds and entail differences in how the arguments are evaluated. On one hand, the deductive arguments, mostly regarded the strongest in the discursive argumentation, are seldom applicable in the deliberative argumentation. On the other hand, the non-deductive plausible arguments, the most persuasive in the deliberative argumentation, which include such widely used schemes of reasoning as appeals to expert opinion, to consequences, negative or positive, to popular opinion or behavior, etc., are often considered fallacious in the discursive argumentation.

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The structure of intellectual agents in the discursive argumentation presupposes exclusively descriptive elements, such as knowledge and opinions (beliefs), and in the deliberative argumentation it also includes their opinions about norms, values, as well as desires, goals and intentions. Accordingly, there are special requirements for the agentive properties that are imposed on the agents with respect to evaluation of deliberative arguments, for example, whether an agent is a reliable source of information when the argument at question appeals to his or her authority, whether he or she is an expert in the issue under consideration when it appeals to his or her expert opinion, whether he or she is trustworthy in assessing the consequences, etc. Deliberations often involve many people, and therefore it is necessary to take into account many individual and group parameters in justifying decisions by means of the arguments [2].

To enhance intellectual activity, many approaches based on the implementation of elements of argumentation and deliberation in software have been proposed, developed and applied. They aim at supporting the deliberation in decision-making in various areas of human activity, for example, medicine [3], public policy and e-democracy [4, 5], law [6, 7], scientific argumentation [8, 9, 10], business and other areas.

Our present study is one of the stages of a comprehensive research project conceived to assess the adequacy of modeling of argumentation by means of appropriate software and information systems. The project aims to bridge the theoretical gap between the concepts of argumentation, implemented in the software, and the concepts of argumentation, yielded by academic studies of argumentation. At the previous stages of our research project, we 1) studied the capabilities of the software for modeling argumentation [11], 2) identified the key characteristics of the software designed for modeling argumentation, deliberative reasoning and mind mapping [12], 3) formulated the conceptual foundations, or criteria, for assessing the software, by which we divided it into two groups - on the basis of its descriptiveness / normativity and on the modifiability of reasoning [12, 13].

As part of our previous research, we have selected and assessed the software and information systems aimed at supporting the representation of reasoning and critical thinking. The development of such systems and their applications started in the mid-90s of the XX century; and their active development and updating continues up to this day with the top intensity of the development in the first decade of the XXI century.

A characteristic feature of the development of the software is that the ideas of its development are born inside interdisciplinary academic communities, whereas the conceptual projects for its creation are realized mainly by the representatives of the logical community including logicians and specialists in logic programming and artificial intelligence. Here is a list of the most widely used software products for modelling argumentation and reasoning:

- OVA – developed by the Centre for Argument Technology of Dundee University (Scotland), incorporates D. Walton’s ideas of ‘new dialectic’;
- Carneades – developed by T. Gordon (Potsdam University) and D. Walton;
- Rationale – initially developed by T. van Gelder’s team in Melbourne University; today is a commercial software <https://www.rationaleonline.com/>;
- bCisive – elaboration of Rationale for representation of argumentative support of decision-making (<https://www.bcisiveonline.com>);
- Belvedere – initially developed by A. Lesgold and D. Suthers team in the University of Pittsburgh, later elaborated by D. Suthers’s team in Hawaii University.

The existing software is used mostly in teaching critical thinking and argumentation skills, for example, Belvedere [10], LARGO [7], ARGUNAUT. Some systems are initially designed to teach critical thinking and argumentation skills in jurisprudence - Carneades, ArguMed, LARGO, QuestMap, others - in research or all-purpose argumentation in general, for example, Belvedere [14], SenseMaker, Convince Me [15]. Some software products have been developed to implement the IBIS (Issue-Based Information System) methodology [16] for joint planning and design in various subject areas. The earliest implementation of this methodology is gIBIS [17], followed by QuestMap and Compendium [18]. Some software products are used independently of specific subject areas for training general skills related to critical thinking and practical argumentation, for example, Rationale and bCisive [19], Hermes [20].



Carneades, OVA and some other software abstract from the distinction between defeasible argumentation, which is based on plausible arguments mostly used in deliberative argumentation, and infeasible argumentation, which includes deductive and inductive arguments [21, 22]. The abstraction allows modelling both the discursive and the deliberative argumentation, but at the cost of a vague mechanisms of its assessment.

With respect to its practical purpose and regardless of its subject area, the software can be divided into the following groups:

- for modeling of argumentation;
- for visualization of the discursive and deliberative reasoning;
- for mind mapping.

This division is arbitrary as some software systems fall into more than one group. Nevertheless, its criteria put as the groups' titles provides us with a preliminary clue for sorting the software.

The diversity of available software is rooted in the manifold approaches to its creation. However, most of the software systems have some common characteristic features which have been observed in recent review papers appeared as a output of its comprehensive comparative studies. One of such studies is the LASAD project carried in 2008-2013 [23], in the framework of which its team examined 45 systems available to the time and designed for supporting the representation of argumentation and critical thinking. The project team compared the software in relation to the goal of using these systems for teaching reasoning and critical thinking skills and identified the key functional characteristics implemented in them.

## **2. Implements of elements and functions of the deliberative argumentation in the software**

We limit our study of the software to the products designed for modeling argumentative dialogues (disputes) and represents the argumentation in the form of graphs and protocols. The software designed to visualize argumentative dialogues offer no tools for scoring assessments of arguments and establishing solutions to disputes, which means that with respect to the analysis of argumentation, it has descriptive character even in those cases where it implements the concepts regarded normative by their developers, as in cases of Rationale and bCisive which are said to imply the code of critical discussion in pragma dialectics [19], or OVA and Carneades, which involve evaluation of arguments by means of the critical questions [24]. The developers of the software do not explicitly suggest using it for intellectual support of deliberative reasoning, but it is applicable for visualizing some aspects of public deliberations.

Deliberative public opinion plays an essential role in political decision-making and formulating of the political and social agendas in the deliberative democracy with its evolving contemporary feature of disagreement and polarization about many issues. Special software systems and platforms are developed (DemocracyOS, Democracy 2.1, Loomio, OpaVote, Delib, Decidim and others) for supporting of the deliberative democracy. Most of them are social platforms for polls, exchange of views, debates and discussions, they aim at supporting decision-making in state and municipal management, which remain human-oriented. These systems implement technologies for collecting and processing Big Data by statistical methods and imply no function of solving the discussed problems.

There are several levels of implementation of deliberation elements in the software:

- multi-user synchronous (on-line) and asynchronous (off-line) mode for collective argumentation mapping in teaching argumentation skills - Belvedere, OVA, Hermes;
- dialogue modes through feedback toolkits for controlling students' activities and progress (Digalo, ARGUNAUT) or for playing dialogues in teaching critical thinking skills (AcademicTalk, InterLoc), which can be used for group deliberations, too;
- web-oriented systems for wide disputes, which allow an unlimited number of participants to interact in the debates (DebateGraph (<http://www.debategraph.org>) or Collaboratorium [5]);
- constructing arguments, in which users can themselves pick and assemble argument components (Digalo, Athena), which allow modeling their deliberations, too;

- evaluating justification of statements by weighing single pro and contra arguments with the help of special assignments (Carneades, ArguMed), which support determining the solutions [25].

Recently the Critical Thinking Skills BV, the developers of Rationale, have proposed a new software for modeling decision making bCisive (<https://www.bcisiveonline.com>), which is based on the concept of deliberative protocol [26]. They suggest bCisive for visualization of deliberative reasoning and decision support and consciously avoid differentiating between those two otherwise distinct modes of practical argumentation.

In other approaches some developers propose to supplement the ontology of argumentation with "means that allow modeling the audience to which the arguments are directed, and means that allow representing the content of the statements included in the arguments" [8], which open a possibility of taking into account the parameters relevant for the tasks of discovering arguments with special focus on deliberative argumentation.

As regards the modelling of the deliberative argumentation, most of these developments towards creating the software are capable for modelling it either as a side result of their modelling of argumentation and reasoning, in general, or are adjustable for that with subsequent reservations. At the present, there is no software comprehensively aimed at supporting the deliberative argumentation with functions of evaluating arguments and finding solutions.

### 3. Guidelines for the software for modeling and representation of deliberative argumentation with a resolution function

There are diverse approaches and methods to the development of the software designed to model and represent argumentation. The developers seldom clearly indicate the requirements and criteria by which they were guided when creating their software. We examined the software toolkits [23, 27, 28] along with the conceptual approaches to their design [8, 29, 30] and found a number of problems that, on the one hand, restrict the comprehensive use of the software for modeling argumentation and deliberative reasoning, and, on the other hand, resist development of a unified general approach to designing of the software for both representation of argumentation and deliberative reasoning and implementing algorithms for searching solutions:

- unavailability of systems' technical documentation, which prevents implementation of the successful solutions in further developments and creating of the integrative solutions based on using the advantages found in different systems. The documentation for the system installation as well as in the user manuals, which is available in many cases, is of little help for solving those tasks;
- low flexibility in the system settings, which prevents configuring it for specific use. For example, the preset argumentation schemes or types of visualization presuppose no modifications;
- implementation of specific conceptual foundations restricts application of the software for solving a wide range of tasks in modeling argumentation.

There are two other obstacles to exploring and approbation of the software: some products are no longer supported by their developers; others are described only in research papers (ProGraph, ConArg2) which contain no links to the software itself. In general, most projects in the field explore just some of the special aspects of the software design, and very few of them comprehensively focus on its design and development. The special properties of the software for modelling of the deliberative argumentation are left outside the research scope of those projects.

One of the notable achievements in the examination of the software is the LASAD (Learning to Argue - Generalized Support Across Domains) software platform [3, 30, 31, 32] developed with the support from the German Research Foundation (DFG) (<https://www.dfki.de/en/web/research/projects-and-publications/projects-overview/projekt/lasad/>) by the German Research Center for Artificial Intelligence in cooperation with Clausthal University of Technology in 2008-2010. The LASAD team explored the existing software and approaches its creation [23], compared them to the platform developed by themselves and proposed a concept for the creating of a software platform which would consider the challenges and shortcomings in existing systems identified by the team. One of the LASAD goals was to simplify the creation of the formal argumentation systems by means of a flexible configuration mechanism [27], for which the team formulated the special requirements and implemented them in developing of their platform:

- 1) general properties – special conditions for installation, maintenance and use;
- 2) cooperation (joint work) – toolkits supporting joint work;
- 3) analysis and feedback implementing machine learning in the libraries of samples and templates;
- 4) ontology, based on definite conceptual foundations (Tulmin [33] or Wigmore [34]) and providing the possibility of employing the system for solving various tasks belonging to diverse subject areas;
- 5) diversification of the options for visualization and representation in the data sets including argument maps;
- 6) journaling for the discovering, modelling and restoration of the argumentation processes and output in full-fledge explicit forms for spotting fallacies. This requirement ensures the entry of new participants into the already running joint activities including the argument mapping.

These groups of requirements clearly aim at creating of a software system that can be effectively used in education for training of practical argumentation and critical thinking skills relevant in many subject areas. Modular approach of the software designed according to the LASAD requirements presupposes flexibility and extensibility, which allows creating, updating, and applying of the special modules with additional functional potential for solving specific tasks. The architecture of the designed platform reflects the modular approach.

The LASAD system of requirements includes no special guidelines for modelling of the deliberative argumentation, although it contains some elements adjustable to support the deliberative reasoning. Another restriction is that it lacks explicit criteria which would allow implementation of the function for identifying the solutions. Yet another restriction is that the platform is available only in the form of source codes (<https://sourceforge.net/projects/lasad/>) and is impossible to properly testify its work, as it is available in its beta-version, and its demo version is blocked by an empty link to (<http://lasad-demo.cses.informatik.hu-berlin.de>).

The developers of another kind of the software suggest employing of an ontological approach with an extensible ontology [8]. The proposed extension is justified by the tasks of modelling of argumentation in popular scientific discourse, where it is necessary to consider the reliability of the sources of scientific information or the characteristic properties of the audience. They rely on the AIF ontology (Argument Interchange Format) [35] which represents arguments as graphs. The software has the following functions [29]:

- storage of argumentative markup of texts, as well as of the information about the source of argumentation (storage of annotated text corpora);
- genre-, subject area- and linguistic-sensitiveness to the style of the discourse, where the argumentation at question is found;
- a comprehensive analysis of the created argumentation graphs (argumentation maps).

The software can verify the argumentation graphs as an option of the general assessment of the argumentation. The automatic verification algorithms of the software can search for the cycles, analyze the connections, consider the textual indicators of argumentation, compare the obtained maps. For the automated analysis of argumentation, the software proposes the following functions: search in the corpus of experts' output in the system; preparatory processing of texts with marking out the indicators of argumentation; assessment of the arguments' persuasiveness.

The developers certified their software and registered it according to the legal rules of the Russian Federation [36]. Although the software is thoroughly described and screenshotted in the academic papers, nevertheless its unavailability for regular testifying and use limits its assessment to purely theoretical. According to the papers, the key advantages of the software include the possibility of extending the ontology with deliberation elements (value attitudes, weights of arguments, etc.), as well as a special algorithm that "calculates the weights of conclusions by carrying out calculations along a chain, in which the conclusion inferred out of an argument serves as a premise for the next argument, including the pieces of reasoning in which the chain mapped in one and the same graph involves not only supporting claims but the conflicting claims as well as [29] ". For the calculations, the system is operated by a truth values algebra based on fuzzy logic. Alternatively, it contains the algorithm for weighing of premises and conclusions by user manual assignments. Judging by these properties, the software can be classified as proposing a mechanism for solving argumentative tasks and can be applied for automated decision-making in the deliberative reasoning.

Its key restrictions amount to the risks of subjectiveness in the manual assessment of the premises and in its non-flexibility of varying the modes of evaluating arguments in relation to different types of

dialogues. Plausible arguments can be acceptable in deliberations as well as in other types of dialogues, in which they can be assigned with positive weights. However, such arguments can be fallacious in the discursive argumentation, for example in formal or critical discussions which instantiate what we call scientific discussions, and in those dialogues the same plausible arguments have to be assigned with negative weights. Other restrictions of the software include the following:

- visualization is limited to graph representation;
- the system is limited to the analysis of argumentation in popular science discourse, although the developers promise to further elaborate the software for making it applicable in broader subject areas;
- there are no functions of joint activity, feedback and restoration of argumentation.

In general, the descriptions of the key functions of the software and its general functional properties can be taken as requirements for the design and development of that kind of software.

The above considered approaches to designing and creating of the software for modeling and representation of argumentation point to two essential shortcomings. Either there are no requirements or criteria that are explicitly put as those that should be or are taken into account in its development with respect to solving broad or specific tasks related to the deliberative argumentation, or the software or approach to creating it exhibit sensitive functional limitations for its use, which are generated by overly broad or narrow criterial toolkit.

We propose our approach to the development of a body of criteria (requirements) that have to be considered in the development of the software for modeling the deliberative argumentation. The proposed criteria include the guidelines for implementation of a function of arguments' evaluating and finding solutions, and can be taken into account both in the applied and the conceptual agendas of designing of the software. Our proposal is based on the three following issues:

- exploration in the research approaches and publications relevant to designing and development of that kind of the software;
- the results of our own research;
- our experience of using the special software in research and teaching.

We propose the following five (groups of) criteria which take into account definite special properties of the deliberative argumentation as well as presuppose necessary functional options for arguments' evaluation and search for solutions (Table 1).

In the technical documentation of the software, it is preferable to explicitly reflect the cases when the developers consider some (group of) criteria relevant or irrelevant for the software they create.

The development and use of ontologies belong to the key logical and conceptual criteria determining the possibility of modeling of the deliberative argumentation. We propose to use four kinds of ontologies and to implement them as the corresponding libraries: arguments, relations (functions), dialogues (disputes), and agents. As a foundation for their construction, we suggest employing the Argument Interchange Format (AIF-Argument Interchange Format) proposed by an international team of argumentation researchers [35]. AIF covers the first three libraries, but includes no elements for agent profiling. At the present stage, AIF is a common platform for the following three different trends in the development of the software products for modelling argumentation:

- Argumentation protocols, for example, ASPIC+ with molecular arguments, [37],
- Software for visualization of argumentation, such as Rationale [38] or OVA [39],
- Descriptive logic matching tools of mathematical logic and IT-representation of knowledge [40, 41].

The AIF is a template for building ontologies, and it is a result of the collective efforts of the scientists in their development of those three directions and in creating it as a lingua franca of formal, or computational, argumentation analysis. Similar to how gadget users are divided into those who prefer either iPhones or android smartphones, AIF divided the software products and the formalisms for the analysis, modeling and visualization of argumentation into two groups, into those which employ that format as a basic ontology or those which are based on the specially constructed formats. This allows classifying the software products with respect to the ontology employed. Thus, the LACAD project employs not AIF, but a different specially created ontology. The developments of Russian scientists [1] and [8] are based on AIF.

**Table 1**

Necessary criteria for developing of the software for modeling the deliberative argumentation, evaluating arguments and finding solutions

Groups of criteria	Criteria	Explanation
logical	Syntactical and semantic aspects of arguments Dialogue graph representation Modifiable ontologies	The criteria consider the qualitative structure of arguments, requirements for ontologies and argumentation schemes. For example, argumentative marking involve examination of the semantic and syntactic aspects of the structural elements of the created schemes and diagrams, the compositional relations between atomic and molecular elements, etc.
Pragma-linguistic	Rhetorical text mapping Coding and decoding of messages	Considering and profiling of the speech actions by which arguments are put forward
Communicative	Multi-use options for joint work Support of collaboration in deliberation	These criteria ensure the possibility of using the software for deliberation both in the professional activity for collaboration and joint work of individual participants and groups, and in teaching and training of the corresponding skills.
Methodological	Modifiable argumentation Defeasible arguments Journaling deliberations (protocols)	Reflect the goals of the software and special features of its application
Digital-technological	Modular architecture Options for extending or modifying of the software Support of the user-friendly configuration by web- interface Support of cross-platform adaptability Exportation of the argumentative maps (schemes, diagrams) in the formats supported by other widely used software Journaling and profiling of the software design and work	Relate the aspects of the software application to its design and creation

The basic AIF ontology contains two key groups of elements which can be viewed as conceptual and formal. To express them, AIF provides two ontologies, an ontology (conceptual) of forms and a top-level ontology, respectively. The formal elements represented by the top-level ontology are a kind of syntax for representing arguments by means of graphs which consist of nodes and edges. The ontology of forms reflects the substantive elements of arguments, such as premises, conclusions, assumptions, exceptions, schemes of argumentation, criticisms, etc., which are designed for making the top-level ontology meaningful by representing individual arguments, for example, the deductive or the plausible, or representing the types of disputes. AIF and the visualization of arguments with the help of ontologies based on this format can be compared to Wigmore's argumentation and Toulmin's argumentation models, respectively.

In the top-level ontology, there are two types of nodes, information nodes (I-nodes) containing information about the elements of the molecular arguments - premises, conclusion, exclusions, etc., and circuits, or schematic nodes (S-nodes), representing the types of atomic arguments by their structure and forming the three following groups:

- RA (Rules of Arguments) nodes of inference rules,
- PA (Preferred Argument) preference nodes,
- CA (Conflict Argument) nodes (types) of conflicts of opinions.

S-nodes act as nonspecific structural or functional schemes for I-nodes.

The nodes RA, CA and PA express the properties of argumentation at its three levels, respectively, on the level of individual arguments, of the relations between arguments in the framework of the sets of arguments presented by the agents of the dispute, and of the assessments of individual arguments relative to each other. In the three directions of the analysis of argumentation, in their formalisms, the nodes RA, CA and PA are used with different degrees of detailing.

At the present, RA nodes are the most developed, they imply two types of inference rules and divide arguments by the method of demonstration, the connection between premises and conclusions, into the deductive and defeasible arguments. We consider this division confusing and below propose a different one.

CA nodes are designed to express schemes of criticism and differentiate between its two types, symmetric, when in a pair of arguments one attacks the other and vice versa, and asymmetric, when in the pair one attacks the other, but not vice versa. With respect to the elements of argumentation, between which the relation of criticism is established, the CA nodes mark two of its structural types, between the points of view of the parties and between the arguments the parties put forward for their defense or refutation. In relation to criticism and refutation, the CA-nodes contribute to distinguishing between the kinds of disputes depending on the type of disagreement in opinions and imply two types of disputes: asymmetric dispute-disagreement, when one agent defends his or her point of view from doubts or criticisms of another agent who have no point of view other than the opposite to the first one; and a symmetrical dispute-conflict, when each agent defends his or her point and criticizes the opposite point of view. The dispute-conflict can be viewed as two corresponding disputes-disagreements. The varieties of asymmetrical CA nodes are used to express refutation, by which one argument attacks another one in two ways: by undermine which questions the premise or undercut which doubts the demonstration. The undermine and the undercut can be refined by considering the relevant argumentation schemes.

The least developed are PA nodes, designed to express the ratio of assessments of the acceptability of arguments and to play an important role in the search and selection of dispute solutions.

AIF provides three types of relations between elements of the two ontologies: to be a subclass, to fulfil, and to include. For example, CA nodes are a subclass of S-nodes, they fulfil (functions of) criticism schemes and include two kinds of elements, the attackers and the attacked.

Ontologies generated by means of AIF model a dispute in the form of a directed graph, the nodes and edges of which model the arguments put forward in the dispute and forming up its network of arguments. Depending on the properties of the formalism created on the basis of AIF, the nodes express the necessary properties of arguments, such as inferential quality, acceptability, belonging to the position of an agent, etc., while the edges characterize the three types of connections between arguments or relations between their internal elements. The edges of information connecting I-nodes with S-nodes represent the structure of information at the level of individual arguments, for example, the function of an argument premise fulfilled by a proposition. The edges of inference connecting S-nodes to I-nodes express the kind of demonstration, or the kind of argument; and the edges of justification connecting different S-nodes to each other represent the structure of argumentation within an agent's position or on a (sub-) set of arguments in the dispute.

For modelling of the deliberative argumentation, we propose to supplement AIF (Fig. 1) to DelibAIF (Fig. 2) by means of the following three modifications.

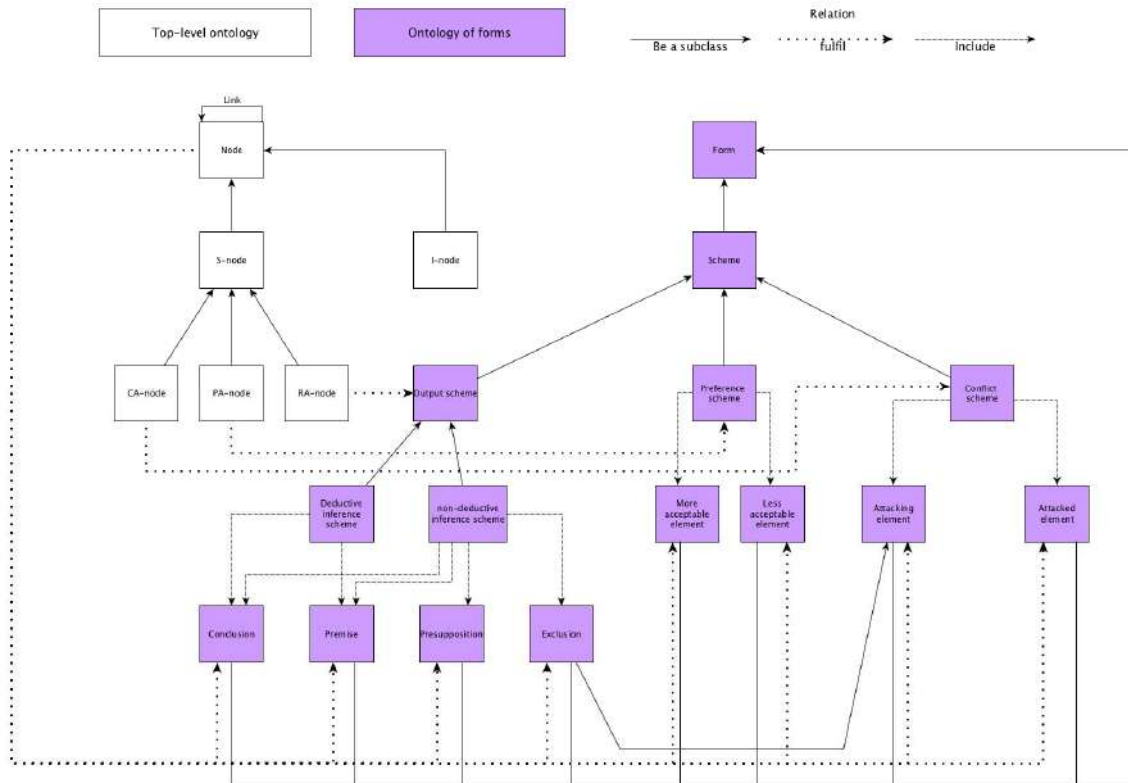


Figure 1: Standard AIF

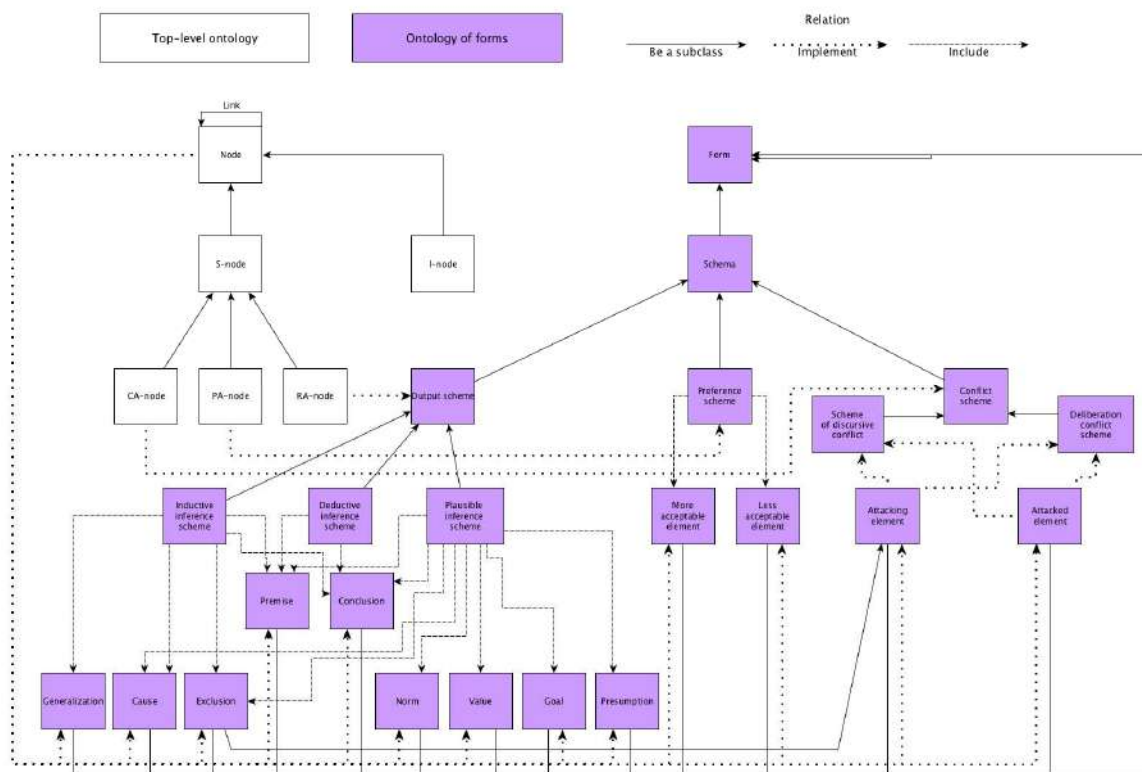


Figure 2: Modified AIF (DelibAIF) for modelling of the deliberative argumentation

First, in RA nodes of inference schemes, we propose to abandon the vague division of schemes into the deductive and the defeasible and to replace it with a division into three classes: deductive, inductive and plausible schemes. Then, indefeasible schemes will consist of the first two classes of the deductive

and the inductive schemes; and the second and the third classes, i.e. the inductive and the plausible schemes, together with make up the class of the non-deductive schemes. There is no need of adding elements such as infeasible or non-deductive schemas to DelibAIF as separate subclasses of the *Inference Schemes* class.

Secondly, to the four structural elements already present in the AIF - *premise*, *conclusion*, *assumption* and *exclusion* we propose to add the following five: *generalization*, *cause*, *goal*, *value*, *norm*. The elements *premise* and *conclusion* are necessary in any argument, so they are necessary elements of each of the three schemes. The rest of the elements are required for expressing of the properties of the premises of the inductive or plausible arguments: *generalization*, *cause*, *assumption* and *exclusion* - for the inductive arguments; and *cause*, *admission* and *exclusion*, and the rest of the elements - for the plausible arguments. The elements *goal*, *value*, *norm* are necessary for modeling the deliberative arguments which are a part of the class of plausible arguments. These elements mark out the specific premises of the practical arguments and reflect the properties of reasoning about actions that are not characteristic of other plausible arguments.

Thirdly, we propose to treat the two subclasses *Scheme of discursive conflict* and *Scheme of deliberative conflict* as the subclasses of the element of the ontology of forms *Scheme of Conflict* and to establish the relation *to fulfil* between the elements *Attacker* (Attacking element) and *Attacked* element and those two *Schemes*. This allows to distinguish between the deliberative, or practical, argumentation from the discursive, or theoretical.

The proposed modifications open the possibility of completing of the library of arguments with the plausible arguments about actions, the library of disputes - with the disputes about actions, and the library of relations – with the relations between special elements of the practical arguments inside the structure of those arguments, at the level of the agent's position in the dispute and at the level of the whole dispute. For modelling of the agents of argumentation, be it discursive or deliberative argumentation, the corresponding library of agents has to be generated separately, since AIF lacks expressive abilities for providing agent profiles and reduces the cognitive diversity of agents to the information diversity expressed by I-nodes.

## 4. Conclusion

We proposed a preliminary approach to the formulation of criteria that have to be considered when developing the software for modeling and representation of the deliberative argumentation with the function of evaluating arguments and finding solutions. However, already at the initial stage, we propose grouping the criteria for reflecting the key properties of that kind of the software. We suggest a modified DelibAIF scheme which allows modeling the deliberative argumentation.

Since for modelling of argumentation, in Russia we have neither domestic, nor localized software, we propose the corpus of (the groups of) the criteria for providing the methodological support in generating guidelines and recommendations for the creation of the software and applications for modeling and representation of argumentation, deliberative reasoning, which will support decision-making, teaching argumentation and training the critical thinking skills. The development of the corpus of criteria aims at methodological support of the academic, research and educational communities and at providing them with the effective selection tools for using the software in their research and teaching activities related to the deliberative argumentation.

In our further research we intend to classify the properties of the software according to the five (groups of) the criteria given in Tab.1., to testify both the criteria and their grouping against the existing and newly developed software, and to update the body of the criteria, if needed. Its another application will be a comprehensive classification of the software and systems for modeling and representation of argumentation, the deliberative reasoning, support of decision-making processes and training of argumentation and critical thinking skills. The classification will enhance the quality of users' decisions regarding the choice of the software and applications for solving their practical tasks.



## 5. Acknowledgements

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# Distributed Administration of Multi-Agent Model Properties

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## Abstract

Modeling long-term or large-scale processes is associated with a significant investment of researchers' time, as well as computer time. In this regard, it can be effective to make adjustments to the model directly in the process of modeling. This article discusses the design and implementation of a web client that acts as an administration system (panel) for a platform for multi-agent modeling of movements and interactions of actors within a city map area. All modeling logic in this platform is implemented directly in modules, while the modeling platform only calls it for specific, connected modules. The modeling platform is implemented on the ASP.NET Core 5.0 framework. For the implementation of the web client, the Angular 11 framework was chosen with the Ant Design UI components.

## Keywords

Simulation, city, C#, modularity, client-server, administration panel

## 1. Introduction

The study of socio-economic systems, aimed at analyzing the interactions of subjects in the real world, requires the development of approaches to processing and representing the state of actors in the model. A common solution is to display simulation results [1]. At the same time, the processes that led to this result remain hidden and require additional research, taking into account various restrictions. The decision maker's understanding and credibility of the simulation result can be diminished.

There are platforms that allow modeling with a graphical representation of the model process in the user interface (Table 1). The graphical user interface in such platforms often has a number of limitations and works inseparably from the platform itself. Because of this, it becomes a direct part of the platform and imposes a number of restrictions on its operation.

**Table 1**  
Overview of Modeling Platforms with Administration System

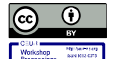
Platform Name	Base Map Editor	Dynamic change of modeling properties	Modularity	Displaying simulation results	Dynamic change of the modeling range
Ant Road Planner [2]	+	-	-	+	-
NetLogo [3]	+	-	-	+	+
AnyLogic [4]	+	-	-	+	-

The target component of this work is an application that is a client-server platform for modeling the movements and interactions of actors within a city map section [5]. The construction of the model

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is based on a multi-agent approach [6, 7]. The program expands the modeling functionality due to the modules plugged into it: it initializes them and displays the functionality on a graphic map of the city. The development of various modules is ongoing and the system is constantly being expanded.

Modules contain all the logic and modeling rules. Initially, the modules are not supplied as part of this software package, each of them is a separate class library. However, the modules are directly involved in the operation of the software package in the case of connecting one or more of them. For example, the module for managing data about objects on an online city map parses data from a file with OSM XML format and converts them to the necessary structure for storing in the list of objects of the main program and further using them by other modules.

The developed administration system is required to execute various modeling scenarios in real time with an extensible property list of the model itself and actors and plug-in components to answer the multiple "what if" question [8, 9].

In this regard, the purpose of the work is to develop a system for distributed administration of the behavior of actors and properties of the city model in real time. At the same time, as a key component of the concept of creating such a system, it was decided to focus on enabling the user to influence the course of modeling by changing the properties of models and actors in real time.

## 2. Problem statement

The existing application models the movement of actors on the basis of modules, however, it has a number of drawbacks and limitations, some of which must be eliminated in the created administration system.

The object of this research is the process of administration of modeling and obtaining results.

The subject of the research is the methods of distributed administration of the behavior of actors and properties of the city model in real time.

The business process diagram (“BPMN AS IS”) in the case using the application is shown in Figure 1.

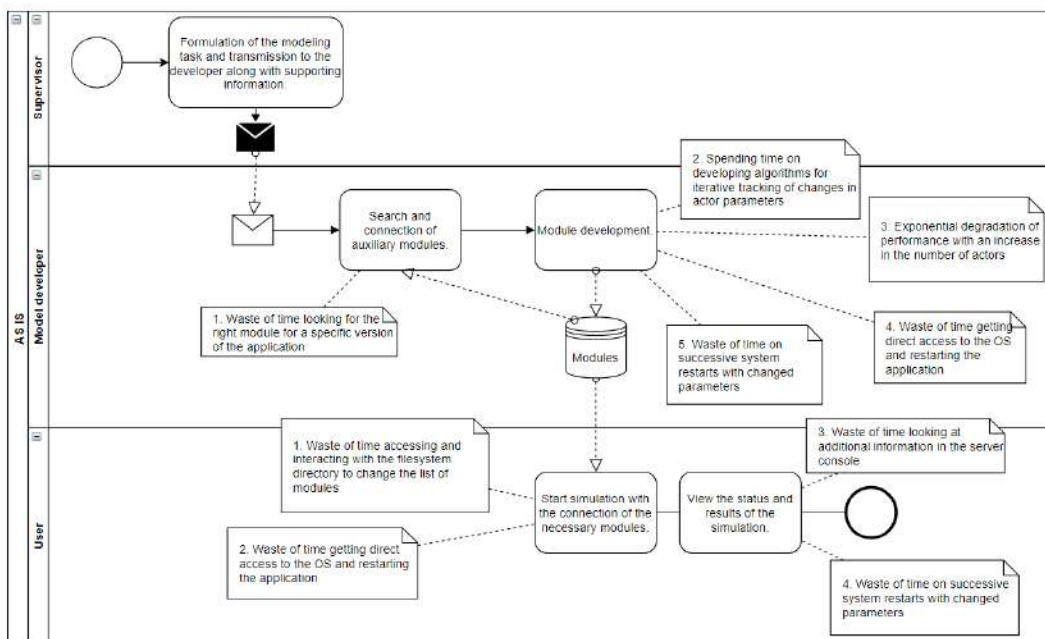


Figure 1: Application usage process (BPMN AS IS)

One of the problems of current modeling administration systems is the lack of approaches to processing and representing the state of actors in real time. The systems display the simulation result without the ability to pause the simulation or restart it during the current simulation with different modules and / or properties.

In some modeling systems, such as Ant Road Planner, it is not possible to dynamically change any properties of the model in general and actors in particular in real time after the initial setting of the modeling properties and the launch of the modeling. The simulation can be restarted on the changed properties only after the simulation has been worked out and the results are obtained.

In this regard, the task was set to develop a system of distributed administration of the behavior of actors and properties of the city model in real time, allowing the user to change the course of modeling by changing the properties of models and actors.

To implement the web client, the Angular framework [10] version 11 was chosen using the Ant Design user interface components [11].

### 3. Platform architecture

The platform architecture takes into account all the needs of the updated processes. The platform architecture is shown in Figure 2.

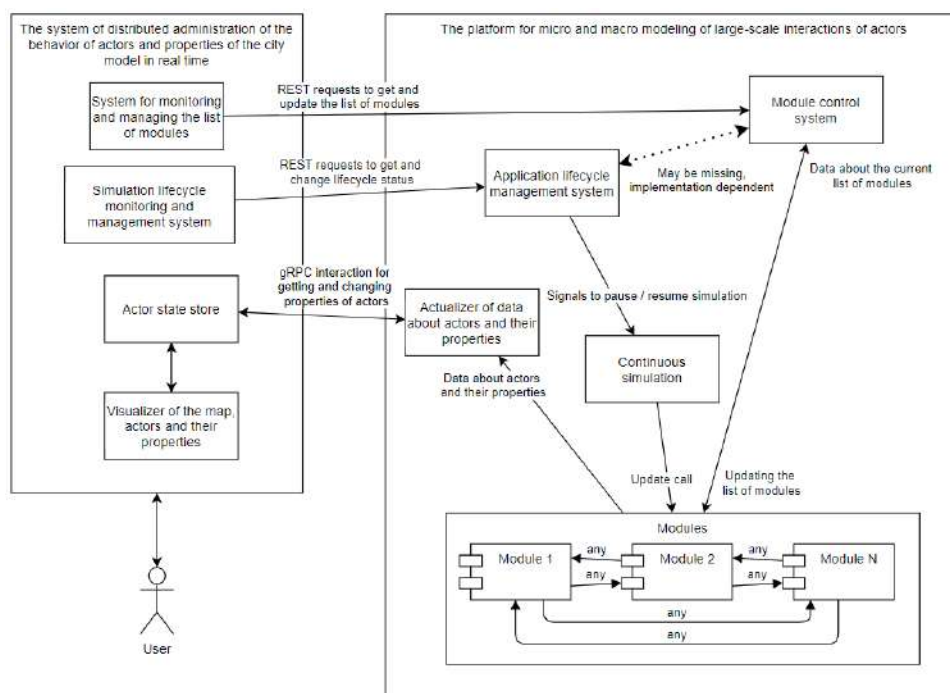


Figure 2: Platform architecture

### 4. Description of the methods used in the research

To solve the problem with the development of an approach to processing and representing the state of actors in real time, the proto3 [12] API of the modeling platform was analyzed, a part of which is shown in Figure 3.

Based on the API, there are several methods that will be needed to process and represent the state of the actors. One of these methods is to divide actors by their type (from the `type_full_name` field) into groups that represent layers. Splitting into layers opens up a number of possibilities, one of which is the ability to turn off the display of certain types of actors, if necessary.

Another important feature, as well as the next used method, opened by using layers, is the ability to apply specific styles to individual layers (from the `open_layers_style` field). This style is javascript code that must be executed before an object of the `Style` class is obtained.

```

1  syntax = "proto3";
2
3  option csharp_namespace = "OSMLS.Map";
4
5  package map;
6
7  import "google/protobuf/empty.proto";
8
9  service MapService {
10   rpc GetMapFeaturesMetadata (google.protobuf.Empty) returns (stream MapFeaturesMetadata);
11   rpc GetMapFeaturesMetadataUpdates (google.protobuf.Empty) returns (stream MapFeaturesMetadata);
12
13   rpc GetMapFeatures (google.protobuf.Empty) returns (stream MapFeature);
14   rpc GetMapFeaturesUpdates (google.protobuf.Empty) returns (stream MapFeature);
15   rpc GetRemoveMapFeatureEventsUpdates (google.protobuf.Empty) returns (stream RemoveMapFeatureEvent);
16
17   rpc GetMapFeaturesObservableProperties (google.protobuf.Empty) returns (stream MapFeatureObservableProperty);
18   rpc GetMapFeaturesObservablePropertiesUpdates (google.protobuf.Empty) returns (stream MapFeatureObservableProperty);
19   rpc SetMapFeatureObservableProperty (MapFeatureObservableProperty) returns (google.protobuf.Empty);
20 }

```

**Figure 3:** proto3 modeling platform API

The method for displaying actors in specific coordinates should be based on the GeoJSON format [13], since data in this format can be obtained from the `geo_json` field. Because methods provided by the OpenLayers library [14] are already used to solve most of the other subtasks; methods [15] from this library, aimed at working with this format, can also be used to work with the GeoJSON format.

To solve the problem with the development of an approach to representing and changing the properties of the model in general and actors in particular in real time, a number of methods from the REST API of the modeling platform can be used. For example, the State group of methods allows the user to manage the life cycle of a simulation, which can be started, temporarily paused, and stopped. The Assemblies method provides the ability to add new assemblies with modules and module dependencies to the application, and the Modules method group allows the user to get the entire list of modules obtained from the added assemblies, and also provides the ability to manage the list of modules participating in the modeling process (specific modules from the general list can be activate and deactivate for the model). In addition, there are a number of methods for working with the list of properties of specific actors.

Thus, a brief description of the methods that will be used in the research when creating a targeted method for distributed administration of the behavior of actors and properties of the city model in real time is given.

## 5. Implementation of the basic part of the administration system

### 5.1. Generation of REST API and gRPC-web infrastructure

It was customary to add the entire generated infrastructure along the `src/app/generated` path, so this path was added to the standard `.gitignore` file.

The modeling platform route `/swagger/v1/swagger.json` is called to get the `swagger.json` file used for generation. This route is created automatically using the `Swashbuckle.AspNetCore` library. Then this file is added to the root of the project.

The npm module `ng-openapi-gen` is used to generate the API infrastructure.

To generate the javascript gRPC-web infrastructure [16], `protoc` is installed with the ability to access it by the appropriate command. After that, the npm module `ts-protoc-gen` was added, which allows converting the javascript generated using `protoc` into typescript code. Modules have also been added to support gRPC-web and `google-protobuf`.

After that, a script is created in the `package.json` file to generate the infrastructure based on `map.proto`;

The generated client does not require DI and can be obtained directly from the `grpc` namespace.



## 5.2. Assembly management implementation

Assemblies are managed in `AssemblyCompositorComponent`, a child of `AssemblyComponent`. The `NzUploadModule` component and `AssembliesService` are used to upload files.

The view of the final component is shown in Figure 4. When the component button is pressed, a file system window opens with a proposal to select one or more assembly files. After selection, assemblies are immediately uploaded to the server.

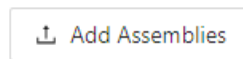


Figure 4: View of the "Add Assemblies" component

## 5.3. Module management implementation

Modules are managed in the `ModuleManagerComponent`, a child of the `ModuleComponent`. For this, `ModulesService` is used.

The view of the resulting component is shown in Figure 5. Each of the component buttons can be active or inactive, depending on the current state of the model.

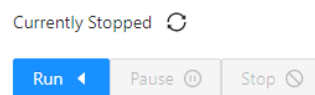


Figure 5: Button view when the simulation is stopped

## 5.4. Model state management implementation

Model state is managed in `ModelStateManagerComponent`, a child of `ModelComponent`. The `StateService` is used for this.

The view of the resulting component is shown in Figure 6. This component supports multiple choice of modules for the model.

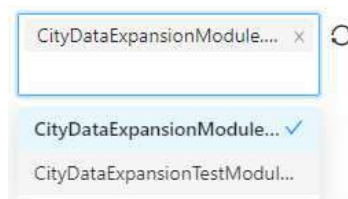


Figure 6: Component with selected module

After selecting or deselecting one of the modules, the changes are immediately sent to the server.

## 6. Receiving and processing of map data

### 6.1. Metadata handling

Getting the current metadata occurs when the map component is initialized. To get metadata, the contract method `GetMapFeaturesMetadata` is used, which returns a stream of objects of type `MapFeaturesMetadata`.



Each of the obtained objects is transferred both to the component of the map browser (to create a new layer [17], on which the actors will be placed in the future), and to the component of the map properties (to create a new table with actors of this type).

The map browser component uses the type (`type_full_name`) as the name of the layer to create and the style (`open_layers_style`) as the layer style. This component does not work with observable properties.

The map properties component uses the type (`type_full_name`) to classify actors into various tables. The list of observable properties is used by this component to create the table infrastructure. So, if the “editable” flag of the observed property is “true”, then the corresponding cell in the table can be edited. The value type (`value_type`) is used for correct conversion from gRPC types to javascript / typescript types and vice versa.

After the method for obtaining metadata has finished its work, subscribes to the method for updating the metadata `GetMapFeaturesMetadataUpdates`, which returns objects of the same type, which are processed in the same way. This subscription exists until one of the applications (modeling platform or administration system) stops working.

## 6.2. Actors handling

Getting the current list of actors occurs after getting the list of metadata. This is necessary in order for the resulting actors to be correctly placed on a previously created map layer. The list of actors is obtained using the `GetMapFeatures` method, after which a subscription to updates is performed using the `GetMapFeaturesUpdates` method (using an approach similar to working with metadata). Both methods return an object of type `MapFeature`.

The resulting object from any of the methods is sent to the map browser component, where it is converted from GeoJson (`geo_json`) to the OpenLayers library format, from which the actor ID is obtained. An actor obtained from the GeoJson format is placed on a layer that has the corresponding type, the same as the type of the resulting actor (`type_full_name`). If an actor with such an identifier already exists in the corresponding layer, then it is previously removed from the layer.

After the initial receipt of the actors, there is also a subscription to the `GetRemoveMapFeatureEventsUpdates` method, which provides a stream of events for removing actors, objects of type `RemoveMapFeatureEvent`.

When objects are received from this stream, objects with parameters corresponding to the type (`type_full_name`) and identifier (`id`) of the received event are removed from both the map browser component and the map properties component.

## 6.3. Actors observable properties handling

The retrieval of the current list of the observable properties of the actors occurs after the retrieval of the list of metadata. The retrieval of the current list of the watched properties of the actors occurs after the retrieval of the list of metadata. The list of actor observable properties is obtained using the `GetMapFeaturesObservableProperties` method, after which a subscription to updates is performed using the `GetMapFeaturesObservablePropertiesUpdates` method (using an approach similar to working with metadata and with actors). Both methods return an object of type `MapFeatureObservableProperty`.

After receiving this object, it is added to the map properties component, in which it is displayed in the table, in accordance with its metadata. The type of the observable property (`type_full_name`) affects the table in which the object will be placed. The identifier (`id`) groups several different properties by one actor, the verbal title of the property (`title`) defines the column in the table, and the value (`value`) defines the current value of the column.

In addition to displaying the properties of actors, there is also the ability to edit them. After finishing editing the cell that has the corresponding property, the updated value is sent to the modeling platform, to the `SetMapFeatureObservableProperty` method, as a `MapFeatureObservableProperty` object.

## 7. Testing the administration system

### 7.1. General information about testing

To test the results, a modeling platform with a connected test module is used.

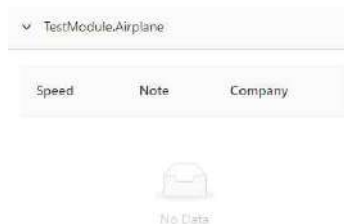
The test module adds several actors to the map:

1. Point (PointActor)
2. Line string (LineStringActor)
3. Polygon (PolygonActor)
4. Airplane 1 with an initial speed of 1000 by "Boeing" (Airplane, actor class created in the module)
5. Airplane 2 with an initial speed of 0 by "Airbus" (Airplane, an actor class created in the module)

The Airplane class inherits from the PointActor class and has several additional observable properties.

### 7.2. Displaying metadata

Metadata is displayed regardless of the status of the modeling process; it is always displayed in the map properties component for all types of actors that have at least one observable property. Figure 8 shows the mapping of actor property metadata for Airplane type actors. Since the modeling process is stopped and there are no actors at the moment, the table has only columns indicating the properties being viewed and has no rows.



**Figure 8:** Displaying property metadata for Airplane type actors

The metadata responsible for displaying styles can be seen when displaying actors in the map browser component (see Figure 9), displaying occurs only when the modeling process is running or paused, since only at this moment there can be actors on the map.

There are two Airplane type actors on the map (lower left corner), displayed as small purple dots, a line string actor (in the center of the map), a point actor (at one of the ends of the line string actor), and a polygon actor (upper left corner). Of all the listed objects, only Airplane objects have a changed style.

### 7.3. Displaying actors

Actors are displayed both when the administration system is connected to the modeling platform with simulation already running, and when modeling is started from the administration system with the same result.

At the same time, updates to actors are correctly displayed by the administration system over time (see Figure 10).

When the modeling process is stopped, the Map Browser component is cleared of actors.



Figure 9: Displaying Actors in the Map Browser Component



Figure 10: Displaying a moving actor at timestamps 1 and 2

### 7.4. Displaying observable properties

When the simulation is run, the map browser component displays the browseable properties according to the table layout and metadata (see Figure 11, a).

TestModule.Airplane			TestModule.Airplane		
Speed	Note	Company	Speed	Note	Company
1000		Boeing	1000.1		Boeing
0		Airbus	0		Airbus

< 1 >                      < 1 >

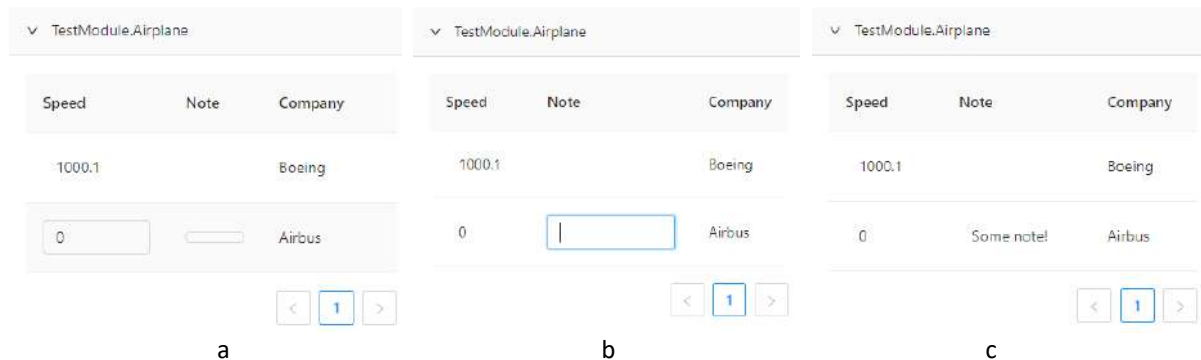
a                                      b

Figure 11: Displaying observable properties of actors with Airplane class: a. Current property state; b. With one property changed

If the observable properties on the modeling platform change (for example, the speed of one of the Airplanes increases over time), the changes will be reflected in the administration system, without the need to reload the page (see Figure 11, b).

## 7.5. Editing observable properties

When the cursor is hovering over a row that contains editable observable properties, the editable property cells will be highlighted (see Figure 12, a). Clicking on one of these cells will open the editing element (see Figure 12, b)



**Figure 12:** Interacting with editable properties: a. Howering editable properties cells; b. Opening a cell edit element; c. Displaying a property with a changed value

If the property value is changed and the edit dialog is closed, this property will be changed on the modeling platform, as well as in the current and all other connected administration systems (see Figure 12, c).

## 8. Conclusion

To interact with the platform for modeling the movements and interactions of actors within the city map section, a web client was developed that plays the role of an administration system and provides:

- Custom display of real-time actors with specific styles based on actor types
- Ability for the user to manage the list of model modules
- Ability to the user to manage the life cycle of the simulation
- The ability for the user to influence the course of modeling by changing the properties of the model and actors

Compared to existing solutions, this administration system is distinguished by the ability to work with a specific modeling platform, which in turn offers a number of advantages over other modeling solutions, such as:

- Cross-platform
- Open source
- Extensibility of functionality using modules

Thus, the developed administration system makes the modeling platform more accessible for interaction with the end user by providing a graphical user interface instead of a software one (REST and gRPC API).

## 9. Acknowledgements

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# Digital Humanities Approaches to Learning Methods Development

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## Abstract

The article discusses the possibilities of the project method implementing to the university education in the transition period from offline to online training. The pedagogical aspects are considered in the context of the interdisciplinary approaches of digital humanities as learning content and teaching methods. Such approaches to the higher education pedagogy allow to improve the quality of education and ensure the successful mastering by students of the competencies necessary of the digital labor market specialists. The article presents the results of an experiment that was carried out as part of the pedagogical activities of the Department of Information Systems in Art and Humanities of the Faculty of Arts of St. Petersburg State University during 2018-2021. The results obtained indicate that the approaches of digital humanitarian pedagogy contribute to the more effective development of students' competencies of a specialist in a digital society.

## Keywords

Digital Humanities, Project Method, Electronic Learning

## 1. Introduction

In pedagogical context the current period is a transition from offline to online learning. Research (long-term included surveillance, surveys, interviews) shows that the main pedagogical solution at the moment is the mechanistic transfer of offline teaching methods to online. Wherein, peculiarities and advantages of the online learning are not fully exploited. Therefore, studying of pedagogical approaches are adequate to the online environment is very relevant.

If in the first decades of 21 centuries scholars and practitioners focused on the technological and even technical aspects of the problem, recently there has been a tendency to concentrate on humanitarian aspects of complex which includes technological, pedagogical and learning content aspects (Technological Pedagogical Content Knowledge concept). In this connection with the concept of digital humanities as a theoretical basis for the development of digital pedagogy is very promising.

As a rule, the learning environment of a modern university develops on the basis of a combination of corporate and open sources. In this context, the courses «Digital Heritage» and «Information Technologies in Museums» included in the curricula of the Faculty of Arts of St. Petersburg State University are digital humanitarian educational resources (Figure 1). They are developed on the basis of the interaction of corporate materials and open web resources [1, 2]. Corporate materials include files such as course programs, study guides, presentations, assignments developed by the course author. Open resources are represented by multimedia materials, including websites of museums, galleries, open data databases and repositories, massive open online courses, etc.

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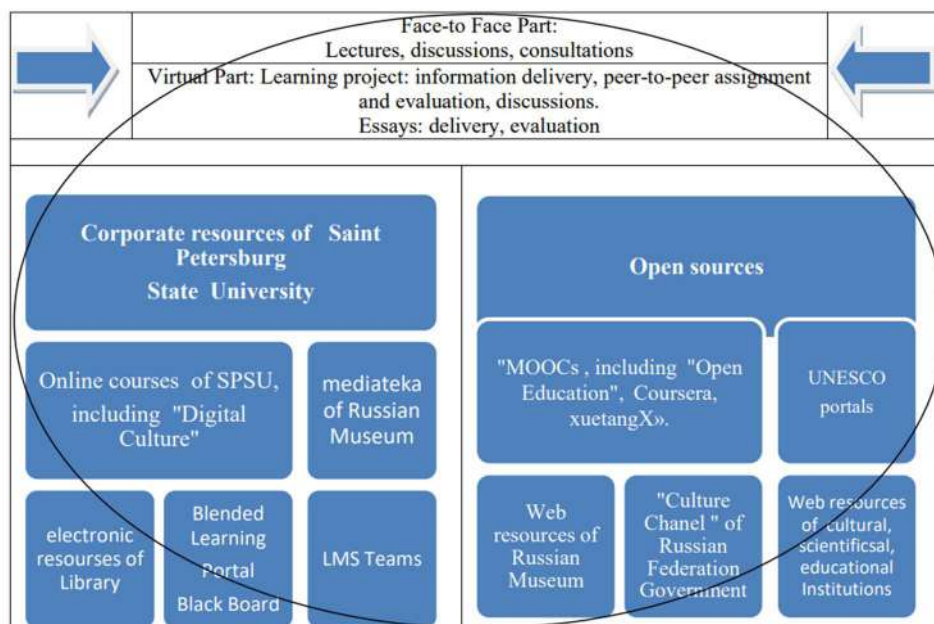


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**Figure 2:** Blended Learning Environment: Case of Saint-Petersburg State University, 2020-2021

## 2. Statement of the issue

Hypothesis of the research is that the virtual learning environment requires special pedagogical approaches and methods that are adequate to the content of the course and information and communication technologies for its delivery. An issue of development teaching methods that are adequate to the digital environment of modern society is interpreted from the point of view of the personal development of future professionals interacting with the electronic learning environment.

The research context is concepts of Digital Humanities [3-6], Technological Pedagogical Content Knowledge Concept [7], Project Method [8], and the Taxonomy of Pedagogical Goals by B. Bloom [9].

Digital Humanities postulates the equality of technological and humanitarian components and TPACK consider learning as interaction between learning content, pedagogical approaches and technologies. Main role in this tirade obtains learning content, namely fundamentals of scientific knowledge.

From the didactic point of view, the research focuses on the study of those conditions which contribute to the development of digital humanitarian competencies of the classical university students. The complex of virtual environment and learning assignments is considered as a tool for development of the specified knowledge, skills, and abilities of future professionals. According with the Taxonomy of Pedagogical Goals by B. Bloom, the tasks are designed in a such way that students gradually acquire skills and knowledge from the reproductive, algorithmic, heuristic to creative level [6, 9].

In this case, digital humanitarian competences can be described in the terms of the methodology of Human-Centered design, HCD («Design Based on Human Engagement»). It is a way of designing and managing the process of creating products and services, when each stage of problems solving based on the developers creative thought and emotional involvement. Human participation is implemented with observing a project realization challenges, brainstorming, conceptualizing, decision making and fulfill the solution. The project object in this case is a virtual museum, which is being developed by a third-year student [1, 5, 6].

According to UNESCO suggestions one of contemporary pedagogical issues is development of learning methods which allow including students in research activities already at the stage of future specialists training [2]. In proposed research context, such kind of activity concern with providing students with opportunities to co-work with distributed expert communities and is associated with



the development of the competencies presented in the educational standard of Russian Federation. Flagging the importance of a systematic approach to the development of specialist competencies, we highlight the following ones among them as significant for the implementation of the pedagogical design of educational assignments, control and measuring materials and assessment tools. These competences are developed in aforementioned courses of Saint Petersburg State University:

- ability to use modern information technology and software, including domestic production, in solving problems of professional activity (OPK-2),
- ability to solve standard tasks of professional activity based on information and bibliographic culture using information and communication technologies and taking into account the basic requirements of information security (OPK-3),
- ability to take part in the management of projects for the creation of information systems at the stages of their life cycle (OPK-8),
- ability to take part in the implementation of professional communications with stakeholders in frame of whole project activities and within project groups (OPK-9)
- ability to understand, study and critically analyze the received scientific and technical information on the research topic and results, be fluent in methods of processing, analysis and synthesis information, information search and databases on the Internet using the capabilities of modern search queries (PKA-1),
- ability to analyze and structure information needs in a subject knowledge areas, formulate requirements for their information technology support, design information systems in accordance with the needs of information management in a subject knowledge areas (PKP-1),
- ability to use modern technologies for creating multimedia content in the print, 3D graphics, animation, video and audio forms for placing it in information systems (PKP-8)
- ability to search, critically analyze and synthesize information, apply a systematic approach to solving assigned tasks (UK-1)
- ability to determine the range of tasks within the framework of the goal and choose the best ways to reach them, based on the current legal norms, available resources and restrictions (UK-2)
- ability to carry out social interaction and fulfill own role in the team (UK-3)
- ability to carry out business communication in oral and written forms in the state language of the Russian Federation and foreign language (s) (UK-4)
- ability to perceive the intercultural diversity of society in the socio-historical, ethical and philosophical contexts (UK-5)
- ability to participate in the development and implementation of projects, including entrepreneurial (UKB-1)
- ability to understand the essence and significance of information in the development of society, use the main methods of obtaining and working with information, taking into account modern technologies of the digital economy and information security (UKB-3)

The virtual learning environment of the presented courses is digital content which includes files are created by different developers, namely highly qualified professionals (experts from the Russian Museum, St. Petersburg State University), members of student groups, and open sources. Thanks to this, conditions are created for the development of such competencies as (1) understanding connection and equality of digital and humanitarian components of electronic resources, (2) evaluation web resources according to following criteria (2.1) reliability in context of their heterogeneity in the scientific level of knowledge in connection of the level of the developers qualifications, as well as (2.2) relevance to project tasks.



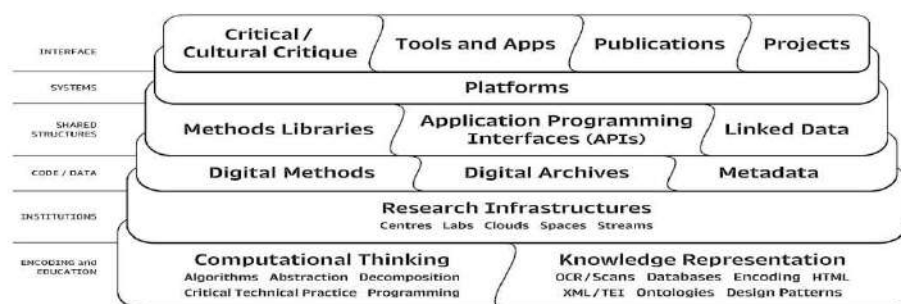
### 3. Literature Review

#### 3.1. Digital Humanities

Consideration of ways to solve these problems is carried out on the basis of the theory of digital humanitarian knowledge (DH) and pedagogy, namely TPACK. It should be noted the complexity of defining the DH subject area, as well as the dynamics of its development.

Digital humanities today encompass a wide range of research methods and social practices: rendering large sets of images, 3D modeling of historical artifacts, alternate reality games, mobile production and learning spaces, and more. At the same time, continued interest in the traditional areas of DH digital archives, quantitative analysis, projects to create electronic tools for the implementation of digital research.

The Digital Humanities Rack [3] showcases the wide range of science, technology, social practices and structures that make up the digital humanities today. At the same time, the fundamental elements of Digital Humanities, such as computational thinking and knowledge representation, lie at the lower base levels of the "rack", and it is also shown that the "shelf" is higher, the level of abstraction of the interaction of technology and humanitarian knowledge increases. In the case is presented in this paper, the subject knowledge areas are associated with knowledge representation (first floor) and project activities (sixth floor) [Figure 2].



**Figure 2:** The Digital Humanities Stack (from Berry and Fagerjord)

The Digital Humanities Manifesto [4] positions digital humanities (DH) as an area of research, teaching and publishing based on the systematic application of digital technologies in the humanities and social sciences. At the same time, a distinctive feature of DH is the development of bilateral relations between the subject areas of this tandem: on the one hand, the possibilities of using technologies in a wide range of studies in the field of humanitarian knowledge are being studied, on the other hand, digital technologies are subjected to scientific expertise on an unlimited range of issues: from philosophical to applied. Such approach is in line with the views of John Unsworth, Susan Schreibman, and Ray Siemens who, as editors of the anthology *A Companion to Digital Humanities* (2004), distinguished the Digital Humanities field from being viewed as «digital computing» or «mere digitization» [7].

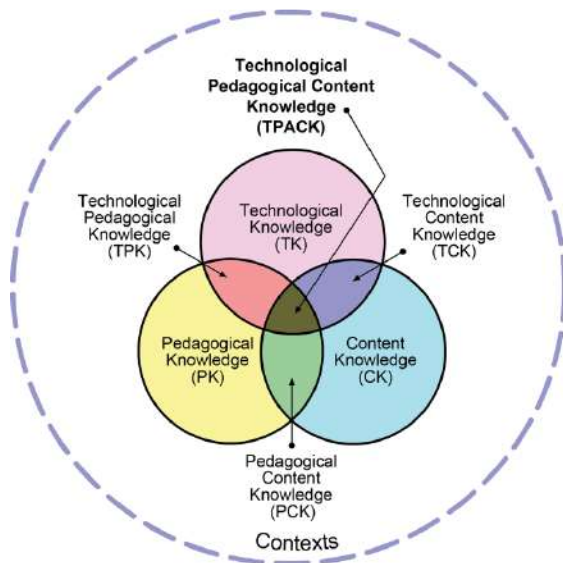
#### 3.2. Technological Pedagogical Content Knowledge Theory (TPACK)

The theory reflects the pedagogical aspects of the educational paradigm of the information society. TPACK concept was introduced by Jhon Shulman in 1986 and Punya Mishra and Matthew J. Koehler [8]. Scholars, teachers and the learning resources' designers support ideas of the researchers. According to this theory, eLearning develops as the intersection of three areas (1) content knowledge, (2) pedagogical knowledge and (3) technological knowledge (Figure 3).

Hypothetically, each electronic learning resource consists the following types of knowledge (1) Content Knowledge (CK), (2) Pedagogical Knowledge (PK), (3) Technology Knowledge (TK), (4)

Pedagogical Content Knowledge (PCK), (5) Technological Content Knowledge (TCK) (6) Technological Pedagogical Knowledge (TPK), (7) Technological Pedagogical Content Knowledge (TPACK).

There are three levels of knowledge here. The first is «Pure Knowledge». (1) Content knowledge includes knowledge of concepts, theories, and conceptual frameworks as well as knowledge about methods of developing knowledge. (2) Pedagogical Knowledge (PK) Pedagogical knowledge includes generic knowledge about how students learn, teaching approaches, ways of assessment and knowledge of different theories about learning (3) Technology Knowledge (TK) refers to an understanding of the way that technologies are used in a specific content domain. This type of knowledge depends on the resource content, so the resource developer sometimes should have knowledge in a technology enhanced, but sometimes he/she needs only a computer literacy.



**Figure 3:** Main Components of Technological Pedagogical Content Knowledge theory (from Shulman, L. S., Mishra, P., & Koehler, M. J.)

The second level of knowledge occurs at the intersection of two areas of expertise, namely (4) Pedagogical Content Knowledge (PCK) (5) Technological Content Knowledge (TCK) and (6) Technological Pedagogical Knowledge (TPACK).

Pedagogical content knowledge is knowledge about how to combine pedagogy and content effectively. This is knowledge about how to make a subject understandable to learners. Technological content knowledge refers to information about how technology may be used to provide new ways of teaching content. Technological pedagogical knowledge refers to the affordances and constraints of technology as an enabler of different teaching approaches.

The highest level of knowledge is (7) Technological Pedagogical Content Knowledge (TPACK). It address to the knowledge and understanding of the interplay between CK, PK and TK when using technology for teaching and learning. It includes an understanding of the complexity of relationships between students, teachers, content, practices and technologies.

In our view, the theory gives a whole picture of the education development in information society. It allows solving aforementioned problems. The TPACK provides an idea, that the Content Knowledge is component, which determines technological design and pedagogical methods of e-learning resources. It is obvious, that a course of Mathematics or Fine Arts needs sets of different technological solution and pedagogical activities. Thus, we can see path how wide range of trendy and disparate methods gradually turn into a methodology of information society education.

The issues of the development of «social educational space» and «social educational environment» as well as the interaction between them are in the focus of modern pedagogical research in Russia (T.N. Noskova, N. . Morze, J. Malach, P. Kommers, T.). Scholars emphasize constantly increasing of the global electronic environment significance as a component of professional and personal

development. The contemporary professional is faced with the task of individualizing this space. The systematization of the above questions is presented in the concept of the educational pedagogical environment, developed at the Russian State Pedagogical University. A.I. Herzen [9].

Emphasis the following aspects of the theory: consideration of the pedagogical environment as a system based on the interaction of virtual and classroom spaces and including the following components: target, subjective, scientific and educational, psychological and didactic, subject-material, organizational and managerial, socio-psychological. Highlight the psycho-didactic component. It describes the methodology for solving the research issues through the development of a system of assignments, which implementation leads to the development of the competencies of a specialist in a digital society. There are competencies which are manifested in sufficient knowledge and skills, both in the humanitarian and technological areas of knowledge. An example of the Implementation of this approach is presented in this article.

### **3.3. Project Method**

According to M. Knoll, [10], the project method is a way to achieve a didactic goal via solving learning problem, which should achieve with a practical result, formalized in a way is assigned by an educator. This method presupposes a combination of tasks that are problematic and creative in nature. The teacher within the framework of a project is allocated a role of developer, coordinator, expert, and consultant.

The main didactical purpose of the project method is to provide students with the opportunity to independently develop their competencies in process of a practical problems solving or issues that require the integration of knowledge from various subject areas both theoretical, and empirical. For example, humanitarians and technological ones are in context of the presented research.

The project method has a long history. Founded in 1577 by the Academia di San Luca in Rome, and developed in 1763 by the Royal Academy of Architecture in Paris. It was originally aimed at training architects, but then was increased to other subject areas and now is successfully used by European universities. In 1860th the project method was moved to the American continent by the founder of MIT William B. Rogers, supported by a number of American universities and is also actively developing to this day. The philosophical rationale of this method is the concept of pedagogical constructivism is presented in the writings of L.S. Vygotsky, J. Dewey, and others.

The classical models for the implementation of training based on the project method are linear, holistic and universal, proposed, respectively, by Calvin M. Woodward (1879, Washington University, CIIIA), Charles R. Richards, 1900, Teachers College, Columbia University, New York, USA), William H. Kilpatrick, 1918 Teachers College, Columbia University, New York, USA). In the 90s, this list was replenished with a telecommunications project, the author of the term is E. Polat (Institute of Secondary Education, Russian Academy of Education IOSO RAO).

The educational project presented in the paper is linear and telecommunication. It is an educational, cognitive, research, creative activity of students, having a common problem, goal, agreed methods of activity directed to achieve an individual results. It is realized via computer telecommunications and wide range of pedagogical approaches. There are lectures and essays, independent work, communications with external experts, classmates, open sources study, reflection via PMM, the project results presentation and evaluation.

## **4. The experiment methodology and results**

The experiment tool is a complex of virtual learning environment and the set of tasks aimed at developing digital competencies through pedagogical communication in blended learning environment. The depth of development of competencies is carried out on the basis of the systematic of B. Bloom's pedagogical goals [11]. The assignments' complex which includes the following tasks: generalization of lecture materials (an essay performed by each student once a week or once every two weeks, a total of 8 to 16 essays per semester), implementation of an educational project, filling in individual semantic maps (method of personal meaning maps), surveys, tests [1, 6].

An aim of the research is to study the relationship between the development of educational content of universities and teaching methods in the context of digital humanities, TPACK. To achieve this goal, a blended learning environment was designed, based on the courses «Museum Information Systems» and «Theory of Communication». These courses are included in the main educational program of the Faculty of Arts of St. Petersburg State University in the direction 09.03.03 «Applied Informatics» with the assignment of the qualification (degree) - bachelor in the profile «Applied Informatics in Art and Humanities». Also a component of the virtual learning environment is a massive open online course «Basics of working in a digital environment», in the development of which the authors actively participated.

The digital learning environment requires the development of adequate teaching methods. Below are presented the results of an experiment aimed at studying pedagogical approaches which make conditions for students to develop competencies which are manifested in sufficient knowledge and skills, both in the humanitarian and technological areas of knowledge.

The research includes the following components: (1) formation of a blended learning environment; (2) development of a methodology that allows students to be included in activities related to the implementation of research already at the stage of training future specialists [2].

There are following research methods were used: participatory observation, analysis of works and surveys of students, as well as semantic mapping (PMM).

The implementation of the educational project is included in the course program and consist in creation electronic resource called «Virtual Museum» by each student. The project realization is carried out through the following set of tasks: (1) formulation the museum title; (2) development of the concept of the museum (including the target audience (audiences) of the museum and methods of its (their) activities; (3) making of the museum collection; (4) grounding of the technological solutions for implementation of the museum; (5) development of virtual tour around the museum; (6) creation of the project presentation; (7) evaluation of the project by fellow students, instructor and external experts, if possible. The work on the project takes 16 hours, provided by the Program of the course in the block «Practical tasks».

1st stage (1-3 lessons): defining the subject area of the museum, the goals of its activities and implementation technology, for example, page on social networks, blog, website, etc. Creation of the collection in accordance of the subject area and the goals of museums are started on this stage.

2nd stage (4-13 lessons): development of projects, which is accompanied by the publication of the resource prototypes in the web space. It allows the participants to discuss the working process with fellow students, as well as consult with the teacher and external experts.

3rd stage (14-15 lessons): defense of the project in a student group and assessment of the project by fellow students, teachers and external experts.

In the process of implementation of aforementioned stages, the experimenters examined the level of students' mastering of cognitive operations related to the design of virtual museums in the following components: (1) subject area of the museum, (2) implementation technologies, (3) comprehension of the equality of technological and content components.

**Table 1**

The levels of DH competencies mastering by 3rd year students

<b>The level of the competencies mastering by students</b>	<b>2018/19 students</b>	<b>2019/20 students</b>	<b>2020/21 students</b>
Repetition	12 from 12	11 from 11	13 from 13
Algorithmic Action	12 from 12	11 from 11	13 from 13
Applying	10 from 12	11 from 11	13 from 13
Analysis	09 from 12	08 from 11	07 from 13
Synthesis	06 from 12	09 from 11	09 from 11
Evaluation	05 from 12	07 from 11	11 from 13

The experiment was carried out for 3 years (2018/19 - 2020/21). It was attended by 36 third year bachelors. The 2018/19 group was considered as a control group, and the 2019/20, 2020/21 groups were considered experimental.

The level of mastering cognitive operations (table 1) was checked on the basis of the taxonomy of pedagogical goals by B. Bloom [11]. In the course of checking the knowledge of the control group, it turned out that the students experience the greatest difficulties in comprehending the equality of technological and content components, the least - in the choice of technologies for implementing the project (2) identification of the museum subject area caused minor difficulties.

To solve the identified problem in 2019/20 the following adjustments were made to the pedagogical design of the course: a system of written assignments aimed at understanding the role of humanitarian knowledge in the development of the museum was developed, and an excursion to the multimedia center of the Russian Museum was organized. The result was a positive trend in the development of these competencies.

Circumstances of 2020/21 made possible to add changes in the conditions of the experiment via involvement of external expertise of projects and activation of the online component of pedagogical communication. Analysis of the results obtained allows us to draw the following conclusions. External examination of projects (Nanjing Pedagogical University, Nanjing, China) led to an increase in the quality of projects by introducing additions to the content which need for understanding the materials by carriers of Chinese culture. Reducing classroom interaction with students does not have a significant impact on the development of knowledge and the implementation of projects.

## 5. The Results Discussion

Hypothesis of the research is that the virtual learning environment requires special pedagogical approaches and methods that are adequate to the content of the course and information and communication technologies for its delivery. The presented study examined the implementation of the project-based teaching method in a virtual learning environment.

The virtual learning environment of the presented courses is digital content which includes files are created by different developers, namely highly qualified professionals (experts from the Russian Museum, St. Petersburg State University), members of student groups, and open sources. Thanks to this, conditions are created for the development of such competencies as (1) understanding connection and equality of digital and humanitarian components of electronic resources, (2) evaluation web resources according to following criteria (2.1) reliability in context of their heterogeneity in the scientific level of knowledge in connection of the level of the developers qualifications, as well as (2.2) relevance to project tasks.

In addition, the inclusion of a student in the interaction with the Network as a member of the community of professionals working in the space of open resources at an early stage of training [6], allows solving the problem of mastering competencies related to research activities. For example, the following activities can be carried out on the Web: implementation of student and expert projects; conducting a variety of presentations of research results: from presentation in virtual class room to maintaining pages in social networks and blogospheres. Also, it is possible to participate in various forms of assessing the work of colleagues is possible: from intermediate and final attestation at the university to participation in discussions with experts and blind review of the project results (virtual museums in this case), etc.

Finally, analysis of the projects results obtained shows that regarding technology, web sites are mainly used as implementation technologies. Only one student chose a social network (Project «Museum of Computer Games»). The blog has not been chosen by anyone.

Themes of virtual museums developed by students: «Virtual Museum of Neuroart», «Virtual Museum of Talking Walls», «Museum of the History of Computer Games», «Trail of the Silk Road in St. Petersburg», «Countries of the Great Silk Road», «Retrospective of video games», «Internet meme as an arts of youth», «Where art meets technology», «Museum of Fonts», «Museum of Video Games».

Subject areas of sciences presented in the themes of virtual museums implemented by students in 2018 / 19-2020 / 21: art history, intercultural communication, history, social problems. They reflect

the digital humanities perspectives. Together with the data on the performance of other tasks, this indicates the achievement of the set goals.

## 6. Conclusion

In the context of the concept of digital humanities, the presented methodology makes it possible to implement an innovative direction of interdisciplinary research, which corresponds to contemporary educational demands for the development of the competencies of a professional working in the modern society.

Also, the presented pedagogical solution is a methodology that allows students to be included in the educational process and to implement activities related to the implementation of the functions of scientific research, discoveries, innovations already at the stage of training future specialists [2]. As the study assignments are completed, students form a virtual museum as a prototype of an individual professional environment that becomes a part of the virtual space of courses, and, consequently, a virtual component of the learning environment of St. Petersburg State University. Hypothetically, these spaces can be transformed into expert communities in the future professional life of their authors. Tracking the process of origin and development of these hypothetical communities can lead to very promising discoveries in the field of networked pedagogy in methodological and empirical aspects.

Finally, these pedagogical approaches are associated with expanding the accessibility of users to digital materials based on an expert assessment of the compliance of electronic material with educational goals [2].

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# Computational Linguistics





# Monitoring Governmental Topics on Social Media Using Dynamic Topic Modeling

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## Abstract

The paper discusses the experiments on dynamic topic modeling of the corpus of Russian governmental posts from VKontakte social network. The study is aimed at detecting hidden topical relations and tracking the evolvement of main topics within the text collection. The experiments were conducted on ministerial posts from 15 communities, we give explanations on the resultant dynamic topic models, and establish links with the issues that were important at a specific period in the Russian government. The results justify the use of dynamic topic modeling as a means of social media analysis that can be applied to Russian corpora of Internet texts.

## Keywords

Social Network, Governmental Post, Corpus Linguistics, Russian, Dynamic Topic Modeling

## 1. Introduction

The past decade of the XXI century was marked by the rapid transition of life to the virtual space, as a result, it allowed a great number of scientists to get access to a large amount of textual information, which helps them track the development of the language levels on the Internet. There have been papers dedicating to automatic analysis of Internet texts [2, 3, 4]. Recently it has become popular to use methods of semantic compression for dealing with corpora. One of these methods is topic modeling.

The algorithms of topic modeling can be defined as the compressed representation of documents in order to highlight the main topics. It may be valuable for different spheres of life: political campaigns, business etc. A number of topic modeling methods are widely used in practical research nowadays, some of them are probabilistic models such as pLSA (probabilistic Latent Semantic Analysis) or LDA (Latent Dirichlet Allocation). Using them, one can detect main constant topics in a set of documents. Later other extensions of probabilistic models, that focus on tracking topics over time, appeared in computational linguistics – dynamic topic modeling (DTM). We decided to analyze the evolution of the topical structure of the Russian ministerial corpus proposed in [13] as its texts represent the current situation both in the country and in the world. We give explanations on the final dynamic topic models and establish links with the issues that were important at a specific period in the Russian government.

## 2. Related works

The main application of dynamic topic modeling is analyzing evolution of topics in large texts collections in different areas of science. For instance, in [15] linguists revealed some niche topics in Russian prose of the first third of the XX century that characterize the main events in the history of Imperial Russia and Soviet Russia: philosopher's ships, revolutions etc. In [7] economists studied how the evolutions of topics on cryptocurrency on forums were interconnected with big events in the cryptocurrency area. They concluded that if any cryptocurrency related service (currency exchanges or mining hardware manufactures) was hacked, users would instantly express their opinions on forums. As a result, the resultant dynamic topic models would change.

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It is also important to note that the procedures of dynamic topic modeling are widely used for examining governmental texts. In 2020 the pandemic of the coronavirus became one of the issues being discussed both in real life and on the Internet. In [10] the authors analyzed tweets posted by U.S. Governors and Presidential cabinet members to track the decisions made by federal or state authorities. They used a Hawkes binomial topic model [9]. The final evolving models were dedicated to businesses issues, research in creating a vaccine, and calls for social distancing and staying at home. In [14] the authors also discussed the problems of the pandemic from the social network corpus, but they used another approach for obtaining topics – Dynamic LDA. The models partly overlap with the ones described in [10] as both corpora were based on the same social network.

In [5] the evolution of political agenda of the European Parliament plenary was analyzed with the help of dynamic topic modeling based on Non-negative Matrix Factorization (NMF). The authors created a corpus of speeches from 1994 to 2014. The results show that the political agenda of the EP reacts to exogenous events such as the Euro-crisis of 2008.

The paper [4] is dedicated to analyzing politically oriented posts on the US 2016 elections and detecting trolls. They proposed a graph-based algorithm called Dynamic Exploratory Graph Analysis (DynEGA). It helped to reveal the following topics: the right-wing trolls posted messages on supporting Donald Trump's presidential campaign, antiterrorism content, as well as attacking the Democrats; the left-wing discussed supporting the Black Lives Matter movement and activities against black culture and music.

It is also worth mentioning that during the past years Russian scholars started paying special attention to describing automatic analysis of Russian governmental messages from social media, especially in terms of dynamic topic modeling. Papers [11, 12] are dedicated to the analysis of politically oriented texts of RBK Group and governmental websites. The authors ran a number of experiments, they including three different topic modeling algorithms: LSI, LDA and DTM with NMF. As a result, DTM with NMF algorithm proved to be less time-consuming, and its results can be as precise as the results of LSI and LDA algorithms are.

Our experiment is going to continue the contemporary research of Russian corpora with the help of dynamic topic models, we try to focus on the texts of governmental communities on social networks.

### 3. Experiment

#### 3.1. The corpus of ministerial posts

The material for collecting the dataset was based on the corpus described in [13], but it was enlarged, as the previous corpus contained posts of 2019 and the beginning of 2020. We added posts from other periods of 2020. The corpus consists of posts of 15 ministerial communities from VKontakte social network. We divided all the posts into eight periods: 1) winter 2019, 2) spring 2019, 3) summer 2019, 4) autumn 2019, 5) winter 2019-2020 (December 2019, January 2020, and February 2020), 6) spring 2020, 7) summer 2020, 8) autumn and winter 2020. It allows tracking the change of topics during the periods and create the final picture of the governmental development.

#### 3.2. Corpus preprocessing

To implement further procedures of dynamic topic modeling, the corpus needs to be processed using standard NLP approaches.

1. The first step is extracting tokens from the posts.
2. All the tokens are normalized with the help of the `pymorphy2` library<sup>2</sup> [6].
3. Then we created a stop-list that is based on a Frequency Dictionary of Contemporary Russian by O.N. Lyashevskaya and S.A. Sharov<sup>3</sup>. This list contains about 1400 words: they are high-frequency conjunctions, prepositions, particles, and common words that can reduce the quality of the resultant models (*прочий* (*other*), *накануне* (*on the eve*), etc.)
4. As any text consists of unigrams and n-grams, we need to enrich the bags-of-words with lexical constructions. We use the `gensim` library<sup>4</sup> for this purpose. As a result, we obtain lexical

<sup>2</sup> <https://pymorphy2.readthedocs.io/en/stable/>

<sup>3</sup> <http://dict.ruslang.ru/freq.php>

<sup>4</sup> <https://radimrehurek.com/gensim/>

constructions that are typical for ministerial posts: *оказывать\_помощь* (*accord\_assistance*), *первый\_медицинский\_помощь* (*first\_aid*), *тушение\_пожар* (*put\_out\_fire*), *московский\_область* (*moscow\_region*), *эпидемиологический\_обстановка* (*epidemic\_situation*), *министерство\_внутренний\_дело* (*ministry\_of\_internal\_affairs*), etc.

After preprocessing the size of the final corpus turned out to be 61 591 063 words.

### 3.3. Dynamic topic modeling with non-negative matrix factorization

There are a lot of ways to implement dynamic topic modeling: using the gensim library, FastDTM [1] etc. In [5] the authors used dynamic topic modeling with non-negative matrix factorization for analyzing the speeches of the EP. Also, papers [11, 12, 15] proved the consistency of DTM with NMF. We chose the DTM procedure provided by derekgreene GitHub user<sup>5</sup>. We consider this approach to be effective for the Russian corpus of ministerial posts and try to adapt it for Russian governmental texts on social networks. Below we present the steps to implement dynamic topic modeling.

1. First there is a need to build a skip-gram word2vec model of the entire corpus. The following parameters are used: minimum number of documents for a term to appear – 10, minimum document length – 50 characters, the dimensionality of word vectors – 500, window – 5.
2. We specify a comma-separated range of topics (5, 15) in each time window in order to calculate topic coherence based on the pre-built word2vec model. The top recommended number of topics for each time window was saved in a csv-file.
3. Finally, we automatically search for the optimal number of dynamic topics, specifying the range of topics and basing on the word2vec model.

After applying all the steps, we figured out that six main topics evolve during two years.

**Table 1**  
Main dynamic topics within the ministerial corpus

Dynamic topic	Topic
1	<i>проект, россия, российский, новый, образование, минпросвещения, работа, школа, производство, школьник</i> ( <i>project, russia, russian, new, education, ministry of education, work, school, production, pupil</i> )
2	<i>полиция, россия, мчс, мвд, пожарный, полицейский, сотрудник, спасатель, область, служба</i> ( <i>police, russia, ministry of emergency situations, ministry of internal affairs, firefighter, policeman, employee, rescuer, region, service</i> )
3	<i>военный, учение, россия, флот, боевой, полигон, условный, оборона, военнослужащий, стрельба</i> ( <i>military, exercise, russia, navy, combat, firing field, conditional, defense, serviceman, shooting</i> )
4	<i>россия, российский, страна, дело, министр, иностранный, международный, вопрос, федерация, оон</i> ( <i>russia, russian, country, affair, minister, foreign, international, issue, federation, united nations</i> )
5	<i>театр, культура, музей, россия, область, спектакль, фильм, российский, портал, выставка</i> ( <i>theater, culture, museum, russia, region, performance, film, russian, site, exhibition</i> )
6	<i>россия, спорт, российский, олимпийский, чемпион, день, мир, поздравлять, чемпионат, чемпионка</i> ( <i>russia, sport, russian, olympic, champion, day, world, congratulate, championship, champion</i> )

In the following sections we will comment on each topic and overall situation.

<sup>5</sup> <https://github.com/derekgreene/dynamic-nmf>

## 4. Interpretation and Results

### 4.1. The first dynamic topic

The first set of topical words describes the sphere of education in Russia in 2019-2020. Below we present the evolution of the topic in five time windows.

**Table 2**

The evolution of the first topic

Time window	Set of topical words	Situation
winter 2019	<i>российский, россия, производство, проект, мантуров, новый, завод, промышленность, просвещение, автомобиль (russian, russia, production, project, manturov, new, plant, industry, education, car)</i>	-
summer 2019	<i>россия, российский, проект, развитие, новый, производство, работа, предприятие, министр, промышленность (russia, russian, project, development, new, production, work, enterprise, minister, industry)</i>	-
spring 2020	<i>россия, проект, работа, онлайн, студент, российский, время, новый, образование, университет (russia, project, work, online, student, russian, time, new, education, university)</i>	The beginning of the coronavirus pandemic, everyone starts the remote study.
summer 2020	<i>россия, проект, университет, новый, российский, спорт, программа, работа, наука, студент (russia, project, university, new, russian, sport, program, work, science, student)</i>	The enrollment of students in universities, the great number of online and real events on sports and science are held in Russia.
autumn and winter 2020	<i>минпросвещения, просвещение, учитель, школьник, педагог, школа, всероссийский, образование, страна, новый (ministry of education, education, teacher, student, teacher, school, all-Russian, education, country, new)</i>	The ministry of education starts publishing information about upcoming exams (the Russian state exam) and competitions for teachers.

Basing on the table above, we can conclude that the education topic was acute during the pandemic of the coronavirus. In 2020 almost all the topics can be compared with the situation in 2019 in which we have only two periods when the topic on education evolved: in spring and summer. Unfortunately, they are hard to connect with real-based events. It may be linked to the focus of the government on the development of education in technical spheres such as engineering, manufacturing etc.

### 4.2. The second dynamic topic

Unlike the first topic, we can track the evolution of the second one during all the periods of two years.

**Table 3**

The evolvement of the second topic

Time window	Set of topical words	Situation
winter 2019	<i>полиция, мвд, полицейский, россия, сотрудник, мужчина, водитель, помощь, мчс, служба (police, ministry of internal affairs, policeman, russia, employee, man, driver, help, ministry of emergency situations, service)</i>	-
spring 2019	<i>полиция, россия, мвд, сотрудник, мчс, полицейский, пожарный, опасность, внутренний, весна (police, russia, ministry of internal affairs, employee, ministry of emergency situations, policeman, firefighter, danger, internal, spring)</i>	-
summer 2019	<i>мчс, россия, пожарный, полиция, спасатель, человек, область, пожар, вода, спасательный (ministry of emergency situations, russia, firefighter, police, rescuer, man, region, hot, water, rescue)</i>	The beginning of forest fires in the Far East of Russia.
autumn 2019	<i>россия, мчс, пожарный, полиция, мвд, спасатель, сотрудник, полицейский, человек, работа (russia, ministry of emergency situations, firefighter, police, ministry of internal affairs, rescuer, employee, policeman, man, work)</i>	-
winter 2019-2020	<i>полиция, мчс, россия, мвд, пожарный, полицейский, сотрудник, спасатель, служба, область (police, ministry of emergency situations, russia, ministry of internal affairs, fire, policeman, employee, rescuer, service, region)</i>	-
spring 2020	<i>полиция, россия, пожарный, мвд, мчс, коронавирус, сотрудник, спасатель, дезинфекция, помощь (police, russia, firefighter, ministry of internal affairs, ministry of emergency situations, coronavirus, employee, rescuer, disinfection, help)</i>	The ministry of emergency situations disinfects a great number of facilities in the Russian Federation.
summer 2020	<i>полиция, россия, мчс, мвд, пожарный, сотрудник, полицейский, область, ребёнок, служба (police, russia, ministry of emergency situations, ministry of internal affairs, fire, employee, policeman, region, child, service)</i>	-
autumn and winter 2020	<i>полиция, мвд, россия, мчс, сайт, сотрудник, спасатель, мошенник, распродажа (police, ministry of internal affairs, russia, ministry of emergency situations, site, employee, rescuer, fraud, sale)</i>	Posts try to pay attention to frauds on the Internet, especially during the Black Friday.

After analyzing the table, it is clear that the topic, dedicated to the police and rescue operations, has almost the same distribution in all the time windows. We can state that all the posts of these communities are written on the only topics: work of policemen and rescuers. There are only three well-interpreted topics. For instance, the third time window (summer 2019) is notable as its topical words like *пожарный, спасатель, пожар, вода (firefighter, rescuer, fire, water)* indicate the topic of forest fires in Russia that are typical for this season. At the same time, it should be noted that the topic is not fully covered in the seventh time window although it is also summer. This fact can be explained that in 2020 there were less fires than in 2019.

### 4.3. The third dynamic topic

The third niche topic describes the military and navy service in the Russian Federation that also can be seen in all eight time windows.

**Table 4**

The evolvement of the third topic

Time window	Set of topical words	Situation
winter 2019	<i>военный, флот, боевой, корабль, стрельба, условный, россия, учение, оборона, самолёт (military, navy, combat, ship, shooting, conditional, russia, exercises, defense, aircraft)</i>	-
spring 2019	<i>военный, сирийский, рукбан, лагерь, флот, россия, боевой, оборона, стрельба, этап (military, syrian, rukban, camp, navy, russia, combat, defense, shooting, stage)</i>	Russia-Syrian diplomatic and military delegation tried to resolve the conflict in the Rukban camp between the USA and the Syrian refugees.
summer 2019	<i>военный, россия, армия, учение, конкурс, оборона, условный, боевой, международный, войско (military, russia, army, exercises, competition, defense, conditional, combat, international, army)</i>	The increasement of number of international competitions and exhibitions (Armygames 2019 and others).
autumn 2019	<i>военный, учение, россия, оборона, войско, условный, боевой, флот, корабль, противник (military, exercises, russia, defense, army, conditional, combat, navy, ship, enemy)</i>	-
winter 2019-2020	<i>военный, россия, боевой, оборона, учение, армия, полигон, флот, российский, шойгу (military, russia, combat, defense, exercises, army, firing field, navy, russian, shoygu)</i>	The number of official visits to military facilities were made by Sergey Shoygu, the minister of Defence.
spring 2020	<i>военный, россия, сербия, военнослужащий, стрельба, полигон, российский, минобороны, коронавирус, специалист (military, russia, serbia, serviceman, shooting, firing field, russian, ministry of defense, coronavirus, specialist)</i>	Russian servicemen deliver medical equipment to Serbia to help the nation.
summer 2020	<i>военный, конкурс, россия, полигон, учения, армия, российский, военнослужащий, команда, экипаж (military, competition, russia, firing field, exercises, army, russian, serviceman, team, crew)</i>	Returning to calling to military service after the stabilization of the situation with the pandemic of the coronavirus.
autumn and winter 2020	<i>военный, россия, российский, учение, полигон, минобороны, условный, военнослужащий, пациент, сила (military, russia, russian, exercises, firing field, ministry of defense, conditional, military officer, patient, force)</i>	Servicemen build hospitals for patients diagnosed with a new coronavirus.

In the area of military and navy service there are more topics to be interpreted. For instance, in spring 2019 despite the measures taken by Syrian and Russian authorities, the Rukban camp of internally displaced people still existed up to the present moment, and its residents are still unable to return home due to tough opposition from the side of the USA, so it was one of the acute topics that time. In winter 2019-2020 the minister of defense had a series of official visits to the military facilities and held some meetings with ministers of defense of other countries. Most of these events were held because of the upcoming Victory Day to commemorate the 75th Diamond Jubilee of the capitulation of Nazi Germany. Later, in autumn and winter 2020 main topics on social networks were dedicated to building a number of permanent and temporary hospitals for patients diagnosed with a coronavirus. Although servicemen started building in

spring 2020, the problem became pivotal only at the end of 2020 when the number of coronavirus cases had increased greatly compared to spring 2020.

#### 4.4. The fourth dynamic topic

The fourth set of topics describes the sphere of external affairs in all the time windows.

**Table 5**

The evolvement of the fourth topic

Time window	Set of topical words	Situation
winter 2019	<i>россия, российский, дело, министр, страна, иностранный, международный, лавров, февраль (russia, russian, affair, minister, country, foreign, international, lavrov, february)</i>	-
spring 2019	<i>россия, российский, министр, лавров, встреча, страна, федерация, международный, вопрос, обсе (russia, russian, minister, lavrov, meeting, country, federation, international, issue, osce)</i>	Sergey Lavrov conducted some official meetings in Moscow including the meeting with OSCE general secretary.
summer 2019	<i>россия, российский, дело, министр, иностранный, международный, страна, вопрос, лавров (russia, russian, affair, minister, foreign, international, country, question, lavrov)</i>	-
autumn 2019	<i>россия, дипломат, страна, молодой, международный, министр, вопрос, иностранный, оон, федерация (russia, diplomat, country, young, international, minister, issue, foreign, united nations, federation)</i>	Russia hosts the third international meeting of young diplomats from Russia, India and China.
winter 2019-2020	<i>россия, российский, страна, дело, вопрос, международный, министр, иностранный, федерация, сотрудничество (russia, russian, country, affair, issue, international, minister, foreign, federation, cooperation)</i>	-
spring 2020	<i>россия, российский, страна, сша, вопрос, посольство, дело, международный, рейс, федерация (russia, russian, country, usa, issue, embassy, affair, international, flight, federation)</i>	Russia launches export flights for the Russians who are abroad. The discussion of riots in the USA.
summer 2020	<i>россия, российский, страна, независимость, дело, международный, индия, отношение, сингапур, иностранный (russia, russian, country, independence, affair, international, india, relationship, singapore, foreign)</i>	The community often posts congratulations on the anniversaries of the Independence Day (India, Singapore, etc.).
autumn and winter 2020	<i>россия, беларусь, страна, союз, международный, лукашенко, министр, лавров, вопрос, государство (russia, belorussia, country, union, international, lukashenko, minister, lavrov, issue, country)</i>	Lavrov has several meetings with Belorussian official representatives both in Russia and Belorussia and discussing the development of the Union State.

The obtained topics are rather stable as the lemmata don't change a lot within all the topics. If we have a close look at the posts of the ministry of external affairs, we will see that the posts are usually describe the main events in which Sergey Lavrov took part, special days in the lives of other countries and some official meetings. Only 2020 has certain burning issues like the organization of flights for the Russians that are not in the country because of closing the borders or the discussion of US riots by reason of the presidential race or the Black Lives Matter movement.

#### 4.5. The fifth dynamic topic

The fifth topic on the cultural events was represented in five periods, the spring and summer of 2019 and the spring of 2020 weren't mentioned.

**Table 6**

The evolvement of the fifth topic

Time window	Set of topical words	Situation
winter 2019	<i>театр, хороший, сцена, спектакль, россия, театральный, артист, музеи, фильм, картина (theatre, good, stage, performance, russia, theatrical, artist, museums, film, picture)</i>	-
autumn 2019	<i>россия, культура, российский, театр, фильм, проект, музей, ночь, искусство, выставка (russia, culture, russian, theatre, film, project, museum, night, art, exhibition)</i>	The beginning of "The Artnight" festival, which is timed to the Day of National Unity.
winter 2019-2020	<i>культура, театр, церемония, россия, музей, фильм, ольга, спектакль, официальный, новый (culture, theatre, ceremony, russia, museum, film, olga, performance, official, new)</i>	Olga Lyubimova became a new Minister of Culture, she being presented to the public. She also made some official visits to Saint Petersburg and Svetlogorsk.
summer 2020	<i>культура, россия, область, музей, новый, театр, библиотека, возвращаться, российский, работа (culture, russia, region, museum, new, theatre, library, return, russian, work)</i>	Russian regional museums and exhibitions prepare to welcome visitors after the lockdown.
autumn and winter 2020	<i>театр, культура, музей, россия, фестиваль, ссылка, библиотека, спектакль, концерт, искусство (theatre, culture, museum, russia, festival, link, library, performance, concert, art)</i>	-

According to the table, the cultural sphere on the social networks is well-reflected: the topics describe upcoming festivals, real and online performances, the visit of the new Minister of culture to theatres and libraries, etc. Only two periods cannot be interpreted. As we consider, these periods were rather stable in this sphere.

#### 4.6. The sixth dynamic topic

The sport topic is shown in six periods excluding the spring and summer of 2020 when Russia couldn't hold any sports events.



**Table 7**  
The evolvement of the sixth topic

Time window	Set of topical words	Situation
winter 2019	<i>россия, праздновать, российский, поздравлять, чемпион, завоевать, чемпионка, мир, сегодня, спорт (russia, celebrate, russian, congratulate, champion, win, championess, world, today, sport)</i>	-
spring 2019	<i>россия, российский, проект, кратный, день, министр, образование, первый, развитие, антон (russia, russian, project, multiple, day, minister, education, first, development, anton)</i>	-
summer 2019	<i>россия, олимпийский, спорт, день, российский, сборная, чемпион, чемпионат, мир, чемпионка (russia, olympic, sport, day, russian, national team, champion, championship, world, championess)</i>	-
autumn 2019	<i>россия, праздник, российский, министр, развитие, образование, день, конкурс, страна, первый (russia, feast, russian, minister, development, education, day, competition, country, first)</i>	-
winter 2019-2020	<i>россия, российский, проект, хоккейный, развитие, золото, страна, сборная, работа (russia, russian, project, hockey, development, gold, country, combined team, work)</i>	The Youth hockey team won the third Winter Youth Olympic Games in the USA.
autumn and winter 2020	<i>россия, спорт, российский, минобрнауки, проект, фальков, развитие, новый, наука, спортивный (russia, sport, russian, ministry of education, project, falkov, development, new, science, sports)</i>	-

Unfortunately, the resultant topics don't allow us to highlight pivotal events in the sports sphere. The only well-described topic is dedicated to winning in the third Winter Youth Olympic Games. At the same time, we see that educational sphere somehow interact with the sports one as different topical lemmata can be in one set (*sport – ministry of education* etc.). It can be explained by the fact that the ministry of sports tries to promote sports activities in Russian school and make PE lessons one of the most important one for students.

## 5. Discussions

Below we present a summary table denoting the statistics of the resultant topics.

**Table 8.**  
Statistics on topics

Dynamic Topic	Number of time windows	Number of interpreted topics
Education	5	3
Emergency situations	8	3
Military cases	8	6
External affairs	8	5
Culture	5	3
Sport	6	1
Mean	6,7 (6-7 time windows)	3,5 (3-4 interpreted topics)

While applying the algorithm of dynamic topic modeling to the corpus of ministerial posts, we can describe main advantages and disadvantages. First of all, according to Table 8, more than a half of the corpus turned out to be well-interpreted. Despite the similar sets of lemmata within each period, there can be some special words that help us to understand a described situation (for instance, the *rukban* lemma

denotes the place of a possible military conflict). Moreover, there are few verbs in all the topics, it makes the interpretation of topical sets easier. If there had been more verbs (*declare, say, state, claim* etc.), it would have been harder to name the topics. Also, we can distinguish some relations between obtained lemmata like in the LDA topic models [8]: *россия – страна (russia – country), военный – оборона (military – defense), учитель – школьник (teacher – student)* and others.

As for disadvantages, the final dynamic topic models don't include the collocations that we used for the enrichment of the corpus. In this case, further development of models can be connected with the using another application for detecting lexical constructions. For instance, we can use NLTK that provides the detection based on different measures (t-score, log-likelihood, etc.). The combination of the measures may improve the chance of their appearing in the models. Of course, the models based on the word2vec corpus need more training in the future. Changing the parameters may allow us to obtain more precise corpus, it leading to appearing time periods that weren't covered in the present paper.

Unfortunately, DTM with NMF failed to highlight topics that are on everyone's lips: for instance, there is a topic dedicated to health that was acute in 2020. In [13] it is explained that the coronavirus topic is scattered across all the ministerial communities, and it can be absorbed by other topical sets. For instance, when speaking about dynamic topics on external affairs, we can distinguish a set that is indirectly connected with the coronavirus topic: *россия, российский, страна, сша, вопрос, посольство, дело, международный, рейс, федерация (russia, russian, country, usa, issue, embassy, affair, international, flight, federation)*. As it was previously mentioned, this one is dedicated to Russian export flights. There are a lot of specific topics that might be unknown for an average inhabitant: the celebration of the Independence Day of certain countries, the conflict in the Rukban camp, etc. Further tuning of the algorithm and corpus enlargement may help to improve the quality of topics.

## 6. Conclusion

In the present paper, we have analyzed the development of ministerial post on VKontakte social network for two years. We prove that if some issues discussed in the posts of social networks are pivotal, they will be reflected in a certain time window of the dynamic topic models. At the same time, it will be hard to detect any changes if the topics are evenly distributed within all the time periods. From the point of view of linguistics, we can highlight different syntagmatic and paradigmatic relations in each topic.

Further experiments can be aimed at:

- comparing the results of dynamic topic models and the “openness” of the state in online communities;
- using other algorithms of dynamic topic modeling to distinguish their common and different features;
- involving other Russian social networks to compare the activity of ministries in them and see if there are any difference compared to the posts on VKontakte;
- enriching the existing corpus with collocations as it may help to interpret certain periods.

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# An Interoperable Platform for Multi-Grain Text Annotation

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## Abstract

In this paper, we describe an interoperable platform for creating annotated corpora in different languages and domains. It focuses on two most widely used for practical information processing tasks levels of linguistic annotations, - morphological and conceptual, that can be performed separately or combined. The platform consists of two main modules, - a program shell and a knowledge base. The program shell is universal and features flexible settings that ensure its adaptation to multilingual corpora of various domains and different levels of annotation. It is provided with several interfaces for knowledge acquisition and annotation control. The annotation platform knowledge base includes language-independent and language-dependent linguistic information. The language-independent information is presented by multilingual domain ontology, while the core of the language-dependent component of the platform knowledge base includes unilingual onto-lexicons. The annotation process consists in the practical realization of ontological analysis. In performing the annotation task, the NLP techniques are used to automatically support, rather than completely replace human judgment. The platform is multifunctional, and in addition to corpora annotation, it can directly be used for different types of theoretical linguistic research, e.g., terminology analysis, cross-linguistic comparative studies, etc. The paper covers both, the platform design and its application in the frame of a real project on the conceptual annotation of the "Terrorism" domain corpora in the Russian, English and French languages.

## Keywords

Annotation platform, interoperability, domain ontology

## 1. Introduction

Corpora annotations are a prerequisite for any succession of text processing steps and its accuracy to a large extent defines the quality of the final NLP output. It is therefore the focus of many international theoretical and applied linguistic studies. While many practical texts processing tasks nowadays rely on morphological labelling, conceptual annotation is becoming increasingly used as explicit semantics is starting to play a more prominent role in computer technologies targeted to intelligent processing of unstructured information (automatic classification, intelligent content and trend analyzes, machine learning, machine translation, etc.) [1]. By conceptual annotation (which in many practical projects is called "semantic") we understand that type of semantic annotation, which is developed for solving specific information tasks within a particular domain, and use the term to distinguish this particular type of annotation from the high level semantic mark-up such as "human", "animated", etc. For example, in the "Terrorism" domain the English lexeme "car" will be conceptually annotated as "means of attack", rather than "concrete", "non-animated", etc. We also believe that given the ambiguity of natural language on all levels, combining different types of annotations, e.g. morphological-syntactic and conceptual might provide a feature space that would enhance the chances to resolve annotation ambiguity.

Information processing projects that strive for high quality results require annotating comprehensive corpora, which with any level of tags, let alone conceptual, as a starting point of research and development is nowadays mostly done manually and on its own is a hard, costly and

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time-consuming task. Taking advantage of pre-developed resources that could allow skipping the annotation stage is quite problematic. Annotated corpora are quite sparse and often cannot be accessed at all, because the developers restrict or completely forbid their public use. In addition, the volume and construction principles of most existing annotated resources are non-standardized and are tuned to only a limited number of domains and information processing tasks. The situation puts in focus the issues of developing automated annotation tools and their interoperability to save development effort.

This paper attempts just that and presents an automated interoperable platform for creating multi-grain annotations of corpora in different languages and domains. The platform is ontology-based and is supported by the NLP technology that complements human annotation effort. The tool is multifunctional. In addition to automated corpora annotation, it can directly be used for different types of theoretical linguistic research, e.g., terminology and corpora analysis, cross-linguistic comparative studies, etc. The description covers both, the platform design and its application in the frame of a real project on the conceptual annotation of the "Terrorism" domain e-news in the English, Russian and French languages.

The paper is structured as follows. Section 2 overviews the related work. Section 3 describes the platform design. Section 4 is devoted to a case-study, in the frame of which the platform development and its use is described as applied to the multilingual corpora of the "Terrorism" domain in English, Russian and French. We conclude with the summary and future work.

## 2. Related work

While all annotated corpora created to date necessarily contain morphological markup, since the problem of automatic (or automated) morphological analysis for a large number of languages has now been largely solved, the need to speed up and save human effort in corpora annotation for intelligent text processing applications prompted studies specially devoted to the development of automated concept annotation tools. Some attempts are made to apply unsupervised approaches and completely exclude human labor [2]. However, most popular are semi-automatic approaches that rely on NLP techniques [3], document structure analysis [4] or learning that requires training sets or supervision [5]. Some works to automate annotation rely on information extraction [6, 7]. Most modern semi-automatic annotation tools are based on ontologies where the annotation procedure is performed by the technique of ontological analysis that results in the identification concept instances from the ontology in texts [8]. Notwithstanding whether ontology-based annotation is done manually or involves automation, it has a very serious limitation, - the availability of an appropriate pre-defined and well-established ontologies. Though quite a number of ontological libraries are now publicly available, their suitability for every particular R&D project involving ontology-based conceptual annotation is, as a rule, problematic. Most works on ontology-based annotation therefore assume the availability of an already existing ontology [9] or include the creation of an ontological resource as part of annotation problem solution. Ontologies are mostly created for conceptual annotation of domain corpora in one (often, English) language and are tuned to specific information processing tasks, - medical record analysis [10], personalized filtration of eNews [11], "Terrorism" domain content analysis [12]. Much less research can so far be found on the ontology-based annotation of corpora in other languages. For example, in [13] research on the semantic (in fact, conceptual) annotation of the Russian e-service domain corpus is described as presented in e-news, the system presented in [14] focus on the conceptual annotation of the French corpus. Most often, the methodologies for the ontology based annotation include a combination of automated technics and manual tagging (see e.g., the works cited above).

Given the amount of effort and time needed to construct ontologies for language-specific corpora processing, multilingual ontologies that could be interoperable cross-linguistically got in the circle of research interest. There is no consensus on how to understand multilingualism in ontologies. Within one approach, ontological multilingualism is treated as understandability (or adaptation) of the ontological labels for the users who speak different national languages. In another approach, ontology is taken to be multilingual, if it can be applied to processing texts in different languages no matter

what language was used for concept labels. These interpretations of ontological multilingualism directly rely on ontology definition as either a language-independent or language-dependent resource.

Language-dependent ontologies, a well-known example of which is the famous WordNet [16], are thesaurus-like structures defined by the properties of a particular language. Transition to multilingualism there is treated as the localization of ontological concept labels. The localization itself can be approached in different ways, as a) linking the word senses of different national languages to ontological concepts by means of a specially developed model [16], b) translation of the ontological concept labels from one language into another [17] and c) manual annotation of ontological concepts with labels worded in different languages [18]. Among other ontology-related works in the frame of interoperability are, for example, a research devoted to the creation of universal tools for semi-automatic building of unilingual ontologies [19] and the studies to suggest interoperable methodologies for cross-referencing the data and meta-data of unilingual ontologies [20].

Language-independent ontologies, such as Mikrokosmos [21], SUMO [22] and BFO [23], per definition allow multilingualism in the sense of the capability to process texts in different languages, cross-linguistic conceptual annotation included, which is provided by building lexicons of specific languages and mapping them into the concepts of one and the same multilingual ontology.

One of the annotation challenges, which is discussed in the literature, is a way to find the best set of tags for different levels of tagging from morphological tags up to conceptual labels. The main thing here is to decide on the amount of information coded in a single tag, and on the size of the tagset. Though most of the discussions on the tag subject concern morphological and syntactic tagging, the main ideas of such discussions are worth to be taken in consideration for conceptual tagging as well. For example, in [24], the external and internal criteria in a tagset design are suggested. The external criterion demands the tags to be able to code the distinctions in the linguistic features that are required by the processing task. The internal tag design criterion concerns making the tagging process as precise as possible. It is believed that a smaller and simpler tagset should improve the accuracy of tagging, while a large number of tags causes problems for creating reliable taggers. However, larger amount of information included in the tagset may help tag ambiguity resolution. In [25], it is claimed that tagging precision (or accuracy) depends crucially on using a wide range of linguistic features including lexical ones. There is thus the eternal trade-off: tag coverage versus tag precision. Another way to significantly reduce the number of tags and nevertheless take advantage of additional linguistic knowledge for raising annotation accuracy is the use of supertags. In general, a supertag can code a wide range of features (morphological, syntactic, semantic and conceptual thus providing for significant gain in tagger performance [26]. Certain attempts have been made to develop multilingually universal tagsets. Thus, the results of the experiments carried out on different language families (Roman vs. Slavic) are reported and the most challenging linguistic phenomena for the task are defined. Another suggestion is to use a coarse tagset consisting of twelve cross-language lexical categories [28]. In the frame of the MULTEXT-East (MTE) project, an attempt is made to standardize the tagset for a range of Slavic languages, such as Romanian, Croatian, Slovenian, Czech and, currently, Macedonian and Russian [29]. However, many studies aimed at developing real world applications point out that general-text tagsets usually fail on domain specific texts, and therefore, tagsets should be domain- and application-specific [30].

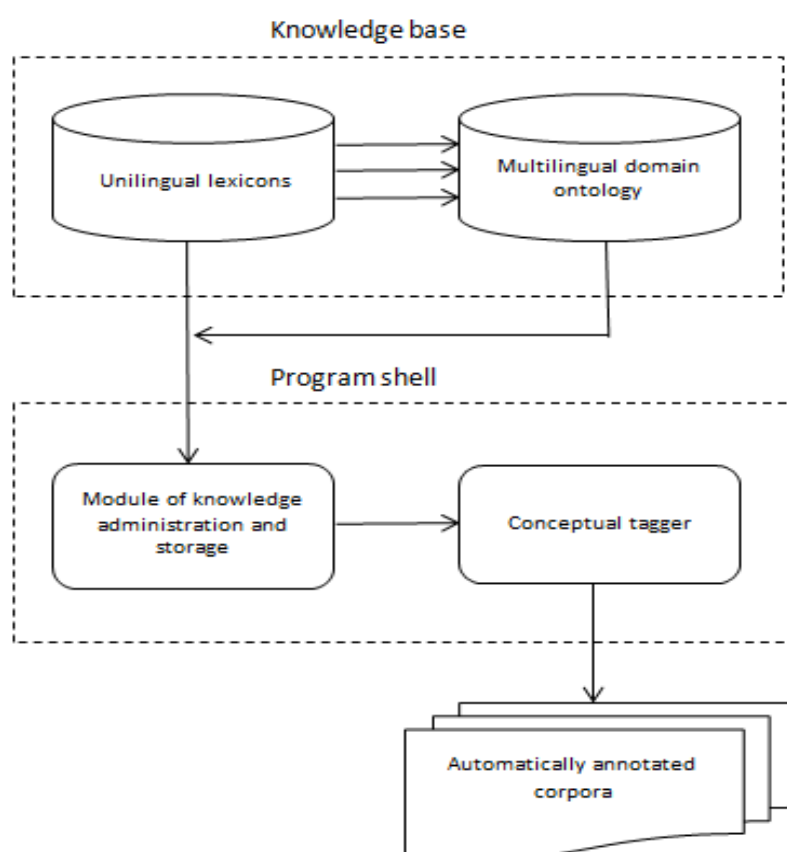
As noted in [31], current applications using concept tags (or codes) show three different approaches for concept tag definition, - conventional, directed and summative that mainly differ in the tag origin. In the conventional approach, conceptual tagging categories are derived directly from the text data. The directed approach for the initial set of concept tags relies on a theory or relevant research findings. Concept tags within the summative approach coincide with preliminary extracted text keywords. Most often, conceptual tag set design concerns the ontology size and granularity. In [32] the ontological granularity is treated in terms of ontological levels, while the reduction of the number of concept tags is suggested by using specific levels of the so-called multilevel ontologies which would allow meeting the interoperability demand with multi-layer corpus annotation. One more way to save annotation effort concerns the development of cross-platform interoperability for collaboration in automated text annotation [33]. However, in spite of the development of increasingly convivial and hardware-independent annotation tools, the need to create intuitive, user-friendly interfaces, which can make the annotation tools more accessible to users without special technical skills (for example, linguists or domain experts) is more and more emphasized [34, 35].

### 3. Design

#### 3.1. Overview

Our research and development effort is defined by the intersection of the following criteria: (i) domain and cross-language interoperability (ii) increase of annotation quality, (iii) automation, (iv) user-friendliness for linguists and domain expert’s with-out special technical skills, (v) annotation multi-granularity from morphology up to semantic and conceptual mark-up.

The requirements of annotation interoperability and multi-granularity were answered by defining the annotation methodology as the practical realization of ontological analysis based on a domain-specific multilingual ontology, a universal program shell and a reusable tagset. In defining our tagset features we aimed at providing a) balance between the features’ annotation relevancy and realistic expectations to detect them automatically, b) possibility to disambiguate the tags using both statistical measures and local context linguistic rules as the quality of annotations depends upon the judicious application of NLP technology, and c) possibility to share the tagset between languages within a particular domain. The integration of these methodological and technological solutions determined the architecture of the annotation platform, which consists of two main components - a knowledge base and a program shell. The overall architecture of the annotation platform is shown in Figure 1.



**Figure 1:** The architecture of the interoperable multi-grain annotation platform

#### 3.2. The knowledge base

The annotation platform knowledge base has the following main components:

- language-independent semantic (conceptual) knowledge of a particular domain presented in the domain ontology;

- language-dependent linguistic knowledge of the domain in question that includes domain-relevant unilingual lexicons of one- and multicomponent units with assigned parts-of-speech and other morphological features relevant for each language;
- linking knowledge on mapping the domain-relevant lexical units into the ontology concepts.

The ontology as the core of the platform knowledge is built based on the following methodological assumptions:

- Ontology is a language-independent resource and serves intermediary between unilingual lexicons.
- Domain ontology is integral part of upper-level ontology, Mikrokosmos [21] in our case.
- The acquisition of the domain ontological knowledge is data-driven based on multilingual comparable domain corpora using mixed (top-down/bottom-up) acquisition techniques.

Building the knowledge base includes extraction of domain-relevant lexemes from training multilingual corpora followed by grouping the resulted sets into semantic (conceptual) categories according to the sense closeness within the one language, and across languages. Thus defined semantic categories are taken to be the seed concepts of the domain ontology and following the Mikrokosmos structure are divided into interrelated classes of the OBJECTS, EVENTS, and PROPERTIES top concepts. The concept labels are worded in English, while the concept meanings are specified by concept definitions. The unilingual lists of domain-related lexemes grouped into conceptual categories are further called onto-lexicons and cover the linking knowledge.

The interoperable annotation platform program shell consists of two main blocks: a knowledge administration and storage module and a tagger (see Fig. 1).

### 3.3. The program main modules

The main modules of the annotation platform program are a knowledge administration and storage module, further TransDict, and a tagger that are two updated and reused components of the earlier developed text processing platform described in [37] that to a large extent meets our design requirements and allowed us reducing the development effort.

TransDict is structured as a set of unilingual lexicons with cross-referenced entries of translation equivalents. The linguistic information associated with every unilingual entry is formalized as a tree of features:

```
[semantic class/concept [language [part-of-speech [other morphology [tag]]]]]]
```

The morphological zone of the module entries contains a full wordform paradigm of a unilingual lexeme, each associated with a supertag that codes conceptual and morphological knowledge. The entry is meant for one sense of a lexical unit. TransDict has a powerful environment for the automated acquisition and administrations of multilingual lexical and ontological knowledge by means of a user interface, which visualizers the platform knowledge (Fig.1) and gives access to the following built-in supporting tools:

*Configuration block* that creates and edits the TransDict feature settings such as semantic classes (concepts), languages, parts of speech, word forms and their tags; any change in the settings will automatically propagates to all the entries in a corresponding language.

*Defaulter* that automatically assigns entry structures and some of the feature values to new entries according to the user-set parameters and values; for example, all semantic classes and some of the knowledge of the English entry are automatically ported to a lexicon in another language, when added; the knowledge can be edited.

*Data importer/merger* that imports wordlists and/or feature values from external files and applications both, in batch mode and individually.

*Data exporter* that exports wordlists and/or feature values from TransDict to external files and applications.

*Copy-entry module* that copies all, or individual fields of one entry into another



*Morphological generator* that automatically generates wordforms for a given word and fills the morphological fields of the entry automatically assigning the tags specified in the configuration settings.

*Content and format checker*, which reveals incomplete and/or ill formatted entries.

*Look-up tool* that performs a wild card search on one or any combination of specified parameters (letters, language, semantic (conceptual) classes and part-of-speech; it is also possible to filter the whole sets of TransDict entries according to a specified lists of lexemes, incompletely filled entries, entries of repeated tokens, etc. The use of the *Look-up tool* allows identification of knowledge gaps and gives a lot of opportunities for analyzing the qualitative and quantitative linguistic characteristics of the domains, which are either language specific, or hold across languages, and can be used to develop metrics for resolving tag ambiguity (unavoidable in annotations) or for contrastive linguistic research.

To provide for a collaborative setup for sharing knowledge acquisition tasks, TransDict is programmed in two versions: the MASTER version with the full range of built-in tools activated and the LIGHT version, - an empty TransDict program shell configured as MASTER but with the Configuration block disabled for consistency of the acquired knowledge. Acquirers can individually fill LIGHTs with new lexical-ontological knowledge, which is then imported into MASTER on a regular basis.

The platform tagger gets a "raw" text as input and outputs its annotated version at a specified level, - with either conceptual tags only or supertags. The main blocks of the tagger program are as follows:

*Configuration block* configures the tagger to a specific language and markup level.

*Lexicon look-up* module tags text with TransDict (super) tags of a selected level

*Data importer* imports texts from external files and from TransDict knowledge.

*Data exporter* has two functions: it exports the annotated text to external files and interactively exports lexical units tagged as “unknown” to the TransDict knowledge.

*Control interfaces* for visualizing tagger output to control the annotation quality.

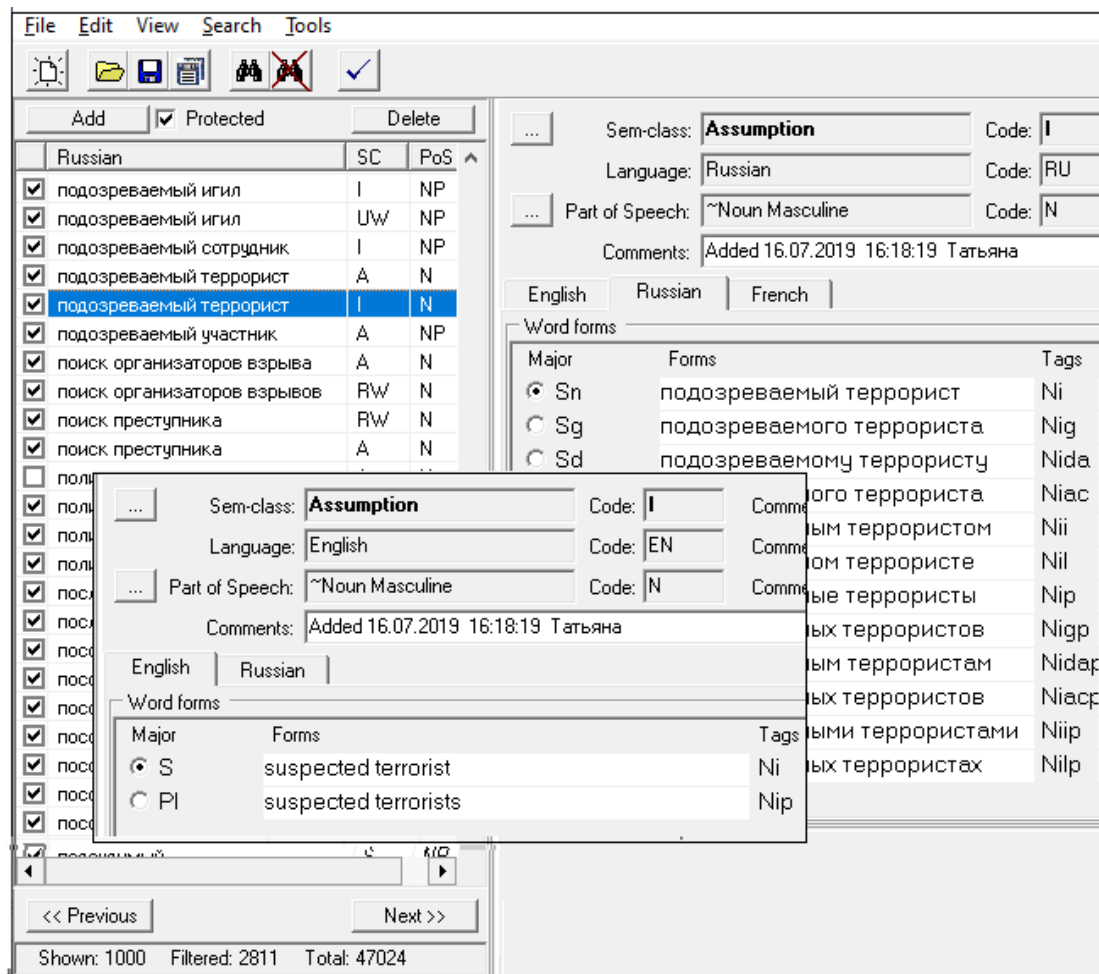
*Disambiguation rules interpreter* integrates the rule-based NLP techniques into the annotation process; the interpreter has a user-friendly interface for writing tag disambiguation rules in the simple IF-THEN-ELSE-ENDIF formalism that does not require programmer’s skills. The rules are written over the lexical knowledge and TransDict tagset and, when saved, are automatically compiled into the program. The tagger disambiguation interpreter is fully functional and with a good rule coverage insures the high quality of annotation. Of course, though the interpreter has a lot of effort saving functionalities, the inherent problem of all rule-based NLP techniques (knowledge bottle-neck) cannot be avoided. The interpreter module is therefore made optional and its use depends on the user’s willingness to invest a sufficient amount of effort in the disambiguation rule acquisition.

## **4. Case study: the “Terrorism” domain annotation platform**

### **4.1. Knowledge handling**

To be applied in practice, the annotation platform program shell should be filled with domain knowledge along the lines given in Section 2.1. We further describe this process as done in the frame of the real on-going project on content analysis of the “Terrorism” domain e-news in the English, Russian and French languages. The major project task requires the conceptual level of annotation as a must prerequisite.

The main parts of the platform knowledge base, - the “Terrorism” domain multilingual ontology and unilingual English, Russian and French onto-lexicons were built in parallel on the data of three comparable corpora of e-news on terrorist acts of 500,000 words each. The knowledge acquisition details are described in [38]. We here concentrate on its presentation and handling in the TransDict program. A fragment of the TransDict main interface is shown in Fig.2.



**Figure 2:** A fragment of the main TransDict interface opened at the Russian onto-lexicon page

In Fig.2, the screenshot of the main TransDict interface displays the entry of the highlighted lexeme. In the center, the pop-up window of its English equivalent entry is shown as called by clicking on the “English” bookmark. The interface buttons are self-explanatory. All fields are interactive and can be edited. On the left pane (from left to right), shown are the interactive list of the Russian onto-lexicon units, corresponding ontology concept codes (SC) and parts-of speech (PoS). Every entry contains a lexeme linked to one ontological concept. In case a lexeme can be mapped into different ontological concepts it appears in different TransDict entries (one per each conceptual meaning). That explains the lexical duplications in the list.

The content of a lexical entry opens on clicks on the lexeme and the bookmark of the language of interest. The knowledge put in the highlighted entry appears on the right pane. The concept, language and part-of-speech with their codes are located on the top of the right pane, under which the morphological zone containing a full paradigm of a lexeme wordforms with supertags is shown. The TransDict supertags and parts-of-speech are the unified sets of the combinations of task-tuned linguistic features of the Russian, English and French languages; the number of fields in the morphological zone is different and defined according to the grammars of corresponding languages. The new knowledge can be exported to TransDict in a batch mode or individually as follows. A click on the “Add” button over the lexeme list calls the pop-up interactive menu of concepts; the selection of a concept opens the part-of speech menu (see Fig.3), which, in turn opens a new TransDict entry with the selected structure and all the knowledge but the morphological paradigm filled out. The acquirer needs to fill only one wordform in the paradigm field, the rest word-forms will be generated automatically. The content of every entry zone is editable and can be copied from one entry to another. All settings are configurable; the setting changes automatically propagate to the lexical entries.

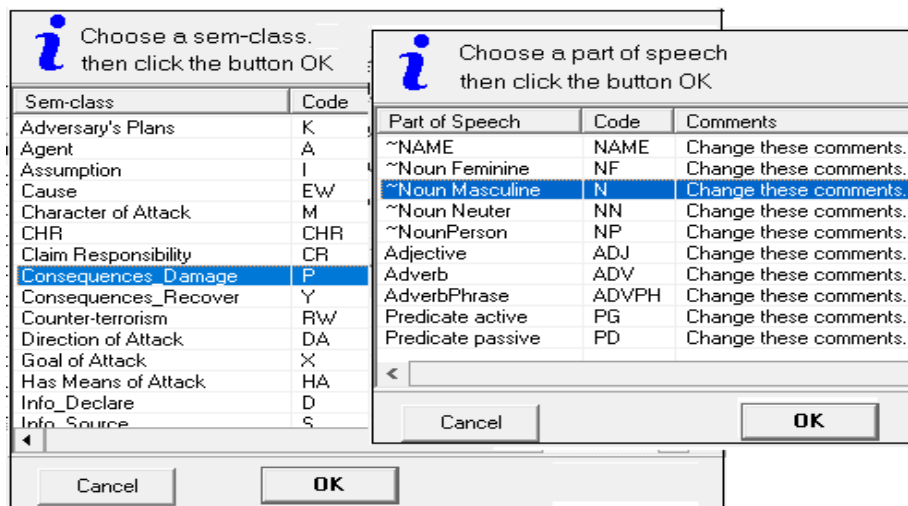


Figure 3: Pop-up windows for assigning a new lexeme its linguistic features

The “Terrorism” domain corpora-based lexemes exported to the TransDict unilingual lexicons is aligned as translation equivalents; the translation gaps are filled out by the acquirers. This augmented onto-lexicons and made the platform useful for machine translation-related tasks as well. The number of aligned lexicon entries is thus the same but the number of unique unilingual lexemes differs due to the different levels of synonymy in each language. The explicit list of lexemes’ paradigms in the TransDict entries allows skipping many analysis problems and annotating the input text by a simple look-up in the TransDict morphological zones. The look-up procedure goes from left to right, longer units first. The results of such look-up can be displayed in the tagger interface on the level of concept tags only (see Fig.4) or on the level of supertags, if necessary.

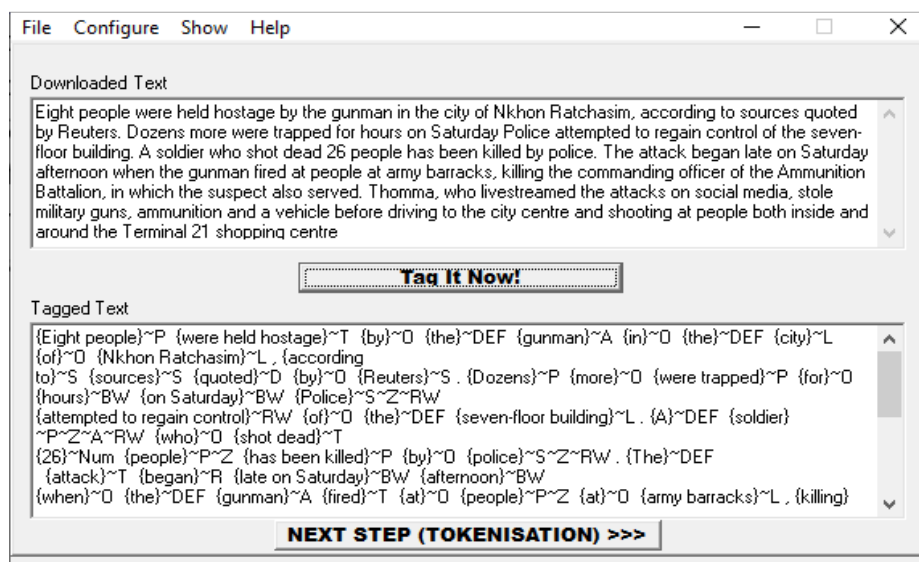


Figure 4: The tagger interface with the concept-only level of annotation after TransDict look-up

## 4.2. The annotation platform as a research tool

The developed annotation platform due to its advanced search functions accessible through the TransDict main interface can also be used as a research tool. We did just that in an attempt to find quantitative disambiguation metrics that could complement or even substitute the disambiguation

rules. As a first step on this way, we sorted out all lexemes that were linked to multiple ontology concepts and thus lead to conceptual multi-tags after the TransDict look-up. Analysis of both, the sorted out lists and the domain corpora showed that multi-tags are caused by two different phenomena, that of lexical conceptual ambiguity and that of conceptual syncretism. The unilingual lexemes are conceptually ambiguous, if in the domain corpora, they can function in different mutually exclusive conceptual meanings, like, for example, the English word “car” and its Russian and French equivalents “автомобиль” and “voiture”, correspondingly ( annotated with the multi-tag ~P~C) :

CONSEQUENCES-DAMAGE (P): The terrorist attack damaged about 50 cars. / В результате атаки террориста повреждено около 50 автомобилей/ L'attaque terroriste a endommagé environ 50 voitures.

MEANS OF ATTACK (C): A car hit people on Westminster Bridge. / На Вестминстерском мосту автомобиль наехал на людей/ Une voiture a heurté des gens sur le pont de Westminster.

The unilingual lexemes are conceptually sincretical, if they have several conceptual meanings that do not contradict each other. Most often, but not exclusively, conceptual syncretism was detected in multicomponent domain-relevant lexemes. For example, in the English noun phrase "airport shooting suspect" the word "shooting" contains information about the type of attack, the word "airport" indicates the place where the attack occurred, the word "suspect" has two conceptual meanings at once - "assumption" and " perpetrator of a terrorist act ". Therefore, after the tagger look-up this lexeme will be conceptually annotated as {airport shooting suspect} ~T~L~I~A.

In the multi-tag syncretism case no ambiguity resolution is required as the meanings of the individual conceptual tags in a multi-tag are complimentary. On the contrary, multi-tags that are caused by conceptual ambiguity need to be disambiguated. We tried to answer the question whether it is possible to automatically identify syncretical multi-tags to exclude them from the disambiguation procedure.

To reduce the volume of annotator tasks, we conducted the research on relatively small portions of the unilingual e-news corpora of 35,000 wordforms each, which were automatically annotated by the tagger TransDict look-up and manually post-edited to the gold standard. We then calculated the frequencies of the multi-tags, which “survived” the postediting and thus were sincretical per definition. The threshold for cutting the top frequency list of the syncretical multi-tags to be excluded from the disambiguation procedure can be defined empirically. We currently experimented with the 10 top sincretical multi-tags in every language. We further introduced a heuristic *concept usage relevancy* (CUR) measure. The heuristic is: the higher the concept CUR value, the more prioritized its tag can be in the set of the other tags assigned to the same lexical unit. The empirical formula we use at the current stage of research to calculate the CUR value is:

$$CUR = (RCF * w_1 + Cf * w_2) / (w_1 + w_2), \text{ where}$$

RCF is the ratio of concept fillers; it accounts for the variety of the lexical units mapped into a concept and is calculated as

$$RCF = n/N, \text{ where}$$

n is the number of unique (different) unilingual corpus lexical units mapped into a particular concept in the corpus and N is the total number of ontology-mapped lexemes in the corpus;

Cf is the concept frequency index calculated as

$$Cf = (Cfs + Cfm) / F, \text{ where}$$

Cfs is the frequency of the concept in the corpus as a single tag, Cfm is the frequency of the concept in the corpus as a component of a multi-tag; F is the total number of conceptual tags (single and multiple) in the corpus; w<sub>1</sub> and w<sub>2</sub> are arbitrary weights; we so far experimented with w<sub>1</sub>= 10 and w<sub>2</sub>=1. The denominator (w<sub>1</sub>+w<sub>2</sub>) in the CUR formula is used to normalize the CUR value to the common percentage scale.

The suggested disambiguation measures are supposed to be crosslinguistically universal, while their values are obviously language-dependent. The scope of this paper does not permit to give the details of the calculations (it takes a forthcoming paper), we here therefore present the preliminary results of using the CUR values in the annotation workflow, which we defined to be performed in the following order:

1. Automatic text annotation with the tagger TransDict look-up,
2. Automatic exclusion of the top 10 of always syncretical multi-tags from disambiguation,
3. Automatic disambiguation of the rest of the multi-tags based on concept usage relevancy (CUR) values,
4. Manual postediting of the resulting annotations.

In assessing the conceptual annotation accuracy we used the temporal post-editing effort quantitative measure [39]. Participants in the evaluation experiment were the project members who acquired the platform knowledge and students of the South Ural State University (Russia) enrolled in a translation studies program and familiar with the computational linguistics concepts and post-editing techniques. They were given same-size portions of raw and automatically annotated texts (stage 3 output of the annotation workflow) and were asked to report on the time they spent on producing the gold annotations of the raw and automatically annotated texts. To make the evaluation less subjective, the raw and automatically annotated texts given to each participant were taken from different corpora. The reported time values were then summarized and normalized. The results showed that the post-editing time spent on the automatically annotated texts was on average 35% less than the time needed to conceptually annotate the raw text, which shows our annotation framework to be viable.

## 5. Conclusions

We have presented an interoperable platform for multi-grain annotation of multilingual domain corpora. The platform is a stand-alone PC application realized for Windows in the C++ programming language. The interoperability of the platform is provided by the tagset that includes conceptual information specified in the language-independent domain ontology and a universal tagging algorithm. The latter is defined to consist of two main successive procedures: ontological analysis (text-to-ontology mapping) and multi-tag disambiguation, for which both the rule-based NLP technique and/or quantitative measures can be applied. The paper covers the platform general design and its application for the conceptual annotation of the "Terrorism" domain corpora in English Russian and French. The potential of the developed interoperable platform as a research tool to define quantitative metrics for tag disambiguation is also demonstrated on the example of the conceptual-level annotation. The suggested quantitative metrics account for a) the frequency of the concept usage in unilingual corpora annotations and b) the variety of the unilingual lexical units mapped into a multilingual ontological concept. The specificity of the approach is that a) the unit of the ontological analysis is taken to be a multicomponent phrase rather than a single word and b) tag disambiguation can be supported by the rule-based NLP technology through the fully functional platform tagger interpreter and/or by quantitative measures. The case study assessment of the conceptual tagging effort with the suggested annotation workflow steps and quantitative tag disambiguation measures (without rule-based disambiguation) showed on average the 35% gain in tagging time, which proves the legitimacy of the proposed interoperable multilingual annotation framework. We are fully aware that more research should be done on disambiguation metrics and see it as our future work. In parallel, we will proceed with enlarging both the depth and the breadth of the multilingual ontology and the coverage of the onto-lexicons both in terms of size and the number of languages.

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# Corpus-Based Study of Word-Formation Models of Feminitives in Contemporary Russian

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## Abstract

The article is devoted to the description of the main derivational models of feminitives in contemporary Russian using corpus data. Today, native speakers often deviate from the rules of word formation of feminitives described in textbooks on Russian grammar or use several derivational models for the same source word. Our research is based on a sample of feminitives that can be found in various VKontakte communities dedicated to feminism. We compare statistics from the Russian National Corpus and Araneum Russicum III Maximum. Also, we use the Google Ngram Viewer corpus to track the tendency in word formation of feminitives. The results allow us to characterize the current state of derivational models of Russian feminitives, as well as to make adjustments to the existing rules.

## Keywords

Corpus Linguistics, Russian, Statistics, Word Formation, Feminitives

## 1. Introduction

One of the modern trends in the development of the mankind in the XXI century is a rise of the women's movement in many spheres of our life: politics, science, cinematography, etc. As a result, all changes are certainly reflected in the Russian language system. In linguistics, scholars have recently begun to develop a great number of research on gender linguistics. Some studies are of particular interest – the studies of word-formation models of feminitives. On social networks, users often argue about the only correct version of a feminitive: for example, *avtoroka*, *avtorsha*, *avtrissa* (*авторка*, *авторша*, *автрица*), etc. Of course, one can turn to traditional grammar and choose the right word to use, but one should not forget that language is a changeable system. Any changes can be tracked in corpora – large text collections presented in a computer format. The aim of our study is to track current trends in the word formation of feminitives using corpus data and to suggest possible changes to the existing grammar rules.

## 2. Related works

Nowadays many studies on the word formation of feminitives are carried out without the use of corpus statistics. For instance, the study [3] is aimed at analyzing feminine nouns with the *-sh* (*-u*) suffix. The word-formation model with this suffix is one of the means of expressing the word-formation category of femininity. 166 lexemes from contemporary dictionaries and the Russian media space were selected for analysis. It was observed that feminine nouns with the *-sh* (*-u*) suffix are actively used in modern media space without negative connotations, though some stylistic deprecations are recorded in dictionaries. At the same time, they are often replaced by neutral word-formation models (for instance, the *-k* (*-κ*) suffix, etc.). In the previous research of the author [2], she focuses on the study of productive and unproductive word-formation models. The author states that the users of social networks often pay attention to such productive suffixes as *-k*, *-in*, *-shits*, *-nits*, *-its* (*-κ*, *-иш*, *-ишш*, *-ишшш*, *-ишшшш*).

In [4], the author also turns to the Russian media field to study the problems of creating feminine nouns. He proves that the task of belonging to the feminine grammatical gender is solved not only by

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means of affixal derivation, but also by nominalization (*уполномоченная* – *уполномоченная*) and analytical word formation (*zhenshchina-president* – *женщина-президент*), thereby he proposes to expand the possible ways of using feminines in media texts.

The paper [1] discusses derivational possibilities of Russian feminines and the existing suffixal patterns that can be changed due to modern trends in the Russian language. Along with the change in the word-formation models, the semantic fullness of derivatives is also subject to change: the suffixes lose their original stylistics, words tend to become common.

At the same time, some scholars try to base their research on Russian corpora. Particularly, in [5], the author investigated the problem of the word-formation models with *-schits/-chits* (*-шущ/-чущ*) suffix basing on both printed dictionaries and the Russian National Corpus (main and newspaper subcorpora). The detailed analysis showed that this suffix is a productive one, it is used in the derivation of new feminines during recent years. It was also revealed that this suffix is used in three productive word-formation models with verbal, substantive and adjective stems.

Nonetheless, we consider that the combination of several corpora for the Russian language helps to represent the most complete picture of the word-formation process of feminines.

### 3. Traditional word-formation models of feminine nouns in Russian

In the Russian grammar reference by N.Yu. Shvedova [6], one can find main word-formation rules of feminine nouns. Below we present a list of main models with brief explanations. In the following sections, it will be easier to explain the existing feminines and the new ones.

1. *-k* (*-k*) suffix is usually added to masculine nouns without any suffixes, to noun with *-ets* (*-ey*) or *-ist* (*-uch*) suffixes, or to nouns with *-man* (*-ман*).
2. *-its* (*-uy*) suffix can also be added to masculine nouns without any suffixes or with *-ets* (*-ey*) suffix, but it has the meaning “a wife of an *X*”, where *X* is a masculine noun.
3. *-nits* (*-nuu*) suffix is added to nouns with *-tel'* (*-мель*).
4. *-ikh* (*-ux*) suffix is used for nouns without any suffixes or with *-nick* (*-ник*) and *-nichy* (*-ничий*). According to N.Yu. Shvedova, it also has the meaning “a wife of an *X*”, where *X* is a masculine noun.
5. *-sh* (*-u*) suffix is used for nouns with *-r*, *-l*, *-n*, and *-nt* (*-р, -л, -н и -нт*) at the end of stems.
6. If a masculine noun has *-ich/-ovich/-evich* (*-ич/-ович/-евич*) suffix, *-n* (*-н*) suffix is used to form a feminine noun.
7. *-in* (*-ин*) suffix is used for masculine nouns without any suffixes or with *-log* (*-лог*) at the end of stems.
8. *-j* (the Russian letter after soft consonant) is used if a corresponding masculine noun has *-un* (*-ун*) suffix.
9. *-ess* (*-ecc*) suffix is added to masculine nouns without any suffixes. It sometimes has the meaning “a wife of an *X*”, where *X* is a masculine noun.
10. *-is* (*-uc*) is added to the masculine nouns with *-or* (*-ор*) and *-tor* (*-тор*) morphemes.
11. *-ukh* (*-yx*) is used for derivating female animals.

N.Yu. Shvedova also states that sometimes a masculine base is absent due to the absence of the corresponding male person in real life (*rodil'nitsa* (*родильница*) has always been a woman, so we can't form a masculine noun). Also, male-female pairs can denote different professions (*tekhnichka* (*техничка*) is a woman who cleans rooms, and *tekhnik* (*техник*) is a builder).

It is also mentioned that if there is no necessity in highlighting a sexual identity, one can use neutral words that have originally been masculine (for instance, *secretar' Ivanova* – *секретарь Иванова*). At the same time, due to the active promotion of feminines in the Russian language, this rule loses its topicality.

### 4. Experimental design

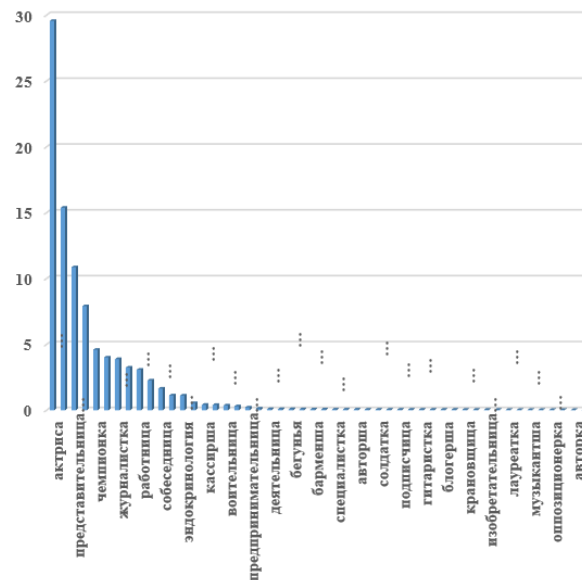
For this study, we selected over 170 commonly used feminines from various VKontakte communities dedicated to feminism and its promotion. The final list includes feminines that use both one derivational model and several ones. In the beginning of the experiments, we developed criteria for choosing communities and feminines:

1. The total number of members of a community should be more than 10000 as the community can be considered as a trustworthy one. The following communities were taken into account: *Feminizm: nablyadno* (Феминизм: наглядно)<sup>2</sup>, *Podslushano Feminism* (Подслушано Феминизм)<sup>3</sup>, etc.
2. The feminitives were chosen manually from posts approved and posted by official representatives, for now we leave feminitives from comments out of account.

Then there was a necessity to choose corpora for further procedures. We used the Russian National Corpus<sup>4</sup> and Araneum Russicum III Maximum<sup>5</sup> in order to get ipm frequencies from each of them. If there are more than one feminine noun for the analyzed word, we also involved the comparative diagrams that can be easily obtained using the Google Ngram Viewer corpus.

## 5. Results and Interpretation

Below we present the main results of the study. Diagrams 1 and 2 show ipm frequencies of the feminitives that were in both corpora. There are totally 151 words in the first diagram, that is approximately 84% of the analyzed words. As for the second one, there are less feminitives – only 98 words (55% of the analyzed words).



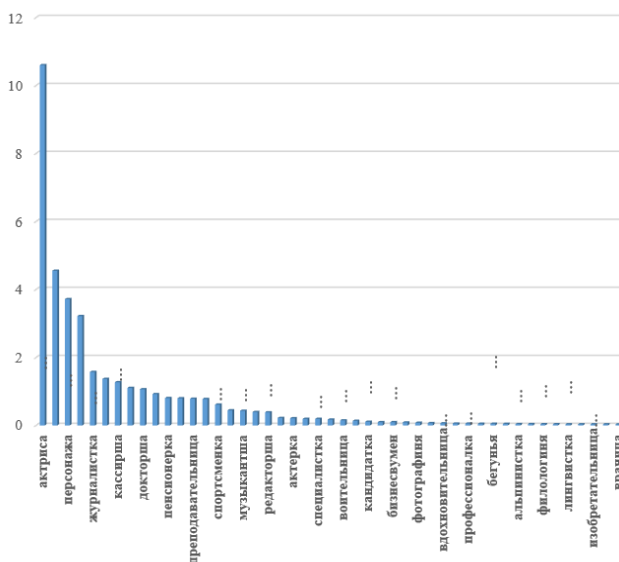
**Diagram 1:** The most frequent feminitives in the Araneum Russicum III Maximum

<sup>2</sup> [https://vk.com/feminism\\_visually](https://vk.com/feminism_visually)

<sup>3</sup> [https://vk.com/overhear\\_feminism](https://vk.com/overhear_feminism)

<sup>4</sup> <https://ruscorpora.ru/new/>

<sup>5</sup> [http://unesco.uniba.sk/aranea/run.cgi/corp\\_info?corpname=AranRusi\\_a](http://unesco.uniba.sk/aranea/run.cgi/corp_info?corpname=AranRusi_a)



**Diagram 2:** The most frequent feminitives in the Russian National Corpus

It is obvious that the left part of the diagrams denotes the most stable feminitives that has been existing in the Russian language for a long time: *actrisa*, *predstavitel'nitsa*, *rabotnitsa* (*актриса*, *представительница*, *работница*), etc. At the same time, there are some disputable lexemes. For instance, in the second diagram there is the *personazha* (*персонажа*) word that has two sets of different grammatical features:

- it can be a feminine noun that was formed by adding an ending to the corresponding masculine word;
- it can be a genitive case or an accusative one of the singular of the *personazh* (*персонаж*) word.

While analyzing examples from the Russian National Corpus, it becomes clear that all the examples have the second set of features. There are no examples with the first set of grammatical features.

- Будем считать, что структура **personazha** vklyuchaet v sebya imya, spisok togo, chto on imeet, i spisok togo, chto on khochet imet' (tsel') (Будем считать, что структура **персонажа** включает в себя имя, список того, что он имеет, и список того, что он хочет иметь (цель)) → *the genitive case*.
- Analoga etomu imeni net ni u odnogo zapadnogo yolochnogo **personazha** (Аналога этому имени нет ни у одного западного ёлочного **персонажа**) → *the genitive case*.
- Ya zhe predlagayu vspomnit' otmennogo **personazha** i vpolne sebe interesnyuyu trilogiyu o zhyostkom okhotnike na vampirov (Я же предлагаю вспомнить отменного **персонажа** и вполне себе интересную трилогию о жестком охотнике на вампиров.) → *the accusative case*.

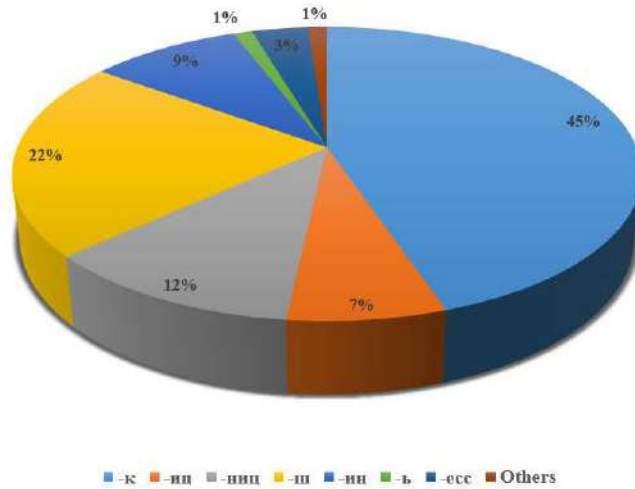
There is also the *adminka* (*админка*) word that has at least two meanings: it can be either a feminine denoting a profession or a special right to access all the functions of a certain website. In the Russian National Corpus, there are only 2 occurrences with the following examples:

- Plyus, sootvetstvenno, obshchaya **adminka**, veb-formy, v kotorykh HR razmeshchayut vakansii (Плюс, соответственно, общая **админка**, веб-формы, в которых HR размещают вакансии).
- I vo-vtoryh, Gennady igral davno, igral khorosho, mnogokratno uchastvoval v sorevnovaniyakh, gde ego mogli videt' v reale, imel blestyashchuyu reputaciyu i pol'zovalsya sredi igrokov bol'shim uvazheniem, za chto emu i predostavlena byla «**adminka**» – special'naya komp'yuternaya programma, pozvolayushchaya regulirovat' khod igry... (И во-вторых, Геннадий играл давно, играл хорошо, многократно участвовал в соревнованиях, где его могли видеть в реальности, имел блестящую репутацию и пользовался среди игроков

большим уважением, за что ему и предоставлена была «админка» – специальная компьютерная программа, позволяющая регулировать ход игры...).

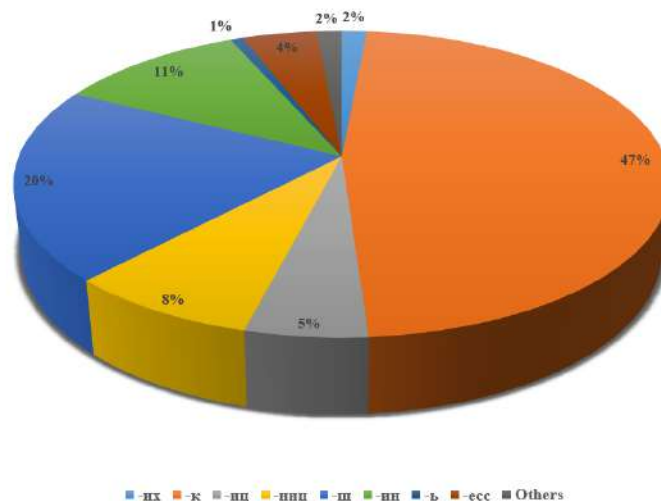
As you can see, in both sentences this word is used in the second sense.

Those femininives, whose ipm frequencies are lower than 1, are of great interest. They represent the femininives that are not widely used and may not be mentioned in contemporary dictionaries.



**Diagram 3:** Main trends in the word-formation models of femininives whose ipm frequencies in the Russian National Corpus is lower than 1

Almost half of the femininives were formed according to the model, in which the suffix *-k* (*-к*) was added to the existing male name of the profession: *guitarist* – *gitaristka* (*гитарист* – *гитаристка*), *spetsialist* – *spetsialistka* (*специалист* – *специалистка*), *yurist* – *yuristka* (*юрист* – *юристка*), etc. These words do not deviate from the traditional rule proposed by N.Yu. Shvedova. There are no deviations in the formation of femininives using the suffix *-nits* (*-ниц*): *deyatel'* – *deyatel'nitsa* (*деятель* – *деятельница*), *voitel'* – *voitel'nitsa* (*водитель* – *водительница*), etc. The *Others* category denotes those word-formation models that were not mentioned in the grammar of N.Yu. Shvedova. There is only one example in this group – *biznesvumen* (*бизнесвумен*). In this case, the derived English-language *-men* (*-мен*) morpheme was replaced by the *-vumen* (*-вумен*) morpheme.



**Diagram 4:** Main trends in the word-formation models of femininives whose ipm frequencies in the Araneum Russicum Maximum Corpus is lower than 1

As for the second corpus, we can track the same tendency. The word-formation model with the *-k* (*-к*) suffix is the most productive, while the models with *-ikh* (*-их*), *-ess* (*-ещ*), *-its* (*-иц*), *-j* (*-ь*) suffixes are not so widely used. The *Others* group includes two words – *biznesledi* (*бизнеследу*) and *biznesvumen* (*визнесвумен*). Among all the femininives of this sample there are some to pay special attention to. First of all, let's consider the *bojchikha* (*бойчиха*) word. A native speaker prefers adding the *-ikh* (*-их*) suffix

to the masculine stem rather than using the derivated English *gyorl* (*гёрл*) word. Another word is *bloginya* (*блогиня*). According to the reference of N.Yu. Shvedova, one can add the *-in* (*-ин*) suffix to the words with the *-log* (*-лог*) at the end. Actually, that is true for the words in which *-log* (*-лог*) denotes sciences or scientists: *filolog*, *astrolog*, *teolog*, (*филолог*, *астролог*, *теолог*), etc. Moreover, the suffix wasn't added to a profession of the masculine gender, it was added to the word of the masculine gender that denotes the set of posts on social networks. That's why we can consider this word to be a deviation from the traditional rules.

Among the analyzed femininives one can notice that there can be some options of feminine nouns that were formed from the same stem but with the help of different suffixes (Table 1).

**Table 1.** Comparison of feminine nouns of different word-formation models

Word	Morpheme	Frequencies (ipm) in the Russian National Corpus	Frequencies (ipm) in the Araneum Russicum III Maximum
<i>redaktor (редактор)</i>			
redaktorka (редакторка)	-k (-к)	0	<b>0,002318</b>
redaktorsha (редакторша)	-sh (-ш)	<b>0,385438</b>	0,019485
<i>bloger (блогер)</i>			
blongerka (блонгерка)	-k (-к)	0	<b>0,001692</b>
blongersha (блонгерша)	-sh (-ш)	0,006217	<b>0,043794</b>
bloginya (блогиня)	-in (-ин)	0	<b>0,003321</b>
<i>illyustrator (иллюстратор)</i>			
illyustratorka (иллюстраторка)	-k (-к)	0	<b>0,000564</b>
illyustratorsha (иллюстраторша)	-sh (-ш)	<b>0,003108</b>	0,000251
<i>animator (аниматор)</i>			
animatorka (аниматорка)	-k (-к)	0	<b>0,000187956</b>
animatorsha (аниматорша)	-sh (-ш)	0	<b>0,001816906</b>
<i>geymer (геймер)</i>			
geymerka (геймерка)	-k (-к)	0	0
geymersha (геймерша)	-sh (-ш)	0	<b>0,005012154</b>
<i>koordinator (координатор)</i>			
koordinatorka (координаторка)	-k (-к)	0	<b>0,002694033</b>
koordinatorsha (координаторша)	-sh (-ш)	0	<b>0,000501215</b>
<i>reper (репер)</i>			
reperka (реперка)	-k (-к)	0	<b>0,000751823</b>
repersha (реперша)	-sh (-ш)	0	<b>0,001378342</b>
<i>avtor (автор)</i>			
avtorka (авторка)	-k (-к)	0,00310837	<b>0,024371601</b>
avtorsha (авторша)	-sh (-ш)	0,046625544	<b>0,060208504</b>
avtrissa (автрисса)	-iss	0	0

Word	Morpheme	Frequencies (ipm) in the Russian National Corpus	Frequencies (ipm) in the Araneum Russicum III Maximum
	(-исс)		
avtoritsa (авторица)	-its (-иц)	<b>0,006216739</b>	0,003132596
avtoressa (авторесса)	-ess (-еcc)	<b>0,015541848</b>	0,00745558
<i>lider (лидер)</i>			
liderka (лидерка)	-k (-к)	0	<b>0,004322983</b>
lidersha (лидерша)	-sh (-ш)	<b>0,006216739</b>	0,003821768
<i>yurist (юрист)</i>			
yuristka (юристка)	-k (-к)	<b>0,096359459</b>	0,025812595
yuristsha (юристка)	-sh (-ш)	0	0
<i>vrach (врач)</i>			
vrachinya (врачinja)	-in (-ин)	0	<b>0,000187956</b>
vracheya (врачeя)	-e (-е)	0	<b>0,000250608</b>
vrachitsa (врачница)	-its (-иц)	<b>0,031083696</b>	0,00357116
<i>politik (политик)</i>			
politikessa (политикeсса)	-ess (-еcc)	<b>0,012433479</b>	0,00031326
politessa (политeсса)	-ess (-еcc)	0	<b>0,001002431</b>
<i>aktyor (актёр)</i>			
aktyorka (актeрка)	-k (-к)	<b>0,211369135</b>	0,004573591
aktrisa (актpиса)	-is (-ис)	10,59954044	<b>29,56350331</b>
<i>tantsor (танцор)</i>			
tantsorka (танцорка)	-k (-к)	<b>0,055950653</b>	0,005388066
tantsovshchitsa (танцoвщица)	-щиц (-shchits)	1,367682637	<b>2,266746808</b>
<i>fotograf (фотограф)</i>			
fotografinya (фотографиня)	-in (-ин)	<b>0,077709241</b>	0,010776132
fotografistka (фотографистка)	-k (-к)	0	0
<i>pensioner (пенcионер)</i>			
pensionerka (пенcионерка)	-k (-к)	0,805067734	<b>4,009034315</b>
pensiorinya (пенcиориня)	-in (-ин)	0	0
pensioneressa (пенcионерeсса)	-ess (-еcc)	0	0
<i>biznesmen (бизнесмен)</i>			
biznesledi (бизнеслeди)	-ledi (-лeди)	0	<b>0,028318672</b>
biznesmensha (бизнесмeнша)	-sh (-ш)	0,006216739	<b>0,006265193</b>
bizneswumen (бизнесвyмен)	-vumen (-вyмен)	0,096359459	<b>0,304738985</b>
<i>pol'zovatel' (пользоватeль)</i>			
pol'zovatel'nitsa (пользоватeльница)	-nits (-ниц)	0	<b>0,047114251</b>
pol'zovatel'ka (пользоватeлька)	-k (-к)	0	0
<i>reportyor (репортёр)</i>			

Word	Morpheme	Frequencies (ipm) in the Russian National Corpus	Frequencies (ipm) in the Araneum Russicum III Maximum
reportyorsha (репортерша)	-sh (-ш)	<b>0,021758587</b>	0,016414806
reportyorka (репортерка)	-k (-к)	<b>0,00310837</b>	0,001816906
<i>psikhiatr (психиатр)</i>			
psikhiatressa (психиатресса)	-ess (-есс)	0	<b>0,000187956</b>
psikhiatrinya (психиатриня)	-in (-ин)	0	<b>0,000187956</b>
psikhiatrisa (психиатриса)	-is (-ис)	<b>0,00310837</b>	0
psikhiatorka (психиаторка)	-k (-к)	0	<b>0,000125304</b>
<i>psikhoterapevt (психотерапевт)</i>			
psikhoterapevtka (психотерапевтка)	-k (-к)	0	<b>0,000814475</b>
psikhoterapevtessa (психотерапевтесса)	-ess (-есс)	0	0
psikhoterapevtsha (психотерапевтша)	-sh (-ш)	0	<b>0,000125304</b>
<i>doctor (доктор)</i>			
doktorsha (докторша)	-sh (-ш)	<b>1,063062413</b>	0,129376234
doktorka (докторка)	-k (-к)	<b>0,00310837</b>	0,003007293
doktoritsa (докторица)	-its (-иц)	<b>0,068384132</b>	0,010901436
<i>dizayner (дизайнер)</i>			
dizaynerka (дизайнерка)	-k (-к)	0	<b>0,003508508</b>
dizaynersha (дизайнерша)	-sh (-ш)	0,00310837	<b>0,008144751</b>
<i>prezident (президент)</i>			
prezidentka (президентка)	-k (-к)	0	<b>0,001691602</b>
prezidentsha (президентша)	-sh (-ш)	<b>0,024866957</b>	0,01265569
<i>milliarder (миллиардер)</i>			
milliarderka (миллиардерка)	-k (-к)	<b>0,00310837</b>	0,000375912
milliardersha (миллиардерша)	-sh (-ш)	<b>0,031083696</b>	0,018607623
<i>kommentator (комментатор)</i>			
kommentatorka (комментаторка)	-k (-к)	0	<b>0,000187956</b>
kommentatorsha (комментаторша)	-sh (-ш)	<b>0,00310837</b>	0,002944641
<i>kapitan (капитан)</i>			
kapitanka (капитанка)	-k (-к)	<b>0,00310837</b>	0,002318121
kapitansha (капитанша)	-sh (-ш)	<b>0,394762943</b>	0,032391048

Word	Morpheme	Frequencies (ipm) in the Russian National Corpus	Frequencies (ipm) in the Araneum Russicum III Maximum
<i>champion (чемпион)</i>			
championka (чемпионка)	-k (-к)	0,798850995	<b>4,59432864</b>
championsha (чемпионша)	-sh (-ш)	<b>0,00310837</b>	0,000063
<i>repetitor (репетитор)</i>			
repetitorka (репетиторка)	-k (-к)	0	<b>0,000125304</b>
repetitoressa (репетиторесса)	-ess (-есс)	0	0
<i>direktor (директор)</i>			
direktorka (директорка)	-k (-к)	0	<b>0,005074806</b>
direktorshka (директоршка)	-sh (-ш), -k (-к)	0	0
direktrissa (директрисса)	-iss (-исс)	<b>0,018650218</b>	0,01428464
<i>prepodavatel' (преподаватель)</i>			
prepodavatel'nitsa (преподавательница)	-nits (-ниц)	<b>0,786417516</b>	0,538869245
prepodka (преподка)	-k (-к)	0	<b>0,00031326</b>
prepodsha (преподша)	-sh (-ш)	0	<b>0,022554695</b>
<i>spiker (спикер)</i>			
spikerka (спикерка)	-k (-к)	0	<b>0,000125304</b>
spikersha (спикерша)	-sh (-ш)	0	<b>0,000814475</b>
<i>organizator (организатор)</i>			
organizatorka (организаторка)	-k (-к)	0	<b>0,001002431</b>
organizatorsha (организаторша)	-sh (-ш)	<b>0,012433479</b>	0,005450718
<i>muzykant (музыкант)</i>			
muzykantka (музыкантка)	-k (-к)	0,00310837	<b>0,006641105</b>
muzykantsha (музыкантша)	-sh (-ш)	<b>0,428955009</b>	0,028506628

The first important feature that is worth mentioning is the attempt to create other feminine nouns while there are words that are used by native speakers in their everyday life. These are *aktrisa*, *tantsovshchitsa* (*актриса*, *танцовщица*) and some others. They having ipm frequencies more than 1, it means that they and their word-formation models are rather stable in the Russian language. Nonetheless, new models can be also used. For example, here is an example from the Russian National Corpus: *Moya doch — aktyorka?! Ub'yu! Idi von v stayku, Zor'ku pochist'...* (Моя дочь — актёрка?! Убью! Иди вон в стайку, Зорьку почисть...).

As for the most often-used morphemes, they are *-k* (-к) and *-sh* (-ш). According to the reference of N.Yu. Shvedova, these suffixes are added to the word of the masculine gender that have *-r*, *-l*, *-n*, and *-nt* (-р, -л, -н и -нт) at the end of stems or that don't have any suffixes. Of course, we can track some deviations. For example, let's consider *prepodka* (*преподка*) and *prepodsha* (*преподша*). The compatibility of the stem ending with *-d* (-д) and the *-sh* (-ш) suffix is out of the rule. They are added to



the short colloquial form of the *prepodavatel'* (*преподаватель*) word and have stylistically reduced meanings. Mind the following sentences from the Araneum Russicum III Maximum corpus.

- A **prepodka** na kursakh tak ne dumaet (А **преподка** на курсах так не думает).
- Akhakhakhakha, **prepodsha** teper' menya dazhe ne dostayot na parakh (Ахахahaha, **преподша** теперь меня даже не достаёт на парах).

Basing on Shvedova's reference book, we can distinguish two different linguistic situations of the use of *-k* (*-к*) and *-sh* (*-ш*). At the same time, based on Table 1, we can analyze the statistical difference between these suffixes. For example, let's overview some ipm frequencies from the Araneum Russicum III Maximum corpus. There are 24 pairs of words for which one can use both *-k* (*-к*) and *-sh* (*-ш*). We can use t-test to check whether our datasets are significantly different from each other or not.

$$t = \frac{|M_1 + M_2|}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}} = \frac{|0,2 + 0,017|}{\sqrt{\frac{0,88}{24} + \frac{0,0008}{24}}} = 1,13 \quad (1)$$

With a threshold value of  $p = 0,05$  and a degree of freedom  $df$  that is equal to 46, we can find the critical value according to the t-distribution table:  $t_{cr} = 2,013$ . As  $t$  is less than  $t_{cr}$ , there are no significant differences in the usage of the suffixes, that's why we can consider them interchangeable in the contemporary word-formation process of feminines.

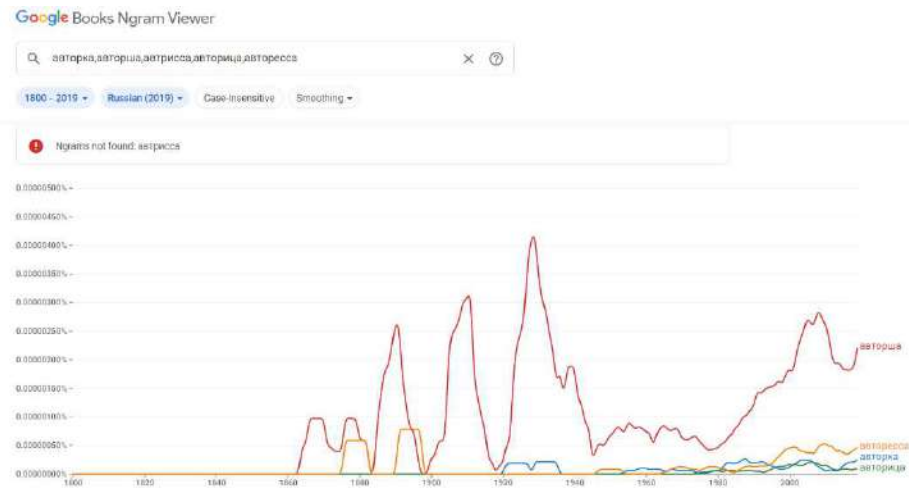
There are also feminine nouns to which native speakers add the *-iss* (*-исс*) suffix that is another option of the *-ess* (*-есс*) suffix: *avtrissa* (*автрисса*) and *direktrissa* (*директрисса*). The first word has no occurrences in both corpora, and the examples with the second one can be easily found.

- — A chto ty, Sanya, na zabore pisal? — sprosila **direktrissa** (— А что ты, Саня, на заборе писал? — спросила **директрисса**).
- **Direktrissa** mne ponravilas' — takaya pozhilaya dama staroy zakalki (**Директрисса** мне понравилась — такая пожилая дама старой закалки).

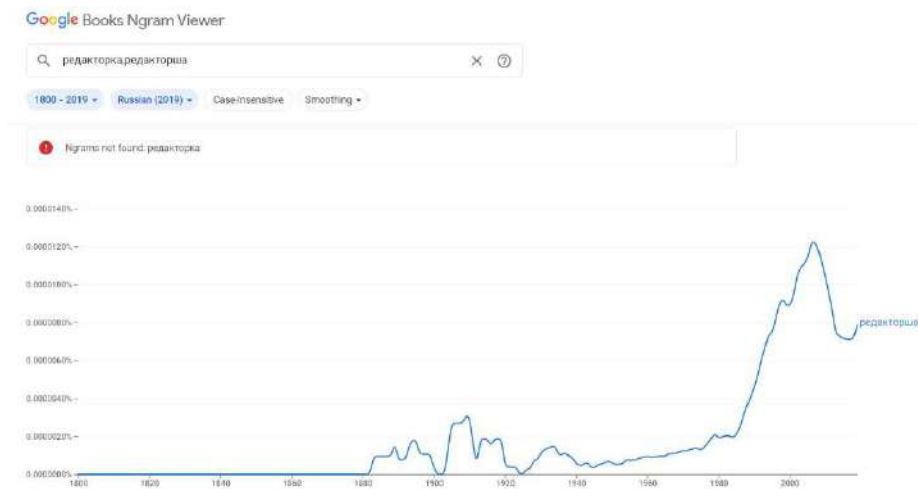
At the same time the word *direktrissa* (*директрисса*) can be met in the dictionaries dedicated to military and mathematical spheres. In the Russian National Corpus, there is an example of this word with another meaning: Пояснуйу: **direktrissa** — u nas eto termin, oznachayushchy napravlenie vystrela, udara ili dvizheniya (Поясню: **директрисса** — у нас это термин, обозначающий направление выстрела, удара или движения). Nowadays people get used to using another derivational model with the *-is* (*-ис*) suffix – *direktrisa* (*директриса*). This word has more occurrences in both corpora, but it is not widely used in feminine communities on VKontakte social network.

There are also two feminine nouns that should be mentioned: *politikessa* (*политикесса*) and *politessa* (*политесса*). Although the suffix is the same, different stems are used: *polit-* (*полит-*) and *politik-* (*политик-*). The same situation is with the *bloginya* (*блогиня*) word, as the suffix is not added to the masculine profession.

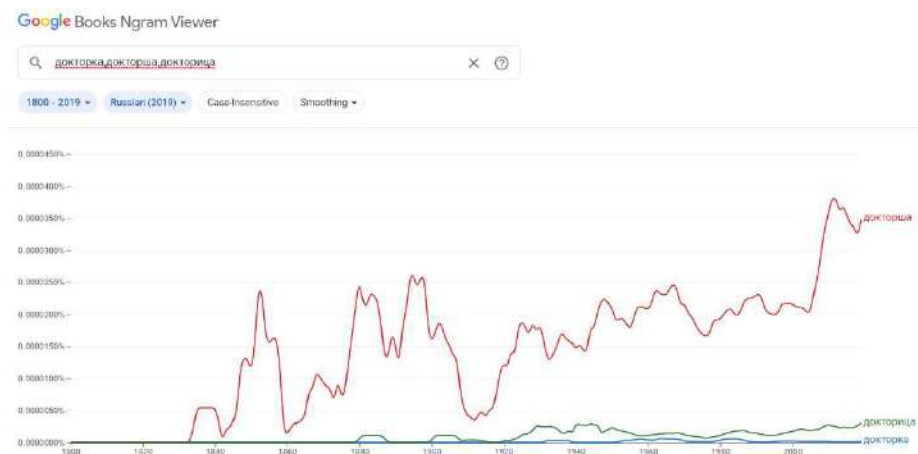
All the feminines mentioned above can be demonstrated with the help of the Google Ngram Viewer corpus. The Russian 2019 corpus was used. The horizontal axis of graphs shows the years within a given period. The vertical axis shows the relative frequency of occurrence in the corpus. Below we present some of the diagrams.



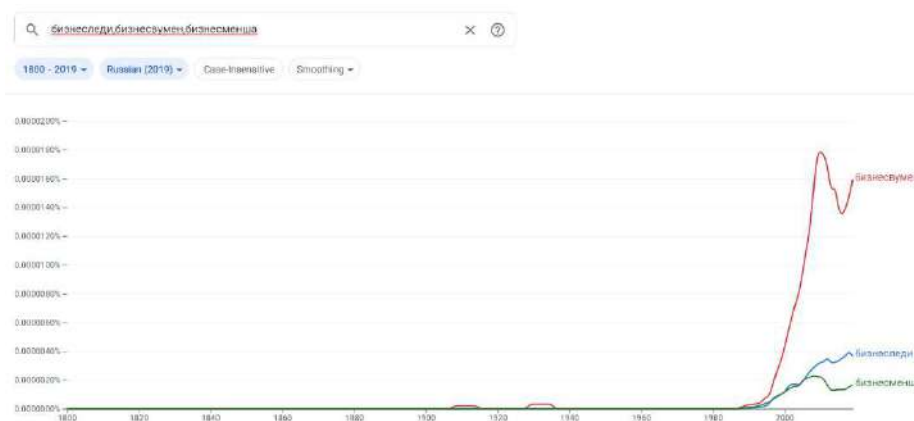
**Diagram 5:** Tracking trends in the use of word-formation models for the word *avtor* (*автор*)



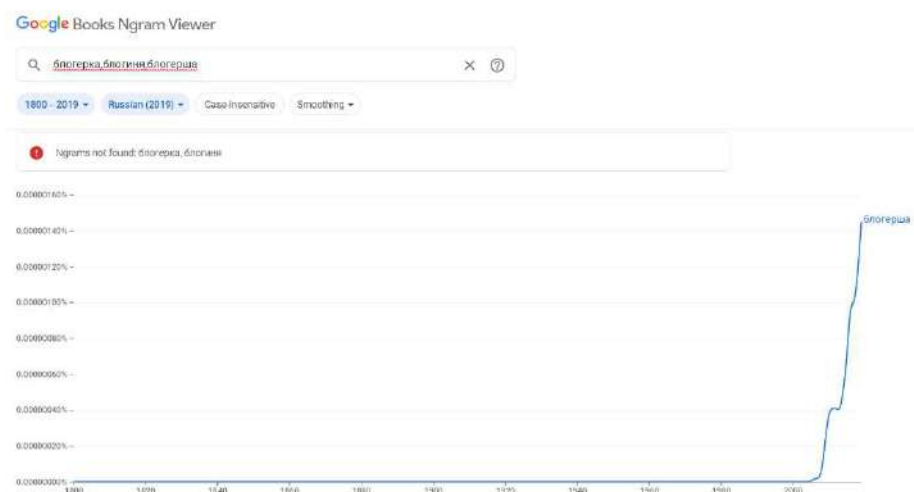
**Diagram 6:** Tracking trends in the use of word-formation models for the word *redaktor* (*редактор*)



**Diagram 7:** Tracking trends in the use of word-formation models for the word *doktor* (*доктор*)



**Diagram 8:** Tracking trends in the use of word-formation models for the word *biznesmen* (бизнесмен)



**Diagram 9:** Tracking trends in the use of word-formation models for the word *bloger* (блогер)

As the Google Ngram Viewer corpus contains only printed sources, it doesn't reflect the usage of feminitives on the Internet. As a result, it leads to the absence of some feminitives in the corpus. Nonetheless, we can highlight some results. The most productive word-formation model is using *-sh (-ш)* suffix that can be also proved by the previous corpus statistics. The *biznesvumen* (бизнесвумен) word can be also met in the printed sources in the first third of the XX century (for example, in a book titled *Strana gospoda boga* (Страна господа бога) that was first published in 1932). It shows that feminine noun can be also formed by using a foreign feminine word without adding any suffixes to the masculine one.

## 6. Conclusion

Word formation of feminitives is still a controversial issue among linguists and ordinary native speakers. The traditional approach to analysis is interpreting feminitives in terms of morphological and stylistic features. However, it does not include statistical indicators. The present study of feminine nouns in Russian corpora allowed us to reveal productive word-formation models and deviations from the traditional rules basing on the frequencies. Among the main results, the following ones should be noted:

- the statistical data do not show large deviations in using feminitives with suffixes *-k (-к)* and *-sh (-ш)*, which can mean their interchangeability in most cases;
- adding suffixes to feminitives is possible not only for masculine professions, but also for nouns denoting general concepts: *blog*, *politika* (блог, политика), etc.;
- the *-iss (-исс)* suffix is a variant of the *-ess (-есс)* suffix that can also be found in contemporary feminine nouns;
- sometimes the suffixes that are used for forming feminitives can be used for forming nouns of other meanings, so the corpora statistics should always be carefully analyzed;

- web corpora (for example, Araneum Russicum III Maximum) allow scholars to track tendencies on the Internet while others allow to track tendencies in printed sources, mass media and everyday life.

Of course, this paper is a preliminary research for further studies on feminitives in the Russian corpora. The following experiments may relate to the extension of the list of feminitives by involving other communities and social networks and the extension of the used corpora (ruTenTen from Sketch Engine and others).

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# A Disambiguator for Pymorphy2 Morphological Analyzer

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## Abstract

Pymorphy2 is a morphological analyzer implemented in Python for Russian. The parser takes a word and, based on its morphology, produces a series of classification hypotheses regarding class, gender, number, case, etc. However, the analysis of the isolated word rarely occurs without any ambiguity. This article presents an implementation of a trigram tag model that works on top of the morphological parsing performed by pymorphy2 and uses the sequence of words in the sentence to choose the most probable morphological interpretation for each word.

## Keywords

Russian language, pymorphy2, NLP, tagger, part-of-speech, morphological disambiguation

## 1. Introduction

Part-of-speech tagging for Russian language is a well-researched field and many taggers have been developed applying different approaches. When it comes to working with NLP, Python is arguably the most widely used programming language today and pymorphy2, a popular choice for performing the morphological analysis of Russian words. According to the official documentation [1] pymorphy2 is capable of:

- transforming a word to its dictionary form (lemma), for example, "люди → человек", or "гулял -> гулять";
- converting a word to the desired form, for example, change its grammatical case, put it in plural, etc;
- providing grammatical information about a word (number, gender, case, part-of-speech, etc.).

To parse a word form, pymorphy2 relies on modified version of the dictionary of the OpenCorpora project [2] that was optimized for speed and memory saving. The OpenCorpora dictionary is structured around lexemes. A lexeme consists of all the forms of a word and the labels with the grammatical information, where the first word form in the list corresponds to its dictionary form. For example, the lexeme for "ёж" (hedgehog) looks like figure 1:

```
ёж      NOUN,anim,masc sing,nomn
ежа     NOUN,anim,masc sing,gent
ежу     NOUN,anim,masc sing,datv
...
ежами   NOUN,anim,masc plur,abl
ежах    NOUN,anim,masc plur,loct
```

Figure 1: Example of a lexeme [3]

If the word form does not exist in the dictionary, pymorphy2 conducts a predictive analysis on the unknown word, identifying suffixes, prefixes and applying other strategies that could provide a criterion to classify it.

Taken separately, Russian word forms often allow for more than one grammatical interpretation.<sup>2</sup> Since `pymorphy2` parses one word at a time, it returns a list of possible parses with an associated probability. When working with bag-of-words models, a common practice is to simply select for each word form the parse with the highest probability. In this case, assuming only the dictionary form of the word is required, `pymorphy2` will get the correct part-of-speech about 92% of the time. However, if the grammatical case of the word is taken in consideration, the precision will drop to 82% (see the experiment's results in section 6) and the parsing will often produce ungrammatical sequences.

In order to improve the percentages shown in the previous paragraph, the proposal presented in this article is to implement a trigram part-of-speech model to disambiguate the morphological analysis that `pymorphy2` performs on the isolated word. The part-of-speech tags of those word classes that have declensions are augmented with the grammatical case, while other features such as number or gender are discarded in order to keep the trigram model at a reasonable size and prevent data sparseness when training it on a rather small corpus.

Since this paper proposes a method to disambiguate `pymorphy2` parsing results, it will focus exclusively on this morphological analyzer and measure its performance before and after the suggested extension. It does not intend to be a superior solution to other morphological analyzers available for Russian, but rather a helper tool for `pymorphy2` users. For state-of-the-art taggers or comparisons between the performance of `pymorphy2` and other available options (`mystem3`, `TreeTagger`, `FreeLing`, etc.), the reader is referred to the work of Kuzmenko [4] or Kotelnikov et al. [5].

The remainder of the paper will cover: 2. A `pymorphy2`'s parsing example, 3. Trigram hidden Markov Model, 4. Training the trigram model, 5. Code implementation example, 6. Testing the model and 7. Conclusions and further work.

## 2. A `pymorphy2`'s parsing example

As noted in the introduction, `pymorphy2` processes each word separately and returns one or more "Parse" objects containing the possible parses for the given word form. For example, the morphological analysis of the word forms "мама", "мыла", "паму" produces the following lists (1), (2), (3):

```
[
  Parse(word='мама', tag=OpencorporaTag('NOUN,anim,femn sing,nomn'), normal_form='мама', score=1.0,
  methods_stack=((<DictionaryAnalyzer>, 'мама', 1907, 0)),)
]
```

(1)

```
[
  Parse(word='мыла', tag=OpencorporaTag('NOUN,inan,neut sing,gent'), normal_form='мыло', score=0.333333,
  methods_stack=((<DictionaryAnalyzer>, 'мыла', 54, 1)),)
  Parse(word='мыла', tag=OpencorporaTag('VERB,impf,tran femn,sing,past,indc'), normal_form='мыть',
  score=0.333333, methods_stack=((<DictionaryAnalyzer>, 'мыла', 1813, 8)),)
  Parse(word='мыла', tag=OpencorporaTag('NOUN,inan,neut plur,nomn'), normal_form='мыло', score=0.166666,
  methods_stack=((<DictionaryAnalyzer>, 'мыла', 54, 6)),)
  Parse(word='мыла', tag=OpencorporaTag('NOUN,inan,neut plur,accs'), normal_form='мыло', score=0.166666,
  methods_stack=((<DictionaryAnalyzer>, 'мыла', 54, 9)),)
]
```

(2)

```
[
  Parse(word='паму', tag=OpencorporaTag('NOUN,inan,masc,Geox sing,datv'), normal_form='пам', score=0.5,
  methods_stack=((<DictionaryAnalyzer>, 'паму', 32, 2)),)
  Parse(word='паму', tag=OpencorporaTag('NOUN,inan,femn sing,accs'), normal_form='пама', score=0.5,
  methods_stack=((<DictionaryAnalyzer>, 'паму', 55, 3)),)
]
```

(3)

With the exception of "мама", the other word forms have more than one possible interpretation. In the case of the noun "паму" the ambiguity arises in gender and case, while "мыла" can be analysed as

<sup>2</sup> For example, the nominal and accusative plural cases endings for nouns like "сталь" (declension type 8a according to A. A. Zaliznyak's classification) are identical for the singular cases of the genitive, dative and locative; most of the singular feminine adjectives in the genitive, dative, locative and instrumental cases share the same inflection; a word form can even belong to different word classes, like "мыла", that can be analyzed as a noun or a verb.

a verb or noun. Every parse object inside the list has a parameter "score" with an associated probability. Korobov [3] states that the score corresponds to the conditional probability  $p(\text{analysis} | \text{word})$  estimated on the basis of the OpenCorpora corpus. This is obtained by counting how many times a certain analysis has been associated with a given word form and, based on these frequencies, its conditional probability is calculated using Laplace smoothing. The parse objects within the list are sorted according to this probability in descending order, therefore picking the first item in the list is equivalent to selecting the parse object with the most probable interpretation for the given word form. For example, the parse objects with the highest score for each of the word forms analysed in (1), (2) and (3) would be:

```
Parse(word='мама', tag=OpencorporaTag('NOUN,anim,femn sing,nomn'), normal_form='мама', score=1.0,
methods_stack=((<DictionaryAnalyzer>, 'мама', 1907, 0),)) (4)
```

```
Parse(word='мыла', tag=OpencorporaTag('NOUN,inan,neut sing,gent'), normal_form='мыло', score=0.333333,
methods_stack=((<DictionaryAnalyzer>, 'мыла', 54, 1),)) (5)
```

```
Parse(word='паму', tag=OpencorporaTag('NOUN,inan,masc,Geox sing,datv'), normal_form='пам', score=0.5,
methods_stack=((<DictionaryAnalyzer>, 'паму', 32, 2),)) (6)
```

If "мама", "мыла", "паму" are no longer treated as separate tokens, but as words in the sentence "мама мыла паму", the parse object with the highest score incorrectly classifies the last two. When working with bag-of-words models and lemmas, the misclassification in case is usually not harmful (most of the time it will still provide the right dictionary form)<sup>3</sup>, but a wrong part-of-speech attribution will produce a different interpretation of the lemma. The next section suggests how the score values can be combined with the trigram tag model to obtain better results.

### 3. Trigram hidden Markov model

Hidden Markov models (HMM) are probabilistic sequence classifiers that have been widely used in NLP tasks like part-of-speech tagging and word class disambiguation. The task of the model is to find for any string of word forms of the set  $\Psi$  (the observable states) the most probable sequence of part-of-speech tags of the set  $\Omega$  (the hidden states). For a better understanding of HMM the reader is referred to Jurafsky [6] or Bocharov et al. [7]. Although, nowadays POS-taggers are build using more advanced techniques, for example those based on neural networks, for the purpose envisaged here of eliminating the ambiguity of the analysis previously carried out by pymorphy2, a modified HMM model would be an easy solution to implement. The HMM is briefly described below along with the intended modification to disambiguate the analysis from pymorphy2.

To train an HMM model, it is necessary to calculate two parameters in a tagged corpus: the emission and the transition probabilities.

The emission probabilities

$$p(w_i \vee t_i) \quad (7)$$

where  $p$  is the conditional probability that the word  $w_i$  corresponds to the tag  $t_i$ . This assumes that the probability of an output observation  $w_i$  depends only on the state that produced the observation  $t_i$  and not on any other states or observations.

The transition probabilities

$$p(t_t \vee t_{i-1}, t_{i-2}) \quad (8)$$

where  $p$  is the probability that the tag  $t_i$  occurs, provided that is preceded by the tags  $t_{i-1}$  and  $t_{i-2}$ . This assumes that the probability of a particular tag depends only on the previous two tags (trigram).

---

<sup>3</sup> Here the missclassification of "паму" produces a different dictionary form.

The HMM tagging algorithm chooses as the most likely tag sequence the one that maximizes the product of two terms: the probability of the sequence of tags (the transition probability) and the probability of each tag generating a word (the emission probability).

Trigram HMM

$$\operatorname{argmax}_p(x_1, \dots, x_n, y_1, \dots, y_{n+1}) \approx \operatorname{argmax} \prod_{i=1}^{n+1} p(y_i \vee y_{i-1}, y_{i-2}) \prod_{i=1}^n p(x_i \vee y_i) \quad (9)$$

where  $p(y_i | y_{i-1}, y_{i-2})$  is the transition probability and  $p(x_i | y_i)$  is the emission probability.

The approach taken here is to implement the tagging algorithm on top of the pymorphy2 parsing results and use the score values from the Parse object as the emission probabilities.

Modified trigram HMM

$$\operatorname{argmax}_p(x_1, \dots, x_n, y_1, \dots, y_{n+1}) \approx \operatorname{argmax} \prod_{i=1}^{n+1} p(y_i \vee y_{i-1}, y_{i-2}) \prod_{i=1}^n p(y_i \vee x_i) \quad (10)$$

where the last term of the equation, the emission probability of a word given a tag, is replaced by the score value from the pymorphy2 parse: the probability of the analysis given a word.

#### 4. Training the trigram POS tag model

Pymorphy2 not only implements the OpenCorpora dictionary, it also adopts the same set of tags. To take advantage of this fact, the model was trained on the OpenCorpora labeled subcorpus with homonyms removed [8] (26011 sentences, 256311 tokens, 188319 words), so no modifications on the tags were required. As mentioned in the previous section, the emission probabilities are directly replaced by the score values from the parse objects. Therefore, only the transition probabilities in the corpus were calculated on the basis of the following 49 tags, which were obtained by combining the 20 basic part-of-speech tags from pymorphy2/OpenCorpora and the grammatical case (where applicable):

**Table 1**

Part-of-speech tags without case declension

part-of-speech	tag
adverb	ADVB
comparative	COMP
conjunction	CONJ
gerund	GRND
infinitive	INFN
interjection	INTJ
particle	PRCL
predicative	PRED
preposition	PREP
verb	VERB
short form adjective	ADJS
short form participle	PRTS

As table 2 shows, those part-of-speech that have declensions, were augmented with the grammatical case. Gender and number were not taken into account to keep the tag set within reasonable limits. It was assumed that case is a good predictor to be included in the transition probabilities (although this hypothesis remains to be proven). Table 4 presents a fragment of the resulting matrix with the transition probabilities. The cells contain the conditional probability for the tag in the row when it is preceded by the two tags from the columns. For example, the probability that an adjective in the nominative case appears at the very beginning of the sentence is 0.0731339900. Those combinations that were not



observed in the corpus were assigned a very small probability of 0.000000001; for instance an adjective in any other case than is not instrumental after an adjective in the instrumental case at the beginning of the sentence. The transition probabilities were stored in a JSON-format file.

**Table 2**

Part-of-speech tags with case declension

case	noun	adjective	participle	pronoun	numeral
nominative	NOUN nomn	ADJF nomn	PRTF nomn	NPRO nomn	NUMB nomn
genitive	NOUN gent	ADJF gent	PRTF gent	NPRO gent	NUMB gent
accusative	NOUN accs	ADJF accs	PRTF accs	NPRO accs	NUMB accs
dative	NOUN datv	ADJF datv	PRTF datv	NPRO datv	NUMB datv
locative	NOUN loct	ADJF loct	PRTF loct	NPRO loct	NUMB loct
instrumental	NOUN ablt	ADJF ablt	PRTF ablt	NPRO ablt	NUMB ablt
vocative	NOUN voct				
2 <sup>nd</sup> genitive	NOUN gen2				
2 <sup>nd</sup> locative	NOUN loc2				

**Table 3**

Other tags

part-of-speech	tag
Latin word or character	LATN
roman number	ROMN
unknown class	UNKN

**Table 4**

Fragment of the matrix with the transition probabilities

	<*_<S> <sup>4</sup>	<S>_ADJF ablt	<S>_ADJF accs	<S>_ADJF datv	...
<E> <sup>5</sup>	0.006326730	0.05263158	0.04285714	0.052631589	...
ADJF ablt	0.007155230	0.09473684	0.000000001	0.000000001	...
ADJF accs	0.005272275	0.000000001	0.1	0.000000001	...
ADJF datv	0.001431046	0.000000001	0.000000001	0.052631589	...
ADJF gent	0.003765910	0.000000001	0.000000001	0.000000001	...
ADJF loct	0.000150636	0.000000001	0.000000001	0.000000001	...
ADJF nomn	0.073133990	0.000000001	0.000000001	0.000000001	...
...	...	...	...	...	...

## 5. Code implementation example

The code written in python<sup>6</sup> implements the Viterbi algorithm to find the most probable sequence of parse objects from the morphological analysis performed by pymorphy2. It takes as input the JSON file with the transition probabilities and a list that contains all the possible parse objects that pymorphy2 returns for each word. The output is a new list with only one parse object per word. The code and the file with the transition probabilities are available for download from a GitHub repository [9].

<sup>4</sup> Symbol for “start of sentence”.

<sup>5</sup> Symbol for “end of sentence”.

<sup>6</sup> System requirements: python3, pymorphy2 version 0.8.

### Code implementation example

```

from pymorphy2 import MorphAnalyzer #1

from hmmtrigram import MostProbableTagSequence #2

morph = MorphAnalyzer() #3

token_list = ['Мама', 'МЫЛА', 'Памя', '.'] #4

pymorphy2_parsed = [morph.parse(token) for token in token_list] #5

mpts = MostProbableTagSequence('transition_probabilities.json') #6

mpts.get_sequence(pymorphy2_parsed) #7

```

(11)

#1: imports the class for morphological analysis from the package “pymorphy2”  
 #2: imports the class for calculating the most probable tag sequence from “hmmtrigram”  
 #3: instantiates the object “morph” from the class “MorphAnalyzer”  
 #4: any list of tokens  
 #5: the “parse” method of the “morph” object parses each token in the list and stores the parsing results in the new list “pymorphy2\_parsed”  
 #6: instantiates the object “mpts” from the class “MostProbableTagSequence” with the name of the json file that contains the transition probabilities as argument  
 #7: the “get\_sequence” method of the “mpts” object takes the list with the parse objects stored in “pymorphy2\_parsed” and returns a new list with the most probable parsing for the sequence of tokens.

### Code output

```

[
  Parse(word='мама', tag=OpencorporaTag('NOUN,anim,femn,sing,nomn'),
  normal_form='мама', score=1.0, methods_stack=((<DictionaryAnalyzer>, 'мама', 1907,
  0))),
  Parse(word='мыла', tag=OpencorporaTag('VERB,impf,tran,femn,sing,past,indc'),
  normal_form='мыть', score=0.333333, methods_stack=((<DictionaryAnalyzer>, 'мыла',
  1813, 8))),
  Parse(word='памя', tag=OpencorporaTag('NOUN,inan,femn,sing,accs'),
  normal_form='памя', score=0.5, methods_stack=((<DictionaryAnalyzer>, 'памя', 55,
  3))),
  Parse(word='.', tag=OpencorporaTag('PNCT'), normal_form='.', score=1.0,
  methods_stack=((<PunctuationAnalyzer>, '.')))
]

```

The most probable sequence correctly disambiguates 'мама' as a noun in the nominative case, 'МЫЛА' as verb and 'памя' as a noun in the accusative case.

## 6. Testing the model

The test was conducted on the OpenCorpora subcorpus without homonyms and unknown words of 10966 sentences, 72671 tokens and 50433 words. The experiment presents the results for 55 275 tokens (no punctuation marks).

The baseline summarizes the results of selecting the parse object with the highest score for each independent word form (the first item in the list that pymorphy2 generates).

**Table 5**

Pymorphy2 part-of-speech tagging results (most probable parse object)

method	precision	recall
baseline (simple tags)	0.92	0.91

Table 5 shows the averaged precision and recall for the 20 part-of-speech tags (the base POS tags without case). This outlines the performance that can be expected of getting the right part-of-speech

(POS) tag for a given word form. When grammatical case is also taken into account (augmented tags), these values drop significantly (compare with the baseline in table 6).

**Table 6**

Baseline and trigram model extension using augmented tags

method	precision	recall
baseline (augmented POS tags)	0.82	0.80
trigram model	0.94	0.89

Table 6 contrasts the averaged precision and recall for the 49 augmented tags (part-of-speech + case) for the baseline with those for the implementation of the trigram model to choose between the parse objects returned by pymorphy2.

**Table 7**

Long form adjectives with case for the baseline and the trigram model

POS tags + case	F-score (baseline)	F-score (3-gram model)
ADJF ablt	0.68	0.97
ADJF accs	0.73	0.92
ADJF datv	0.64	0.88
ADJF gent	0.81	0.95
ADJF loct	0.63	0.93
ADJF nomn	0.91	0.96

Table 7 shows the F-score for the long form adjectives + case for the baseline and the trigram model. When considering case declensions, the trigram model improves clearly over the baseline. However, those differences are less extreme for word classes that do not have case declensions (see table 8).

**Table 8**

POS tags without case declension for the baseline and the trigram model

POS tags	F-score (baseline)	F-score (3-gram model)
ADJS (short adjectives)	0.90	0.98
ADVB (adverbs)	0.94	0.96
CONJ (conjunctions)	0.91	0.90
INTJ (interjections)	0.90	0.88

Conjunctions and interjections constitute the two cases within the 49 tags where the implementation of the trigram model performs slightly below the baseline.

## 7. Conclusions and further work

The testing results support the benefit of applying the trigram model to disambiguate the analysis performed by pymorphy2. However, if pymorphy2 is being used only to get the part-of-speech or the dictionary form of the words within a bag-of-words model, the suggested extension will produce little improvement over the baseline. For that purpose, selecting the first parse object in the list will be enough. The implementation of the trigram model to choose the most probable sequence of parse objects is useful for those tasks that require valid POS tag sequences or greater precision in determining the grammatical case of a word. In Russian, by disambiguating the grammatical case of a word form, most of the time its gender and number are also obtained correctly. The effects of broadening the combination of part of speech + case with respect to number and / or gender remain to be explored.

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# Sentiment Analysis for Russian Academic Texts: A Lexicon-based Approach

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## Abstract

In this paper, we explore to what extent sentiment markers can differentiate the polarity of Russian political texts and academic texts for different ages and grade levels. The Corpus compiled for the study contains UN official records and textbooks of different subjects (Social Studies, History, Biology, Ecology, Technology and Science) and grades (1-11). We provide a brief overview of previous research on sentiment analysis of Russian texts and conduct three-stage lexicon-based sentiment analysis and evaluate sentiment bias of 28 Russian texts. Based on the data registered in RuSentiLex, we propose an innovative quantitative method of assessing sentiment in academic and political domains. As the results obtained compare favorably with the previously published results on the established sentiment characteristics for English and German texts, the study encourages enlargement of the Corpus with the aim to compute sentiment analysis of texts of other genres and time periods. The research findings provide a broad context for understanding the sentiment bias of texts which may be useful for text writers and test developers.

## Keywords

Russian, political texts, academic texts, lexicon-based sentiment analysis, RuSentiLex

## 1. Introduction

Sentiment analysis, also referred to as emotion AI (artificial intelligence) and opinion mining, is a computational text analysis for opinions, emotions, assessments, attitudes. For almost 20 years, it has been one of the most actively developing branches of computational linguistics and a popular research area [1]. Sentiment analysis proves to be a valuable technique in almost all spheres of human activity as assessments and opinions play an important role in evaluation and management of society and its social values. The main areas of application of sentiment analysis are customers' reviews of goods and services [2], public opinion in social networks [3], news [4] etc. Sentiment analysis is also important in marketing, finance, political science, communication and health services and science [5].

However, until recently, it has been sporadically implemented in education and publications in the area are few. Archana R.P. and K. Bagloti pursued a comparative analysis of the role of sentiment analysis in students' perspectives as well as instructional effectiveness and concluded that incorporated in education sentiment analysis is invaluable in assessing teaching methodologies and course curricula [6]. H. Hamdanet et al. [7] conducted a research aimed at Opinion Target Extraction in book reviews and concluded that sentiment analysis has a strong potential to improve teaching materials (see also [8]).

As for textbook sentiment assessment, studies in the area are quite rare, though one which is noteworthy is the study conducted by J. Sell and I. G. Farreras [9] who elaborated a new approach to

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sentiment vocabulary on the corpus of 66 Introductions to Psychology college textbooks published over the last century. The research demonstrated “a less emotional manner” and “a more guarded tone” of modern textbook authors. These findings are especially meaningful as they allow to contrast sentiment in reviews and academic writing which differ in genre, length and function. Reviews are typically rather brief texts generated predominantly with the purpose to assess a referent. Even if a review consists of a number of paragraphs there is always one aimed at evaluating goods or services. Academic texts are not only much longer, they are typically informative or instructional and as such they require a different approach.

In the educational context, sentiment analysis is widely implemented to process students' feedback and is aimed at monitoring effectiveness of instructions and thus contributing to enhancement of learning effectiveness. Sentiment analysis “for big educational data streams”, including teaching materials, is challenging [10] and is still viewed as a new area of research where studies are rare and validated methods are few.

In the paper we aim at the following research questions (RQ):

RQ.1: What is the polarity of Russian academic texts used in elementary, middle and high school?

RQ.2: What is the polarity of UN Russian texts elicited from the United Nations Parallel Corpus?

RQ.3: How different is the polarity of Russian academic and UN Russian texts?

The two hypotheses tested in the research are that (1) academic texts used in high school tend to have a negativity bias and (2) the negativity bias of high school textbooks is similar to that of political texts.

## 2. Related Work

A review of early research on sentiment analysis is offered in [11], and a comprehensive latest review is performed by S. Tedmori and A. Awajan in [12]. The method of sentiment analysis has been developed within a number of approaches. One of the latest approaches is neural networks designed with the advent of deep learning and the era of artificial intelligence [5, 13].

Another approach utilized in a number of research is dictionary-based, the principles and strategies of which are presented in [11, 14]. Lexicon-based approach requires sentiment lexicon, i.e., explanatory dictionaries of words provided with connotative (positive, negative etc.) tags. In studies of Russian discourse researchers utilize a manually created dictionary RuSentilex [15]. An example of dictionary-based approach implementation is described in [16] where Q. Guang et al. study contextual advertising.

Educational texts imply many more difficulties for sentiment classification than services or product reviews as their authors use more elaborated language of sentiment including various stylistic devices. Educational domain was studied by Z. Kechaou et al. [17] who utilized sentiment analysis to examine the emotional nature of e-learning blogs [10]. U. O. Osmanoglu applied a machine learning approach to assess sentiments in distance education course materials [18].

To the best of our knowledge the only research on application of sentiment analysis of Russian educational texts is performed in [14] where the authors used subcorpus of Russian Academic Corpus compiled of Social Studies textbooks. The findings confirm the hypothesis of predominantly negative discourse in the textbooks studied and the conclusion received is revealing since the language comprises more positive than negative words [cf. 8 and 18 for Pollyanna effect]. In this regard, another essential contribution is a diachronic study of Iliev R. et al. [19], who provided clear evidence that the frequency of affective, both positive and negative words in modern discourse has decreased over two centuries.

## 3. Methods and data

The study is aimed at comparative analysis of sentiments in texts of different types, i.e., political texts and educational texts of different subjects and for various age groups.

For this purpose, we compiled four homogeneous Russian subcorpora, three sets of school textbooks and official records from the United Nations Parallel Corpus: (1) 8 Elementary school textbooks, Grades 1 – 4 for schoolchildren aged 7 – 11; (2) 11 Biology textbooks, Grades 5 – 9 for schoolchildren aged 12 – 16; (3) 9 History textbooks, Grades 10 – 11 for schoolchildren aged 17 – 18;

(4) 10 UN Russian texts. The UN Russian texts are elicited from the United Nations Parallel Corpus “composed of official records and other parliamentary documents of the United Nations that are in the public domain” (<https://conferences.unite.un.org/uncorpus>, [20]). The grade number of school textbooks labels textbook complexity (readability) and is used as an index to benchmark sentiment bias of the book. The sizes of all four subcorpora are presented in Table 1 below. To ensure reproducibility of results, we uploaded the Corpus used in the study on the website thus providing its availability online (see Corpus of Russian Academic Texts (CORAT) at <https://clck.ru/U7sCt>).

In comparison with the previous study where we analyzed textbooks on social sciences only [21], we significantly expanded the range of text types analyzed.

**Table 1**  
Sizes of documents measured in tokens

Elementary school textbooks	Tokens	Biology Textbooks	Tokens	History Textbooks	Tokens	UNPC RussianTexts	Tokens
01-4ch <sup>2</sup>	11910	b5-6k	36954	h11p	66743	R1	9469
04.1v	14741	b5-6s	28632	h11d	105678	R2	10573
01.2v	2955	b5-6t	19100	hp11z	92777	R3	12852
T1k	2032	b5l	21887	h11v	46210	R4	7348
T1l	4161	b5pl	17904	h9a2	27331	R5	14036
e3r	17165	b5pon	15935	h9a1	35835	R6	5770
e1r	5505	b5pr	11220	h8d	57766	R7	10803
e2r	7650	b7n	43143	h10k	72455	R8	7148
		b7tih	30530	h10z	84313	R9	16308
		b5p	32830			R10	15434
		b7s	14605				
Subtotal	66119	Subtotal	272740	Subtotal	589108	Subtotal	109741
Total:	1037708						

At present the Corpus of Academic Texts (CORAT, Corpus of Russian Academic Texts [22]) comprises 11 biology textbooks, 9 history textbooks, and 8 elementary school textbooks (n=28). For contrastive purposes we also computed 10 texts in the Russian language from the official United Nations Parallel Corpus (<https://conferences.unite.un.org/uncorpus>) to identify differences the polarity of these texts and the text of school textbooks.

In this study we implemented a lexicon-based approach and estimated textbook sentiments computing frequency of words with positive and negative sentiment orientation. The sentiment with a positive or negative value is traditionally referred to as polarity. For this purpose, we used RuSentiLex containing over 12,000 Russian words and phrases labeled as positive, negative, neutral or positive/negative (indefinite). The category positive/negative is traditionally applied to those words the polarity of which depends on the context. RuSentiLex contains three types of sentiment-related words: (1) opinionated words from Russian sentiment vocabularies; (2) non-opinionated words with connotations conveying information about social phenomena; (3) slang and curse words from Twitter [23]. Sentiment of “non-opinionated words” is identified based on the context they are used in, i.e., social phenomena they nominate [24]. The phenomenon is viewed as positive if it is supported, secured, defended and guarded. If it is negative, the phenomenon is disputed, struggled, conflicted with or fought against, etc. All in all, RuSentiLex contains 35 negative and 20 positive vocabulary patterns enabling researchers to elicit connotations of words under study.

Negative patterns include e.g., Rus. borotysya s (struggle against), Rus. obvinit' v (charge in), etc. Positive patterns can be exemplified with Rus. borotysya za (struggle for), Rus. zashchishchat' (protect). The type (positive or negative) of non-opinionated words is allocated based on the frequency of its

<sup>2</sup> All the books are provided with meta-description containing the number of the grade and the author. E.g. code 01-4ch stands for “The World Around Us”, Grades 1-4, Reference materials, Chudinova E.V., Demidova M.Yu., 2011, see Corpus of Russian Academic Texts (CORAT).zip at <https://clck.ru/U7sCt>

collocations: to be computed as negative a word is to be registered in negative patterns 10 times more often than in patterns of positive type. Otherwise, it is viewed as neutral [1].

The multi-domain origin of the lexicon provides solid foundation for better performance of RuSentiLex in any domain. RuSentiLex is the only Russian sentiment lexicon and as such it is widely used in modern research of Russian discourse [25]. The Lexicon statistics is presented in Table 2 below.

**Table 2**

Quantitative Characteristics of RuSentiLex Vocabulary: Sentiment Orientation

Sentiment orientation	Number
Negative	8,475
Positive/negative	163
Positive	2,883
Neutral	485

Neutral and positive / negative words registered in the lexicon were excluded from the study as they amount to less than 0.05% in our Corpus.

#### 4. Evaluation of Sentiment Bias

Text processing was carried out in three stages. First, with the help of the morphological analyzer UDPipe 2 [26] we performed lemmatization, i.e., 'reduced' the inflected forms of a word to their initial form grouping them together, so they can be analyzed as a single item. The lemmatization accuracy of UDPipe 2 is considered high with F1 estimated at 96.68%.

On the second stage, we annotated texts under study with the help of RuSentiLex labeling the words as positive or negative. Finally, the total number of positive and negative words in the text was computed as a percentage of the total number of words.

As all senses of polysemous words demonstrate the same sentiment [1] we did not face the problem of semantic disambiguation. Another problem which we avoided in the current study is performing complete syntactic analysis which is viewed as compulsory as a researcher has to detect negation reversing the polarity of words, phrases, and sentences. The research showed less than 1% cases of the kind and as such they do not affect the experimental data presented.

#### 5. Results and Discussion

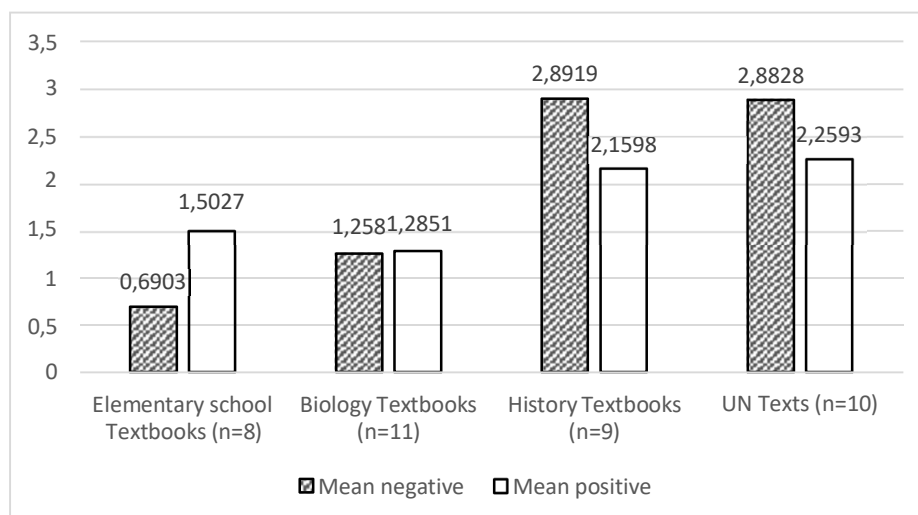
The previous research showed that sentiment vocabulary in children's books is associated with developing higher levels of empathy and even better perspective-defining skills [27]. Thus, sentiment analysis can be an important feature used not only to classify textbooks vocabulary but also to assess their quality and appropriateness for children.

The complete research results presented in Tables 5, 6 confirm the hypothesis that the majority of the Russian textbooks contain some kind of an emotional bias as all the texts analyzed contain words bearing either negative or positive sentiment.

The bar charts in Figure 1 below show the distribution of positive and negative sentiment in the books under study.

The diagram indicates that positive and negative words frequency is unevenly distributed in elementary school textbooks, History textbooks and UN texts. In the first two cases, these differences are statistically significant (see Table 4 below).





**Figure 1:** Average values of sentiment words frequency in texts

**Table 3**

Average values of sentiment words frequency in texts

Groups of texts	Mean negative	SD negative	Mean positive	SD positive	Wilcoxon Matched Pairs Test, p-value
Elementary school Textbooks (n=8)	0,6903	0,5672	1,5027	0,5030	0,0173*
Biology Textbooks (n=11)	1,2580	0,4258	1,2851	0,4675	0,4769
History Textbooks (n=9)	2,8919	0,7015	2,1598	0,2665	0,0077 <sup>3</sup>
UNPC Russian texts (n=10)	2,8828	1,7656	2,2593	0,5333	0,8785

In elementary school textbooks, the number of positive words (1.5027) is almost 2 times higher than the number of negative words (0.6903). In History textbooks, on the contrary, the number of negative words (2.8919) is higher than positive words (2.1598). The unevenness defined is possibly caused by the very nature of the texts: History textbooks narrate of wars, struggle for power, revolutions, etc. which are typically negatively connotated. Elementary school textbooks, on the other hand, are oriented for the target audience, school students aged 7 – 11, who are expected to comprehend mostly positive information. The latter is caused by two factors. Firstly, reading texts in elementary schools are considered not only educational but pedagogical, i.e., disciplinary, and as such are aimed at forming positive personality and a positive picture of the world. Secondly, the texts are supposed to reinforce a positive attitude towards learning. As for textbooks in secondary and high schools, they are expected to develop critical thinking thus exposing students to both positive and negative timelines (<https://www.jstor.org/stable/40014056?seq=1>). As “products of the author’s professional and personal preferences” (<https://www.euroclio.eu/resource/the-textbook-is-man-made/>) modern textbooks reflect “the prevalence of a social representation of history as a process of collective violence” [28] and “two thirds of nominated historical events were negative” [29]. Thus, of two possible timelines, i.e., positive and negative, in the majority of cases textbooks authors prefer the latter. Our findings here also coincide with the findings of V. Bagdasaryan et al. [30] whose research reports on numerous negative images and characteristics in secondary and high school textbooks.

<sup>3</sup>  $p < 0.05$  — statistically significant differences

The frequency of positive and negative words in Biology textbooks is almost the same, which indicates an emotionally balanced presentation of information.

As can be seen from the diagram, on average, the frequency of sentiment words in History textbooks is two times higher than that in Biology textbooks (Fig. 1). The research indicates that History textbooks are most emotionally charged when contrasted with Biology and elementary school texts. The differences are statistically significant for both negative and positive sentiment words (Table 5).

The data in Table 5 indicate that there are significant differences in the frequency of sentiment words in texts. UNPC Russian and History texts demonstrate similarities in the frequency of sentiment words, apparently due to the nature of the texts referents. UN PC Russian texts and history textbooks do not only narrate social events, present social phenomena and describe social objects, they provide explicit emotional assessment of the notions and the facts presented. The frequency of positive words in Biology textbooks are similar to those in elementary school textbooks, while the frequencies of negative words are statistically significantly different. As it was already mentioned above, the number of negative words in elementary school textbooks is much lower than in any other type of texts studied (Fig. 1).

**Table 4**

Contrasting frequency of negative and positive words in texts

	Sentiment differences in texts (Mann-Whitney U)	
	Negative, p-value	Positive, p-value
History Textbooks (n=9) & Elementary school textbooks (n=8)	0,0006*	0,0081*
History Textbooks (n=9) & Biology Textbooks (n=11)	0,0002*	0,0008*
History Textbooks (n=9) & UN Texts (n=10)	0,3913	0,7751
Elementary school textbooks (n=8) & Biology Textbooks (n=11)	0,0287*	0,3020
Elementary school textbooks (n=8) & UN Texts (n=10)	0,0012*	0,0088*
Biology Textbooks (n=11) & UN Texts (n=10)	0,0035*	0,0014*

**Table 5**

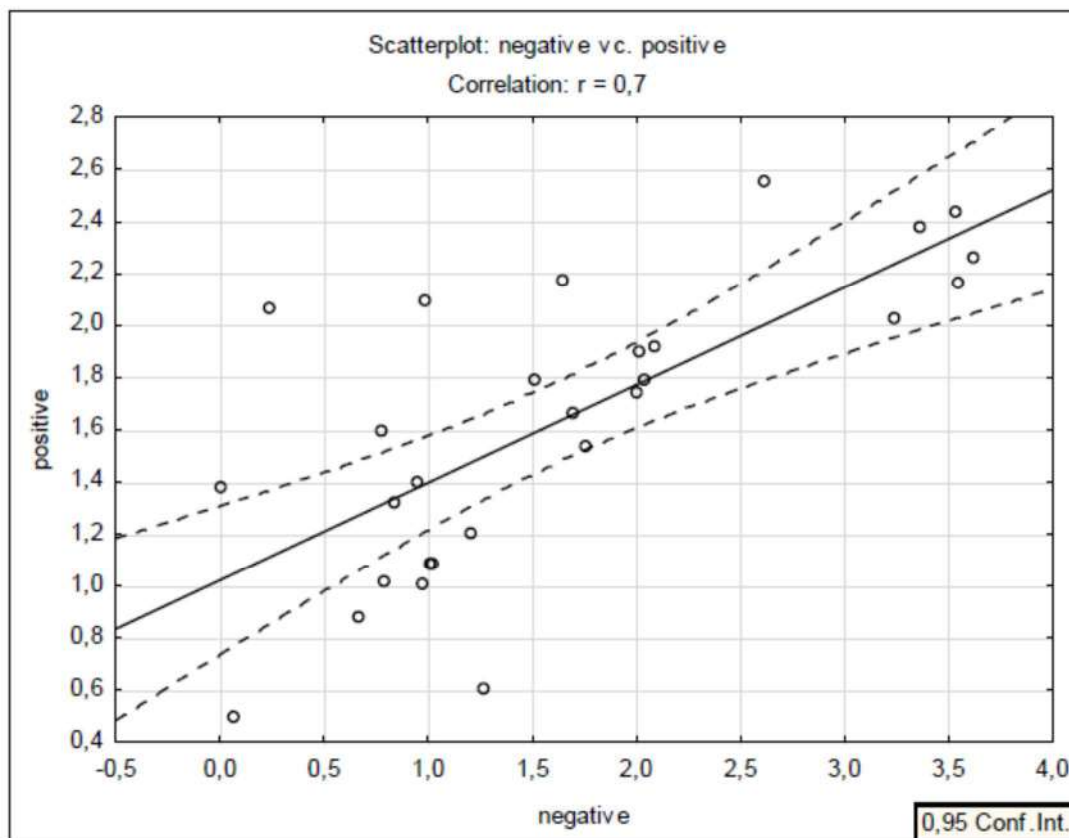
Emotional bias of academic and UN Texts

Elementary school textbooks	Negative sentiment	Positive sentiment	Biology	Negative sentiment	Positive sentiment
01-4ch	0,8312	1,3182	b5-6k	1,0824	1,0175
04.1v	1,6892	1,6620	b5-6s	1,0863	1,0024
01.2v	0,9814	2,0981	b5-6t	1,0157	0,7906
T1k	0	1,3780	b5l	1,7910	1,5123
T1l	0,2403	2,0668	b5pl	1,7426	2,0051
e3r	0,0583	0,5010	b5pon	2,1776	1,6505
e1r	0,7811	1,5985	b5pr	0,8824	0,6595
e2r	0,9411	1,3987	b7n	0,6073	1,2632
			b7tih	1,2021	1,2054
			b5p	1,0082	0,9717
			b7s	1,5406	1,7597

**Table 6**  
Emotional bias of academic and UN Texts

History Textbooks	Negative sentiment	Positive sentiment	UN Texts	Negative sentiment	Positive sentiment
h11p	3,6138	2,2654	R1	1,3940	2,4184
h11d	3,5296	2,4348	R2	6,6868	1,7308
hp11z	3,3618	2,3800	R3	5,0731	1,4628
h11v	3,5469	2,1640	R4	3,4295	2,3680
h9a2	2,0160	1,8989	R5	2,0946	2,4081
h9a1	2,0343	1,7915	R6	2,5477	3,2756
h8d	2,0808	1,9198	R7	1,7310	1,8328
h10k	2,6085	2,5533	R8	1,2171	1,9446
h10z	3,2356	2,0305	R9	1,6863	2,3853
			R10	2,9675	2,7666

We also implemented a correlation analysis (Spearman Rank Order Correlations) to analyze the relationship between the frequency of positive and negative words in all academic texts studied ( $n = 28$ ). We excluded UN texts from this analysis as functionally different types of texts. The data obtained indicate (Fig. 2.) a strong statistically significant correlation between the frequency of negative and positive words in all 28 academic texts ( $0.70$  at  $p < 0.05$ ). We observed a rise in frequency of negative words accompanied with a rise of positive words.



**Figure 2:** Correlation between the frequency of positive and negative words in texts

## 6. Conclusion

In this study, we conducted a contrastive sentiment analysis of educational texts for schoolchildren and UN texts. The Corpus of academic texts comprises three sets of 28 textbooks: elementary school

textbooks, secondary Biology textbooks, and high school History textbooks. This choice makes it possible to compare texts of social and natural sciences, as well as texts for younger and older students. This significantly expands the results of [21], in which we analyzed texts on Social Sciences only.

The shift towards negative vocabulary revealed in [21] comprises all Social Science textbooks for grades 5 – 11, and as such proved to be significant in textbooks of all age groups, from the 5<sup>th</sup> through the 11<sup>th</sup> grade. In this study, we confirmed the earlier findings in the subcorpus of History textbooks for grades 9– 11. A similar shift towards negative vocabulary was observed in UN texts. At the same time, in Biology textbooks (for grades 5 – 7), the number of positive and negative words is approximately the same. The comparative analysis proved the results to be statistically significant.

The sentiment difference in presenting educational material in Russian textbooks on social and natural sciences was revealed for the first time. We also confirmed the hypothesis that positive vocabulary prevails in Russian textbooks for elementary school children: it is true for the three subjects books analyzed, i.e. Ecology, Technology and Science. These results are similar to those received in a recent study by [31] who showed that English and German fiction discourse for children and adolescents demonstrates a distinct positive bias.

We believe that research on the use of positive and negative vocabulary can have a significant impact on textbook writers and testing material developers. Textbook authors are recommended to pay more attention to the so called positivity superiority effect [27], as positive words are comprehended faster than neutral and negative words.

## 7. Acknowledgment

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# Problems of Disambiguation of Prepositional Phrases

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## Abstract

This paper describes the features that appear in parsing procession of multiword turns (phrasemes) able to act as prepositions. These features are considered in the context of automatic analysis of Russian texts. Such phrases have a fairly high homonymy, which creates some difficulties in analysis and defining semantics and, consequently, reduces the accuracy of parsing. More than 320 phrasemes have been classified on the basis of the assumed homonymy types.

In the course of the study, the phrasemes have been divided into three groups. The first group includes those phrasemes that can definitely be called prepositions, but potentially have some semantic ambiguity. The second group combines phrasemes that are characterized by the part-of-speech homonymy of preposition/adverb. The third group is characterized by phrasemes that determine the construction of two or three parsing options. The occurrence of multivariate parsing is based on the presence of one or two phrases related to different parts of speech, and a simple conjunction of a preposition with a noun.

Within each group, lists of the most common phrasemes have been composed (according to the NCRL), indicating the probability that a certain phraseme may serve as a preposition. The paper also defines the basis on which the compilation of effectively removing homonymy rules for the SemSin parser may rely on. The examples provided in this paper prove that it is necessary to consider not only the direct encirclement of the phraseme, but also its remote context to remove homonymy.

## Keywords

automatic text analysis, disambiguation, homonymy, idiomaticity, prepositional phrases

## 1. Introduction

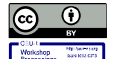
In the process of automatic parsing of the Russian language sentences and building a dependency tree, there is an arising problem of removing homonymy of various types – morphological, lexical, part-of-speech, etc. One of the ways to solve this problem is the broad use of standard combinations of words – phrasemes. This term refers to a wide range of expressions with a varying degree of idiomaticity [1]. The common feature for phrasemes is that the value of the whole is not a composition of the values of the constituent parts. In general, the words that are part of phrasemes can change, however within the scope of this study we are interested in invariable phrasemes, most of which are turns of speech that perform the functions of:

- adverbs – без царя в голове ('one who has bats in the belfry'), без конца и края ('stretching boundlessly'), без устали ('tirelessly'), ...;
- prepositions – без согласия ('without consent'), в память о ('in memory of'), за неимением ('for lack of' or 'failing'), на пути к ('on the way to'), ...;
- inserted clauses – а может быть ('and maybe'), в лучшем случае ('at best'), видишь ли ('you see'), ...;
- conjunctions – а вместе с тем ('and at the same time'), в связи с чем ('in connection with what'), разве только ('unless'), ...;

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- particles – а то что ж ('and then what'), едва ли не ('almost'), как бы ('as if'), чуть было не ('nearly'), ...;
- predicative turns of speech – пруд пруди ('a dime a dozen'), раз плюнуть ('not a big deal').

The most complete lists of turns of speech are given in the NCRL (National Corpora of Russian Language) [2]. The dictionaries of Kuznetsov [3] and Rogozhnikova [4] have also been used.

Currently, close attention is drawn to the semantics of prepositional groups, including those where more-than-one-word combinations act as a preposition [5]. As even a preliminary analysis shows, most of these phrasemes do not have homonymy and are always prepositional turns.

However, it is possible that the same combination of several words can correspond to two different turns. For example, a phraseme *без сопровождения* ('unaccompanied') can function as either a preposition or an adverb, depending on the context of the word on the right: a word in the genitive case, verb, or punctuation mark:<sup>2</sup>

- *Птенцы могли лететь через океан **без сопровождения родителей*** ('The fledglings could fly across the ocean without their parents accompanying them').

- *Медленно, **без сопровождения** запел хор* ('Slowly, unaccompanied, the choir began to sing').

- *Если ребенок выезжает **без сопровождения**, он должен иметь при себе кроме паспорта нотариально оформленное согласие...* ('If the child goes unaccompanied, he must have with him, in addition to the passport, a notarized consent').

A more complex situation arises in the event that a combination of several words, depending on the context, may or may not be a turn. Many word combinations of this kind are considered by Rogozhnikova [4], who notes the possibility of their use as free phrases that are homonymous to turns. So, for example, a phraseme *с целью* ('for the purpose of') can either perform the functions of a preposition or remain a free word combination, depending on the presence or absence of a word on the right in the genitive case:

- *Испания требовала экстрадиции, выдвигая также обвинения в нарушении прав человека, массовых пытках и заговоре **с целью пыток*** ('Spain has demanded extradition, charging accusations of human rights violations, mass torture and conspiracy to torture').

- *В августе, вероятно, с целью **отвлечь** население от дум о хлебе насущном, было объявлено о создании Комитета по чрезвычайному положению* ('In August, probably in order to distract the population from thinking about their daily bread, the creation of a State of Emergency Committee was announced').

An even more complex situation is possible, when the same phraseme can serve as a preposition, adverb, or remain a free phrase, depending on the type of right context:

- *Поэтому я пошел **по пути референтных групп*** ('So I went the way of reference groups').

- *Мы ехали на концерт и **по пути притормозили** на Садовой, у дома Булгакова* ('We were on our way to a concert and stopped on Sadovaya Street, near Bulgakov's house.').

- *По пути в Женеву **Леня сел за руль*** ('On the way to Geneva, Lenya took the wheel').

Taking into account the above, all prepositional turns (and the corresponding phrasemes), depending on their structure and the method of analysis used in the parser, in our opinion, can be divided into three groups, which are to be considered below.

There are two approaches to analyzing such turns. The first approach does not involve any special graphematic separation of them – an example of it is the "ETAP-3" parser [6]. In the context of the second approach, such a turn is emphasized in a special way – an example of it is the ABBYY parser [7]. Recently, these approaches are converging, and in the latest version of ETAP-4 [8], some of the turns are also emphasized (combined into a single token). The principle of operation of our SemSin parser [9], which analyzes prepositional turns, is close to the second example. More-than-one-word phrasemes are combined into a single token [10].

It should be noted that the SemSin parser is designed for analyzing written Russian-language texts, mainly newspaper and scientific profiles. The parser consists of 4 blocks: a dictionary, a morphological analyzer, production rules, and a lexical analyzer. The regular paragraph of the Russian-language text undergoes the morphological analysis with the marking out of individual

<sup>2</sup> Here and further on, all the examples are taken from the NCRL and are separated by a "•" sign, and Russian-language phrasemes that are turns of speech are highlighted in bold in the examples. The words that allow to make a particular decision are underlined in Russian-language examples.

tokens (words, phrases, punctuation marks, numbers, etc.). The token chain is then processed in the lexical analyzer using a system of production rules, the purpose of which is to transform the linear sequence of tokens into a dependency tree.

The principles of building the parser dictionary are based on the ideas of Tuzov [11]. The main table of the dictionary contains more than 195 thousand lexemes distributed over 1700 classes [12]. Each lexeme has morphological characteristics, as well as the number of its semantic class and actants or valences (for connecting dependent words) in the form of cases (!Nom, !Gen, !Acc, etc.) or prepositions, possibly with the corresponding cases (!Without, !For, !inAcc, !onPrep, etc.). Free actants are also used, which define more generalized concepts (!Question, !Where, !How, !Fromwhere, !Why, etc.). Often, before such an actant, the acceptable classes of words that can replace them are indicated. The presence of a classifier can significantly reduce ambiguity and is especially widely used when connecting adjectives and prepositions. About 14% of words in the dictionary have two or more lexemes.

In addition to the main table, there are auxiliary tables that provide the execution of tasks that are of interest in this work. This is a table of word combinations (more than 5350 lines), containing stable combinations of words with different types of inflection. These can be collocations (*вид на жительство*, ‘residence permits’), names of organizations (*Чейз Манхеттен Банк*, ‘Chase Manhattan Bank’), or idiomatic expressions (*белая ворона*, ‘sore thumb’). In these cases, one or all of the words can be used in different word forms.

In this paper, we are interested in immutable phrasemes that form compound prepositions, adverbs, etc. If the parser decides that a certain phrase is such a phraseme, then the words included in it are combined into a single token.

The second auxiliary table is a table of prepositions (more than 2460 lines) with the cases and semantic classes of the connected nouns. If the connection of the preposition with the dependent word is syntactic in nature and, as a rule, coincides with the case of the dependent word, then the connection of the prepositional group to the main word reflects the semantics more fully (Where, When, Why, etc.).

## 2. Group 1. Prepositional phrases without lexical homonymy

Passing on to the analysis of prepositional phrases, we note that the largest of the three groups is the first one, which contains turns of speech that have almost no homonyms and are unambiguous<sup>1</sup>. The analysis of these prepositions does not differ from the analysis of ordinary one-word prepositions. The group consists of two subgroups: the phrasemes of the first end with nouns (1A), the second – with prepositions (1B).

### 2.1. Subgroup 1A

This subgroup includes unambiguous prepositional phrases, whose phrasemes consist of two words: a preposition and a noun. There are more than 60 such phrases in our dictionary.

The vast majority of them require the genitive case after them.

Example: **В конце** своего *пребывания* школьники защищают исследовательские работы на конференции, **в присутствии** всего коллектива Центра (‘At the end of their stay, students defend their research papers at a conference, in the presence of the entire staff of the Centre’).

Other turns require the dative case after them: *в противовес* (‘in contrast to’), *в противоположность* (‘contrary to’), *в ущерб* (‘to the detriment of’), *на благо* (‘for the benefit of’), *на радость* (‘to smb’s joy’).

Example: *Отдавать* все силы организации выборов **в ущерб** профессиональной деятельности (‘Give all the effort to organize elections to the detriment of professional activity’).

Most prepositional phrases of this type can connect to the main word with only one connection. However, there are also such phrases with semantic homonymy that have two connections for connecting to the main word, the choice of one of which depends on the main word (its class, its internal actants, or in general its part of speech). The following turns refer to this type: *в честь* (‘in



honour of') (What for, Why), *из числа* ('from the number of') (From, Which), *на основе* ('on the basis of') (How, Which), *по поводу* ('concerning') (Dat, Why).

The semantics of prepositional relations is examined in detail in the dictionary of Zolotova [13], but there is a lack of formal rules that allow to correlate mainly syntactic relations developed by the parser with the semantics of [13]. This is a rather complex task that is still under consideration in some special cases [14].

Below are the examples of two prepositional phrases, and the connection with the main word of prepositional phrase is presented in parentheses in terms of the SemSin parser and in the semantic connections of Zolotova.

- *В прессе отмечалось, что это был салют в 101 залп **в честь** возникшего в России рабочего вопроса* ('In the press it was noted that it had been a salute of 101 volleys in honor of the labour issue that arose in Russia') – (был – Зачем (финитив) – в честь) (Why (finitive)).

- *И вдруг Олег вспомнил, как однажды он был на торжественном ужине, устроенном **в честь** приезда английского принца Чарльза* ('And suddenly Oleg remembered how he once was at a gala dinner, arranged in honour of the arrival of English Prince Charles') – (устроенном – Почему (каузатив) – в честь) (Why (causative)).

- *Если опальный магнат будет исключён **из числа** сопредседателей ЛР, у партии возникнут финансовые затруднения, полагают влиятельные эксперты* ('If the disgraced magnate is excluded from the number of co-chairs of the Republic of Latvia, the party will face financial difficulties, influential experts believe') – (исключён – Из (финитивно-фазисное) – из числа) (From (phase-finitive)).

- *Обычно в то время, как наверху происходила церемония награждения победителей, внизу совершалась казнь изменников, трусов, неудачников **из числа** подданных Великого курфюрста* ('Usually, while the ceremony of awarding the winners took place above, the execution of traitors, cowards, losers from among the subjects of the Prince-electors was carried out below') (неудачников–Какой (генератив) – из числа) (Which (generative)).

Table 1 shows the most common prepositional phrases of this subgroup that require the genitive case after them. A question of the validity of this table arises. Obviously, expert evaluation is very difficult in this case because of the necessity to view too many sentences. For example, for a phraseme *в глубь* ('into the depth'), it would be necessary to analyse more than 27 hundred sentences in order to identify about 70 cases of absence of a word in the genitive case to the right of the phraseme. It is very likely that if we choose 300-500 sentences in any way, there will be no cases of absence of the genitive case on the right.

Therefore, such method of evaluation has been chosen. With the usage of the capabilities of the NCRL, sentences in which there is a punctuation mark after the studied phraseme *в глубь* ('into the depth') have been selected.

Example: *И светлый месяц, который то серебрил всё море, рассыпая по мелкой ряби свои лучи, то одним цельным блиставшим столбом падал **в глубь**, перерезав всю бухту* ('And the bright moon, which now silvered the whole sea, scattering its rays on the faint ripples, then fell in one solid shining column into the depths, cutting the entire bay').

It is obvious that in all these sentences (171 units) this phraseme does not serve as a preposition, but is simply a combination of a noun with a preposition. Next, sentences, in which there is a verb in the indicative or imperative mood, an infinitive or an adverbial participle after the studied phraseme, have been selected. This set of 57 sentences requires expert analysis, since after this phraseme there are such homonymous words as *души* ('souls' vs 'strangle'), *заросли* ('thickets' vs 'overgrow'), *моря* ('seas' vs 'starve'), *села* ('villages' vs 'sit'), *стекла* ('glasses' vs 'drain'), *суши* ('land' vs 'sushi' vs 'dry'), etc.

Example: *Мы уложили вещи и двинулись **в глубь** села* ('We packed our bags and moved to the heart of the village').

In only 6 sentences, our phraseme is simply a combination of a noun and a preposition.

The sum of these sentences (65+6) determines the reliability of the fact that this phraseme serves as a preposition.

**Table 1.**  
Prepositions that require the genitive case

Turn of speech	Link with the main word	Frequency, ipm	From which preposition
В ВИДЕ ('in the form of')	Как ('How')	35.5	99.4%
В ГЛУБЬ ('into the depth')	Куда ('Where')	8.4	97.5%
В ПОЛЬЗУ ('in favour of')	Как ('How')	15.2	97.2%
В ПРИСУТСТВИИ ('in smb's presence')	Как ('How')	20.5	99.2%
В ТЕЧЕНИЕ ('during')	какДолго ('For how long')	57.8	99.2%
В ХОДЕ ('in the course of')	Когда ('When')	18.6	99.8%
В ЦЕЛЯХ ('with a view to')	Для ('For')	8.2	97.6%
В ЧЕСТЬ ('in honour of')	Зачем, Почему ('For what reason', 'Why')	7.9	98.1%
ВО ВРЕМЯ ('during')	Когда ('When')	212.7	99.2%
ВО ИМЯ ('in the name of')	Зачем ('For what reason')	13.1	99.2%
ДЛЯ СОЗДАНИЯ ('for creating')	Зачем ('For what reason')	6.8	99.1%
ЗА ПРЕДЕЛЫ ('outside the limits of')	Куда ('Where')	12.3	98.0%
ЗА СЧЕТ ('at the expense of')	Как ('How')	27.3	99.6%
ИЗ ЧИСЛА ('from the number of')	Изо, Какой ('From', 'What')	11.8	99.7%
НА ОСНОВАНИИ ('on the grounds of')	Почему ('Why')	31.8	99.3%
НА ОСНОВЕ ('on the basis of')	Как, Какой ('How', 'What')	23.5	99.6%
НА ПРОТЯЖЕНИИ ('throughout')	какДолго ('For how long')	12.2	99.8%
ПО ПОВОДУ ('concerning')	поДат, Почему ('Dative', 'Why')	30.3	99.2%

## 2.2. Subgroup 1B

This subgroup includes unambiguous prepositional phrases, whose phrasemes consist of two, three or four words and end with a preposition. There are more than 150 such phrases in our dictionary. Almost all prepositional phrases ending with a preposition belong to this subgroup. To date, we know only three exceptions: phrasemes *на глазах у* ('before smb's eyes'), *под носом у* ('under the nose of'), and *под самым носом у* ('under the very nose of'). Indeed, let us compare two sentences: *Ты на глазах у зрителя вершишь свой путь* ('You are making your way before the eyes of the viewer') and *Стали мы во дворе, и вижу я: на глазах у него будто слеза поблескивает* ('We are standing in the courtyard, and I see: in his eyes, a tear seems to glisten'). It is quite obvious that in the first sentence the phraseme is a prepositional phrase, while in the second one it is just a free combination of three words. The situation is similar with the other two phrasemes. All of them belong to the third group.

Examples of the most frequent turns of speech of subgroup 1B are given in Table 2. As the table shows, most of them begin with a preposition, usually it is «В» ('in'). At the end, the prepositions «с» «со» ('with') or «от» ('from') are most often located. The case required after the turn is determined by the preposition in the end. Due to the presence of a preposition in the end, the question of the

reliability of the data does not arise – theoretically, an adjective, a participle, a pronoun or in the appropriate case should always be to the right of the preposition (otherwise it is just an error in the text).

**Table 2.**

Phraseemes ending with a preposition

Turn of speech	Required case	Link with the main word	Frequency, ipm
В ОДНОЙ ИЗ ('in one of')	Род ('Genitive')	Где ('Where')	17.8
В ОДНОМ ИЗ ('in one of')	Род ('Genitive')	Где ('Where')	28.8
В ОТВЕТ НА ('in response to')	Вин ('Accusative')	Как ('How')	18.1
В ОТЛИЧИЕ ОТ ('in contrast to')	Род ('Genitive')	Как ('How')	21.4
В СВЯЗИ С ('in connection with')	Тв ('Instrumental')	Почему ('Why')	35.3
В СООТВЕТСТВИИ С ('in accordance with')	Тв ('Instrumental')	Как ('How')	31.6
ВМЕСТЕ С ('together with')	Тв ('Instrumental')	Как ('How')	89.9
ВМЕСТЕ СО ('together with')	Тв ('Instrumental')	Как ('How')	27.1
ВНЕ ЗАВИСИМОСТИ ОТ ('regardless of')	Род ('Genitive')	Как ('How')	32.1
ВПЛОТЬ ДО ('up to')	Род ('Genitive')	Как ('How'), доКогда, Докуда, Сколько	27.6
ВСЛЕД ЗА ('following')	Тв ('Instrumental')	Как ('How')	21.4
НЕ БЕЗ ('not without')	Род ('Genitive')	сТв ('With')	38.1
НЕСМОТРЯ НА ('in spite of')	Род ('Genitive')	Как ('How')	45.6
ПО НАПРАВЛЕНИЮ К ('in the direction of')	Вин ('')	Куда ('Where')	86.4
ПО ОТНОШЕНИЮ К ('in relation to')	Дат ('Dative')	поОтн ('in relation to')	40.9
ПО СРАВНЕНИЮ С ('in comparison with')	Дат ('Dative')	Как ('How')	20.3
РЯДОМ С ('near to')	Тв ('Instrumental')	Где ('Where')	55.6
ЧТО ДО ('as for')	Тв ('Instrumental')	Как ('How')	22.3

Most prepositional phrases of this type can connect to the main word in only one link. However, there are also such phrases that have several links to the main word, the choice of one of which depends on the main word (its class, its internal actants, or in general its part of speech). The following turns refer to this type: *верхом на* ('astride') (How, To where), *вплоть до* ('up to') (How, How long, How far, How much), *начиная от* ('starting from') (How, When), *начиная с* ('starting from') (How, When), *начиная со* ('starting from') (How, When), *совместно с* ('together with') (How, Instr), *совместно со* ('together with') (How, Instr).

Below the examples for the prepositional phrase *вплоть до* ('up to') are given.

• *Помощь готова оказать любую, вплоть до аврального написания сочинения* ('I am ready to provide any help, up to the emergency writing of an essay') – (*оказать* – Как (Интенсив) – *вплоть до*) (How (Intensive)).

• *Вплоть до 1933 года прокуратура входила в состав Народного комиссариата юстиции* ('Until 1933, the Prosecutor's Office was part of the People's Commissariat of Justice') – (*входила – доКогда* (Темпоратив) – *вплоть до*) (How long (Temporative)).

- *То развенчание "культа личности", то внедрение кукурузы **вплоть до** Полярного круга, то построение коммунизма в одной отдельно взятой стране...* ('The debunking of the "cult of personality", the adoption of corn up to the Arctic Circle, the construction of communism in one single country...') – (внедрение – Докуда (Директив) – **вплоть до**) (How far (Directive)).

- *С помощью частиц, разогнанных на ускорителях, мы можем сегодня зондировать расстояния **вплоть до**  $10^{-16}$*  ('With the help of accelerated particles, we can now probe distances up to  $10^{-16}$ ') (зондировать – Сколько (Дименсив-квантитатив) – **вплоть до**) (How much (Dimensive-quantifier)).

### 3. Group 2. Phrases with the preposition/adverb homonymy.

This group includes the simplest homonymous prepositional phrases, whose phrasemes can serve as prepositions or adverbs [15]. In our dictionary, there are more than 20 such turns. For example, a phrase *на краю* ('on the verge') can be a preposition if it is followed by a word in the genitive case, or an adverb in case of its absence:

- *Они остановились **на краю** заполненного серым туманом гигантского провала* ('They stopped at the edge of a giant chasm filled with gray fog').

- *Если бы, Саша, ты успел еще что-нибудь во славу русского национализма высказать, носить бы нам тебе передачи, а так как-то удержался **на краю**...* ('If you had had time to say anything else to the glory of Russian nationalism, Sasha, we would have had to bring you parcels, but somehow you stayed on the edge...')

The vast majority of prepositional turns require the genitive case after them. Example:

- *Родиться князем не мудрено, и можно **по праву** породы называться сиятельством.*

Two phrases require a dative case after them: *в угоду* ('to please'), *не в пример* ('unlike'). Example:

- *Он просто не хотел никого казнить **в угоду** иудеям* ('He just didn't want to execute anyone to please the Jews').

Most prepositional phrases of this type can connect to the main word in only one link. However, there are several turns that have two connections for connecting to the host, the choice of one of which depends on the main word (its class, its internal actants, or in general its part of speech). The following turns refer to this type: *в конце* ('at the end') (Where, When), *в начале* ('at the beginning') (Where, When), *в середине* ('in the middle') (Where, When), *к концу* ('to the end') (When, To where), *к началу* ('to the beginning') (When, To where). Below are examples for the prepositional phrase *в начале* ('at the beginning').

- *Я только успел заметить далеко **в начале** улицы две светлых фигурки* ('I only had time to notice two light figures far away at the beginning of the street') – (заметить – Где (Локатив) – в начале) (Where (Locative)).

- *Да, а **в начале** марта мы-таки устроим массовый вылет* ('Yes, and in early March, we will still arrange a mass flight') (устроим – Когда (Темпоратив) – в начале) (When (Temporative)).

When the phrasemes of the second group are detected, the parser also combines the words included in them into a single token, but outputs two lexemes that are present in the dictionary: a preposition and an adverb. Then a special rule called "Preposition-Adverb" is launched, which makes the final choice. Since this rule is triggered after the formation of the nominal group, the case check is performed at the centre of the nominal group, which ensures the correct choice of these two tokens.

Table 3 shows the most common prepositional phrases of the second group, which require the genitive case after them.

To calculate the frequency of formation of each preposition, here and further, about 300 sentences from the main body of the NCRL had been used, supplemented, if necessary, by the sentences of the newspaper body and the available array of texts (of the volume of about 50 million words), composed of a number of stories, news and sports articles. The selected material had undergone an additional filtering to exclude cases of punctuation marks breaking the phrase (in this case it is definitely not a prepositional turn). Then the automatic analysis of the selected sentences was launched. The obtained result was saved as an xml-file that was finally used to determine the frequency of occurrence of specific preposition.

**Table 3.**  
The most frequent phrases of the second group

Turn of speech	Link with the main word	Frequency, ipm	From which preposition
В КОНЦЕ ('at the end of')	Где, Когда ('Where', 'When')	162.2	92%
В НАЧАЛЕ ('at the beginning of')	Где, Когда ('Where', 'When')	83.0	93%
В ПОДТВЕРЖДЕНИЕ ('in confirmation of')	Как ('How')	3.5	76%
В РАМКАХ ('within')	Как ('How')	31.6	95%
В СЕРЕДИНЕ ('in the middle of')	Где, Когда ('Where', 'When')	29.4	89%
ВО ГЛАВЕ ('headed by')	Где ('Where')	40.4	69%
К КОНЦУ ('towards the end')	Когда, Куда ('When', 'Where')	36.0	78%
К НАЧАЛУ ('towards the beginning of')	Когда, Куда ('When', 'Where')	11.2	93%
НА КРАЮ ('on the verge')	Где ('Where')	13.6	87%
НЕ СЧИТАЯ ('not counting')	Как ('How')	7.7	84%
ПО АДРЕСУ ('about')	Как ('How')	10.6	18%
ПО ПОРУЧЕНИЮ ('on the instructions of')	Почему ('Why')	4.8	96%
ПО ПРАВУ ('by right')	Почему ('Why')	7.1	17,5%
ПО ПРОСЬБЕ ('at smb's request')	Почему ('Why')	7.6	94%
ПО СЛУЧАЮ ('on the occasion of')	Почему ('Why')	25.1	79%
СО СТОРОНЫ ('on smb's part')	Откуда ('From where')	90.7	72%0

#### 4. Group 3. Collocations that may not be phrasemes

This group includes complex homonymous prepositional phrases, whose phrasemes can serve as prepositions or be a simple combination of words. In the first case, all the words that form the phrase must be combined into a single token, in the second case, they must be left unchanged. Thus, the pre-syntactic module, having marked out the next phrase belonging to the third group, cannot combine its tokens into a single one by itself. For further processing of the phraseme, a rule that is practically the first in succession is launched, deciding whether this phraseme may be a prepositional phrase or not. In our dictionary there are about 90 phrasemes of this kind. It should be noted that at the stage of parser analysis, the nominal groups are not yet formed, that is why the rules for analysing these phrasemes are significantly complicated.

The most detailed description of such collocations is given in a study by Rogozhnikova [4], who analyzes them from a semantic point of view. However, this semantics is considered from the point of view of a "person", not a "computer", so it lacks strict formal features. Therefore, when developing rules for text processing, we have to take into account only the surrounding context, its grammar and classes. Sometimes we also have to take into consideration the remote context.

In connection with this approach, it is possible to divide the prepositional turns of this group into 3 subgroups, depending on the complexity of their analysis.

#### 4.1. Subgroup 3A

This subgroup includes homonymous phrasemes, which can play a role of a preposition if the simplest criterion is fulfilled. This criterion is the presence of a word on the right in the genitive case. In the event of absence of such a case, the phraseme remains a simple combination of words. Example:

- *Онтологические системы могут использоваться для решения различных задач в сфере искусственного интеллекта* ('Ontological systems can be used to solve various problems in the field of artificial intelligence').

- *В сфере радиусом в 100 световых лет насчитывается около 10000 звёзд* ('There are about 10,000 stars in a sphere with a radius of 100 light years').

This subgroup includes 13 turns, the most common ones are presented in Table 4. As before, there are prepositional phrases that can be connected to the main word with various links. Example:

- *Такие счета могут быть номинированы в иностранной валюте, а владельцы счёта NRI могут определять бенефициария в пределах Индии* ('Such accounts can be denominated in a foreign currency, and NRI account holders can assign a beneficiary within India.') – (определить – Где (Директив)– в пределах) (Where (Directive)).

- *Отступления сделаны для пироксенов, гранатов, хлоритов и амфиболов, поскольку минералы в пределах этих групп близки по условиям формирования...* ('Deviations are made for pyroxenes, garnets, chlorites, and amphiboles, since the minerals within these groups are similar in terms of formation conditions...') – (близки – Как (Характеристика способа или меры действия) – в пределах) (How (Description of method or measure of an action)).

**Table 4.**

The most frequent phrases of subgroup 3A

Turn of speech	Link with the main word	Frequency, ipm	From which preposition
В ПРЕДЕЛАХ ('within the limits of')	Где, Как ('Where', 'How')	23.8	76%
В СЛУЧАЕ ('in the event of')	Когда ('When')	71.4	67%
В СФЕРЕ ('in the field of')	Как ('How')	15.4	96%
В ЧИСЛЕ ('in the number of')	вПред ('Prepositional')	32.3	88%
В ЧИСЛО ('to the number of')	вВин ('Accusative')	7.6	81%
С ЦЕЛЬЮ ('with a view to')	Зачем ('For what reason')	30.2	65%

#### 4.2. Subgroup 3B

This subgroup includes homonymous phrasemes, which can play a role of a preposition or remain a simple combination of words. To select a particular option, it is necessary to fulfil a complex condition. To have it implemented, the surrounding context, grammar, and classes of individual words have to be taken into account. Sometimes it is necessary to take into consideration even the remote context within the entire sentence [16].

For example, the phrase *на глазах у* ('before smb's eyes') can have two semantic meanings: something happens to somebody's eyes (and this will be a free combination of three words) or something happens in the presence of someone (and this will be a prepositional phrase). To analyse such a phraseme, the following rule is used: if one of the following words – *влага* ('moisture'), *слеза*

(‘tear’), *слезы* (‘tears’) – occurs to the left or right of the phraseme within seven words from it, then we deal with a simple word combination, otherwise it is a prepositional phrase. It has to be noted that in both cases, the phrase is followed by a word in the genitive case:

- *На глазах у Маруси появились слезы* (‘Marusia's eyes filled with tears’).

- *На глазах у посетителей, так и не слезших со столов, ему удалось поймать 28 змей* (‘Before the very eyes of the customers, who had not got off the tables, he managed to catch 28 snakes’).

This subgroup includes about 60 turns, the most common ones are presented in Table 5. As before, there are some prepositional phrases that can be connected to the main word by various links. For example, for the phrase *по вопросу* (‘on the issue of’):

- *Заседание Госдумы по вопросу его ратификации состоится 20 или 21 марта* (‘The State Duma will hold a meeting on its ratification on March 20 or 21’) (*Заседание* – Какой – *по вопросу*) (Which).

- *Самым ярким оппонентом Кука по вопросу распространения американских культурных растений в области Тихого океана много лет был его соотечественник Меррилл* (‘Cook's most ardent opponent on the issue of the distribution of American cultivated plants in the Pacific region for many years was his compatriot Merrill’) (*оппонентом* – *поДат* – *по вопросу*) (Dat).

*По вопросу губернатора Резанов догадался, что тот значительно больше его осведомлен* (‘The governor's question made Riazanov guess that the latter was much more knowledgeable than he was’) – a simple combination of a preposition and a noun.

**Table 5.**

The most frequent phrases of subgroup 3B

Turn of speech	Link with the main word	Frequency, ipm	From which preposition
В ГЛАЗАХ (‘in smb’s eyes’)	вПред (‘Prepositional’)	50.5	44%
В КАЧЕСТВЕ (‘as’)	Как (‘How’)	99.8	94%
В ОБЛАСТИ (‘in the field of’)	вПред (‘Prepositional’)	53.5	79%
В ОТНОШЕНИИ (‘with respect to’)	вПред (‘Prepositional’)	48.7	84%
В ПОРЯДКЕ (‘by way of’)	Как (‘How’)	42.1	29%
В РАЙОНЕ (‘around’)	Где (‘Where’)	34.0	10%
В СИЛУ (‘because of’)	Как (‘How’)	41.7	74%
С ПОМОЩЬЮ (‘with the help of’)	Как (‘How’)	68.5	57%
С ТОЧКИ ЗРЕНИЯ (‘from the point of view of’)	Как (‘How’)	33.7	98%

### 4.3. Subgroup 3C

This subgroup includes the most complex homonymous phrasemes, which can play a role of a preposition, an adverb, or remain a simple combination of words. To select a particular option, a rather lengthy criterion has to be fulfilled. In general, to have it implemented, the surrounding context, grammar, and classes of individual words have to be taken into account. Sometimes it is necessary to take into consideration even the remote context within the entire sentence. For example, let us examine the phraseme *в результате* (‘as a result’). In Rogozhnikova's study, some semantic justification and examples are provided [4]. With this basis, the following rule has been developed for the analysis of the phraseme.

If there are the lemmas СОМНЕВАТЬСЯ (‘to doubt’), СОМНЕНИЕ (‘doubt’), УВЕРЕННЫЙ (‘confident’) to the left of the phraseme and if there are lemmas АНАЛИЗ (‘analysis’), ГОЛОСОВАНИЕ (‘voting’), ИССЛЕДОВАНИЕ (‘research’), ОПЕРАЦИЯ (‘operation’), ОПЫТ

(‘experience’), ТЕСТ (‘test’), ЭКСПЕРИМЕНТ (‘experiment’) to the right (directly or in one word in the genitive case), the wordforms of which are in the genitive case, then the phraseme is a simple combination of words. Example:

- *Не будучи уверен в результате голосования и не желая идти на риск и в то же время сильно надеясь на воздействие ленинской речи, левый блок сделал уступку...* (‘Not being sure of the vote results and unwilling to take any risks, and at the same time pinning great hopes on the impact of Lenin's speech, the left bloc made a concession...’)

- *Я не сомневался в результате этого эксперимента* (‘I had no doubts about the result of this experiment’).

If there are the lemmas СОМНЕВАТЬСЯ (‘to doubt’), СОМНЕНИЕ (‘doubt’), УВЕРЕННЫЙ (‘confident’) to the left of the phraseme and a comma or a full stop to the right of it, then the phraseme is also a simple combination of words:

- *Мой добрый друг был, как правило, уверен в результате* (‘My good friend was generally confident of the result’).

If there is a word in the genitive case to the right of the phraseme, then it performs the function of a preposition:

- *Это сообщение выдаётся автоматизированной системой, если в результате вычисления формула получила значение "ложь"* (‘This message is issued by the automated system if the formula has received the value "false" as a result of the calculation’).

Otherwise, the phraseme performs the function of an adverb:

- *В результате объекты имитационной модели перейдут в некорректные состояния* (‘As a result, the objects of the simulation model will come to incorrect states’).

Thus, it is clear that there is a possibility to formalize semantic relations, but sometimes this process results in rather lengthy rules.

Today, this subgroup includes 15 phrases, the most common ones are shown in Table 6. It should be noted that at least two of them have more than three variants of homonymy. Thereby, the phraseme *в меру* (‘within reasonable limits’) can additionally be a predicate: *Вроде бы все в меру, все на своих местах* (‘Everything seems to be within reasonable limits, everything is in its place’). The phraseme *в разрезе* (‘in section’) can additionally perform the function of an attribute: *У меня над кроватью, сколько себя помню, висел план огромного океанского парохода в разрезе* (‘I have had a plan of a huge ocean steamship in section hanging over my bed for as long as I can remember’).

**Table 6.**

The most frequent phrases of subgroup 3С

Turn of speech	Link with the main word	Frequency, ipm	From which preposition
В ЗАКЛЮЧЕНИЕ (‘in conclusion’)	Где, Когда (‘Where’, ‘When’)	14.7	34%
В МЕРУ (‘within reasonable limits’)	Как (‘How’)	9.5	46%
В РЕЗУЛЬТАТЕ (‘as a result of’)	Как (‘How’)	81.2	62%
ЗА РАМКИ (‘exceeding the limits of’)	Куда (‘Where’)	3.8	95%
НА РАССТОЯНИИ (‘away from’)	Где (‘Where’)	12.8	42%
НА СТОРОНЕ (‘on smb’s side’)	Где (‘Where’)	11.5	70%
НА ФОНЕ (‘against background’)	а Как (‘How’)	24.1	75%
ПО ОКОНЧАНИИ (‘after’)	Когда (‘When’)	19.5	93%
ПО ПУТИ (‘on the way’)	Куда (‘Where’)	18.8	35%



## 5. Conclusion

As a result of the study, the classification of turns of speech (phrasemes) has been performed depending on the type of homonymy. Rules have been developed that allow to remove part-of-speech and syntactic homonymy with high accuracy. We believe that due to the large variability of the Russian language, raising the accuracy of parsing a certain number of constructions to the level of above 95% may require disproportionately large efforts, and, in fact, may turn into analysing specific phrases. Therefore, in some cases, rarely encountered phrasemes have been ignored. For example, the construction *под знаком + род. пад* ('under the sign of' + genitive case) may occur in the main and newspaper corpora of the NCRL over 1700 times, while only 9 cases turned out to be free word combinations, and not compound prepositions (*под знаком интеграла...* ('under the sign of the integral...')).

At the same time, the removal of semantic homonymy is a much more complex task that requires additional research.

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# Crowdsourcing for the Russian Morphological Lexicon

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## Abstract

We present an on-going experiment aimed at improving the results of Russian PoS tagging by means of increasing the size of morphological lexicon that is used for training the respective tagger(s). The frequency list of out-of-vocabulary (OOV) word forms along with the tags and lemmas assigned by the guesser is manually checked, corrected and classified by students in the framework of assignments, so that valid lexical items candidates for inclusion into the morphological lexicon could be identified. We expect to improve the lexicon coverage by the most frequent proper names and foreign words, as well as to create an auxiliary lexicon containing the most frequent typos.

## Keywords

crowdsourcing, Russian POS-tagging, out-of-vocabulary words

## 1. Introduction

Assuming that one of the main features of a representative text corpus is its size, then a 100-million token corpus, considered a standard at the beginning of the century, now often appears to be insufficient to collect relevant statistical data. As soon as the need for larger corpora has been recognized, it became clear that the requirements of the linguistic community cannot be fully satisfied by the traditional methods of building corpora. At the turn of the new millennium, the idea of Web as Corpus (WaC), i.e., creation of language corpora based on the web-crawled data has been born, for the first time explicitly articulated by Adam Kilgarriff [1, 2]. In early 2000s, a community called WaCky! was established by a group of linguists and IT specialists to develop tools for creation of large-scale web-crawled corpora. During the period of 2006–2009, several WaC corpora were created and published [3]. Since then, several other initiatives emerged [4-8], with one of them also being the Aranea Web Corpora Project [9].

The Aranea family presently consists of (comparable) web corpora created for more than two dozens of languages and language varieties. The corpora bear Latin names denoting the Language and size, with two sizes being typically available. The Maius (“larger”) series corpora contain 1.25 billion tokens, i.e., approximately 1 billion words (tokens starting with an alphabetic character). Each Minus (“smaller”) corpus represents a 10% random sample of the respective Maius corpus. For languages spoken in more than one country, corpora for region-specific language varieties may exist. For Russian, for example, the Araneum Russicum consists of Russian texts downloaded from any internet domain, Araneum Russicum Russicum contain only texts extracted from the .ru and .рф .su domains, and Araneum Russicum Externum are based on texts from “non-Russian” domains, such as .ua, .by, .kz, etc. For more details about the Aranea Project see [9, 10]. For some languages, a Maximum class corpora are also created applying the strategy “as much as can get”. The largest corpus within the Aranea family is Russicum Maximum containing almost 20 billion tokens.

To create a web corpus, we usually have to perform (in a certain sequence) operations as follows:

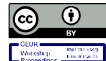
- Downloading large amounts of data from the Internet, extracting the textual information, normalizing encoding

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- Identification the language of the downloaded texts, removing the “incorrect” documents
- Segmenting the text into paragraphs and sentences
- Removing duplicate contents (identical or partially identical text segments)
- Tokenization—segmenting the text into words
- Linguistic (morphological, and possibly also syntactic) annotation—lemmatization and PoS tagging
  - Uploading the resulting corpus into the corpus manager (i.e., generating the respective index structures) that will make the corpus accessible for the users.

Our paper is devoted to the morphological tagging of input texts and, narrower, to the processing of out-of-vocabulary (OOV) tokens.

## 2. Morphosyntactic annotation

From the very beginning of the Aranea Project, only tools with an open-source or free license have been used for all processing. As there are many languages to be processed, for morphosyntactic annotation tools with many language models were preferred. This was especially the case of TreeTagger, that was easy to integrate into our processing pipeline [11, 12].

Despite being a rather old tool, TreeTagger is still being used by many projects. Its main advantage, from our perspective, is the processing speed than can be even by the order of magnitude faster than other tools for the same language. There are, however, some disadvantages as well. The quality of language models provided by its author varies from one language to another, depending on the training data and morphological lexicon available. Perhaps the greatest deficiency of TreeTagger is absence of any procedure that would guess lemmas for out-of-vocabulary (OOV) lexical items – those are simply tagged as “unknown”, leaving decision of further processing to the user.

Several Russian language models for TreeTaggers are available, for our work we rely on that provided by Serge Sharoff. Though its coverage, compared to other languages, is fairly high, the morphological lexicon based on Zaliznyak dictionary and manually disambiguated subcorpus of the Russian National Corpus naturally cannot cover all lexical items appearing in a “fresh” web-crawled corpus.

Russian belongs to languages with several taggers available, so an idea of looking for an alternative is quite straightforward. None of them, however, can be simply declared as “better” – each of them has some drawbacks as well. In our experiments we were using UDPipe [13], a tool developed in the framework of the Universal Dependencies Project [14]. It is able to guess lemmas but, unlike TreeTagger, the UDPipe does not use morphological lexicon at all and all lemmas are guessed, even for lexical items present in the training data. Out of the language models available, we opted for that trained on the SynTagRus treebank [15].

The third tool included in our work was CSTlemma [16, 17], a high performance lemmatizer with a language model provided by its author.

In an attempt to improve the results of annotation, we are planning to apply steps as follows.

- 1 Use the “ensemble tagging” approach, i.e., annotate the corpus by several different tools.
- 2 Aggregate the results by means of manually written rules.
- 3 Manually disambiguate the annotations for most frequent OOV lexical items
- 4 Use the disambiguated list to amend the morphological lexicon for next step of annotation.

The current paper describes the very first phase of or experiment targeted on correcting the lemma and PoS tags by means of crowdsourcing.

### 3. Crowdsourcing

“Crowdsourcing” is a relatively recent concept that encompasses many practices. This diversity leads to the blurring of the limits of crowdsourcing that may be identified virtually with any type of Internet-based collaborative activity, such as co-creation or user innovation [18]. In their paper, authors define eight characteristics typical for crowdsourcing as follows:

- There is a clearly defined crowd (a)
- There exists a task with a clear goal (b)
- The recompense received by the crowd is clear (c)
- The crowdsourcer is clearly identified (d)
- The compensation to be received by the crowdsourcer is clearly defined (e)
- It is an online assigned process of participative type (f)
- It uses an open call of variable extent (g)
- It uses the Internet (h)

From this perspective, language data annotation performed by students in the framework of the end-of-term assignments can well be considered “crowdsourcing”, even if only some of the above characteristics apply. It is also worth noting that, according to our experience, students appreciate the feeling that their work may be useful not only as a tool for classification.

### 4. The Task

The OOV lexical items observed in our corpora are of different nature. Besides the “true neologisms”, i.e., words qualifying for inclusion even into the traditional dictionary, proper nouns (such as personal and geographical names) and their derivatives, we can find also items traditionally not considered as “words” – various abbreviations, acronyms and symbols, URLs or e-mail addresses, parts of foreign language quotations and – above all – all sorts of “typos” and “errors”. Inflected word forms apply to almost all previously mentioned categories, which makes the whole picture even more complex.

In the following text we present an experiment aimed at amending the morphological lexicon used for training the language model(s) by a manually validated list of most frequent OOV items derived from an annotated web corpus. The annotation is to be performed by graduate students of the Mathematical Linguistics Department of the Saint-Petersburg University in the framework of end-of-term assignment for the “Corpora in NLP” subject.

Having only limited “human power” (14 students in total) at hand, we decided to follow the three-fold setup (i.e., each item to be annotated by three independent annotators) and make the task as simple as possible. This is why the annotators were not expected to check all the morphological categories provided by the respective tags, and they were asked to decide only on two parameters - lemma and word class (part of speech).

### 5. The Data

In the first step, we used data from and the Aranea TreeTagger pipelines, and subsequently merged into a single vertical file. Then, we converted the original MTE morphological tags to “PoS- only” tags and produced a frequency list of all lexical items indicated as OOV by both taggers. After deleting the unused parameters, the resulting lists contained the frequency, word form, lemma assigned by the CSTLemma and UDPipe taggers and PoS information derived from the tag assigned by TreeTagger (aTag, using the AUT notation). This decision has been motivated by an observation that TreeTagger is typically more successful in assigning morphological categories for unknown words than others.

As we naturally could expect to be able to process only the rather small part of the list, after some experimenting with various thresholds, we decided to pass into annotation only the most frequent items. This meant that each annotator would process approximately 1000 items.

The example of the source data (in alphabetical order, after applying the frequency cut-off) is shown in Table 1.

**Table 1**

Source Data

Freq	Word	aTag (TreeTagger)	uLemma (UDPipe)	uAtag (UDPipe)	CLemma (CSTLemma)
326	Росстата	Nn	Росстат	Nn	Росстат
116	Ростех	Nn	Ростех	Dt	Ростеха
182	Ростехнадзора	Nn	Ростехнадзор	Nn	Ростехнадзор
117	Ростова-на- Дону	Nn	Ростова-на- Дон	Nn	ростова-на- дон
202	Ростове-на- Дону	Nn	Ростове-на- Дон	Nn	ростове-на- дон
107	Ростове-на- Дону	Nn	ростов-на- дону	Nn	ростове-на- дон
156	Ростов-на- Дону	Nn	Ростов-на- Дон	Nn	ростов-на-дон
202	ротовую	Aj	ротовый	Aj	ротовый
105	роуминг	Nn	роуминг	Nn	роуминг
83	роуминга	Nn	роуминг	Nn	роуминг
176	роутер	Nn	роутер	Nn	роутер
104	РПЛ	Zz	РПЛ	Nn	рпльный
227	РСА	Nn	РСА	Nn	РС
287	РСО-Алания	Nn	РСО-Алания	Nn	РСО-Алания
114	рубцов	Nn	рубец	Nn	рубец
220	руд	Nn	руда	Nn	руд
95	руду	Nn	руда	Nn	руда
91	рулонных	Aj	рулонный	Aj	рулонный
99	румяной	Aj	румяный	Aj	румяный
87	РУСАДА	Nn	РУСАД	Nn	РУСАДА
145	РусГидро	Nn	РусГидро	Nn	русгидро
98	Руссель	Nn	Руссель	Nn	Руссель
83	ручках	Nn	ручка	Nn	ручка
212	ручном	Aj	ручной	Aj	ручный

We can observe several phenomena here. While most PoS categories are classified correctly, abbreviation are mostly tagged as “nouns”, but also as “determiners”, or even “punctuation”, and lemma form as well as its capitalization is sometimes guessed correctly, while sometimes not. The result of simple aggregation of the same data can be seen in Table 2.

The overall task for the annotators was to produce correct data for all lines in the table. To minimize the number of necessary keystrokes and to keep track of the changes, the data have been further modified to contain two newly added columns – Lemmb used as a template for correcting the value for Lemma (it is expected that most modifications will occur at the end of the respective string only) and bTag (to be filled only in case of wrong PoS assignment).

As has been already mentioned, each item (line of the table) has to be annotated by three independent annotators. We decided, however, not to split the data in a straightforward way, but to assign each alphabetical segment of the data to three annotators using a rule as follows: each group of four lines will be split into four tuples containing three lines with one missing line form the original group. Moreover, the whole lot of data has been split to three parts, so that each annotator could get three different sections of the alphabet in his or her data.

**Table 2**

Aggregated annotations, frequency counts discarded, a unique Id added.

Id	Word	Lemma	aTag
ru_003798	Росстата	Росстат	Nn
ru_003799	Ростех	Ростех Ростеха	Nn Dt
ru_003800	Ростехнадзора	Ростехнадзор	Nn
ru_003801	Ростова-на-Дону	Ростова-на- Дон ростова-на- дон	Nn
ru_003802	Ростове-на-Дону	Ростове-на- Дон ростове-на- дон	Nn
ru_003803	Ростове-на-Дону	ростов-на- дону ростове-на- дон	Nn
ru_003804	Ростов-на-Дону	Ростов-на- Дон ростов-на-дон	Nn
ru_003805	ротовую	ротовый	Aj
ru_003806	роуминг	роуминг	Nn
ru_003807	роуминга	роуминга	Nn
ru_003808	роутер	роутер	Nn
ru_003808	РПЛ	РПЛ рпльй	Zz Nn
ru_003810	РСА	РСА РС	Nn
ru_003811	РСО-Алания	РСО-Алания	Nn
ru_003812	рубцов	рубец	Nn
ru_003813	руд	руда руд	Nn
ru_003814	руд	руда	Nn
ru_003815	рулонных	рулонный	Aj
ru_003816	румяной	румяный	Aj
ru_003817	РУСАДА	РУСАД РУСАДА	Nn
ru_003818	РусГидро	РусГидро русгидро	Nn
ru_003819	Руссель	Руссель	Nn
ru_003820	ручках	ручка	Nn
ru_003821	ручном	ручной ручный	Aj

By applying this fairly “sophisticated” assignment scheme, we expected to improve the overall uniformity and quality of the output, as well as to prevent “collaboration” among students, as no two assigned lots were identical.

An excerpt of the data from Table 3 assigned to a single annotator is shown in Table 3.

**Table 3**

Data to Annotate

Id	Word	Lemma	Lemmb	bTag	aTag
ru_003797	Росстат	Росстат	Росстат		Nn
ru_003799	Ростех	Ростех Ростеха	Ростех Ростеха		Nn Dt
ru_003800	Ростехнадзора	Ростехнадзор	Ростехнадзор		Nn
ru_003801	Ростова-на- Дону	Ростова-на- Дон  ростова-на-дон	Ростова-на- Дон  ростова-на-дон		Nn

Id	Word	Lemma	Lemmb	bTag	aTag
ru_003803	Ростове-на-Дону	ростов-на-дону	ростов-на-дону		Nn
ru_003804	Ростов-на-Дону	Ростов-на-Дон	Ростов-на-Дон		Nn
ru_003805	ротовую	ротовый	ротовый		Aj
ru_003807	роуминга	роуминг	роуминг		Nn
ru_003808	роутер	роутер	роутер		Nn
ru_003809	РПЛ	РПЛ рпльй	РПЛ рпльй		Zz Nn
ru_003811	РСО-Алания	РСО-Алания	РСО-Алания		Nn
ru_003812	рубцов	рубец	рубец		Nn
ru_003813	руд	руда руд	руда руд		Nn
ru_003815	рулонных	рулонный	рулонный		Aj
ru_003816	румяной	румяный	румяный		Aj
ru_003817	РУСАДА	РУСАД РУСАДА	РУСАД РУСАДА		Nn
ru_003819	Руссель	Руссель	Руссель		Nn
ru_003820	ручках	ручка	ручка		Nn
ru_003821	ручном	ручной ручный	ручной ручный		Aj

Note that the “missing” every third Id results from the assignment scheme.

## 6. The Crowd Annotation

The split data has been uploaded as excel spreadsheets to a shared Google disk and assigned randomly to the respective annotators. The task has been assigned in the middle of the semester, after the students already got acquainted with the basic concepts of corpus morphosyntactic annotation and acquired the elementary querying skills. The instructions for annotating the data as they are presented in Table 3 were as follows.

- A Only Lemmb and bTag columns may be modified.
- B If both Lemma and aTag values are correct, nothing has to be done.
- C If aTag value is wrong, the correct value should be inserted in bTag.
- D If Lemma value is wrong, it should be corrected in Lemmb.
- E If the word form is obvious typo (missing or superfluous letter, exchanged letters), or the word does not contain the necessary diacritics, the correct lemma marked by an asterisk should entered in Lemmb.
- F If the correct word form cannot be reconstructed by simple editing operations, i.e., cannot be recognized (e.g., part of the word as a result of hyphenation), the value of bTag will be “Er” (error).
- G If the word form is obvious foreign word, the value of bTag will be “Yx”.
- H It is not necessary to evaluate whether the word form is “literary” - words of “lower” registers (such as slang) also have “correct” lemmas.

The annotators were also instructed to check all “non-obvious” items by querying the corpus and analyzing the respective contexts. The initial training was performed during one teaching lesson in a computer lab, so that possibly all frequent problems could be explained.



## 7. Linguistic aspects of Russian tagging

Obviously, recommendations for reannotation of OOV word forms should be not so much technical as linguistic. They should analyze not only typical obvious cases, but also problems. In this case, we should proceed from the following:

- - Russian grammar rules
- - considering tokenization rules when annotating a corpus
- - contexts of using this token in the corpus
- - frequency data on certain uses.

The development and description of such an instruction is a matter of the future and a topic for a separate article, here we give some problems that cause difficulties during annotation.

1. Foreign words should be processed depending on the context: if they appear as part of a foreign language expression (quotation), then the correct PoS tag is "Yx". However, if they are part of a Russian-language phrase, for example, in the meaning of a noun (usually these are proper nouns), then it is reasonable to mark them with the tag "Nn" (or other relevant part of speech).

2. Many languages and taggers have problems with abbreviations. We can say that they are difficult for grammar as such. Usually, abbreviations include words written in capital letters, however, there are many other options. For example. The abbreviation ВУЗ (high school) is widely spelled in small letters (вуз), which has actually become a noun. There are a large number of standardized and non-standardized abbreviations such as *д-р*, (*doctor*), *изд-во* (Publishing House) etc. Abbreviations like МХАТ, *НИИМау* are often inflected as nouns and in fact, they are, without losing the spelling in large letters. Some abbreviations have several standard lemmas (spellings), eg, КЗоТ, *КЗОТ*. (Labor Code, Labor Code).

3. It is desirable to include proper names in the morphological dictionary. The question arises, all or quite often used? So, if the dictionary contains the masculine name Давид, should the feminine name Давида be included with a different declension paradigm? Almost any adjective or common noun can occur as a surname. Should they be presented in the morphological dictionary as separate lexemes? Those common nouns in indirect cases, apparently, need to match two lemmas, for example, the word form Котов (surname) will receive a tag of a noun and two lemmas Котов|кот, or Юнг lemmas Юнг|юнга, the word form in genetiv case Серебряной (surname) gets lemmas Серебряная|серебряный and tags Nn | Aj.

4. The participles in MTE are carried out to the verb lemma (выделенный — выделить), but there are many cases when, along with the verbal lemma, an adjective lemma must also be indicated: *добавленная стоимость* - добавить|добавленный Vb|Aj.

## 8. First Results and Problems

The source data consisted of 5,040 producing 15,120 lines to annotate by 15 students. I.e., each of them had to process 1,008 lines. As only 14 files have been returned, the missing file has been reassigned to a student from a different group.

The resulting data has not been processed completely yet, but the first analysis looks promising – see table 4 and 5.

**Table 4**  
Results of Annotation

	Count	%
Source lines	5,040	100.00 %
Triple Agreement both on Lemma and PoS	4,202	83.37%
Double Agreement both on Lemma and PoS	649	12.88%
Triple Agreement on Lemma	4,448	88.25%
Double Agreement on Lemma	498	9.88%

**Table 5**  
Annotated Data PoS Distribution

PoS	Count	%
Nn	20043	73.86
Aj	5174	19.07
Pn	46	0.17
Nm	27	0.10
Vb	464	1.71
Av	261	0.96
Pp	8	0.03
Cj	10	0.04
Ij	42	0.15
Pt	24	0.09
Ab	185	0.68
Xy	1	0.00
Yx	490	1.81
Er	343	1.26
?	17	0.06
	27135	100.00

## 9. Conclusions and Further Work

There were several goals to be achieved by the annotation. Firstly, we would like to produce a validated list of most frequent neologisms to be included in the morphological lexicon; in this stage, we even do not expect to generate full paradigms for those lexical items. Secondly, we wanted to get the list of the most frequent typos and other types of errors that could also be used as a supplement to that lexicon, but also as source data for a future system for data normalization. And lastly, we also wanted to obtain a list of most frequent foreign lexical items appearing in Russian corpus data.

Although the detailed analysis of the annotated data is yet to be performed, some conclusions can be seen already. They can be summarized as follows:

(1) The Annotation Guidelines must be as precise as possible, showing not only the typical problems and their solutions, but also the seemingly “easy” cases. One-page instruction, as it was in our case, is definitely not sufficient.

(2) The most common errors were associated with the treatment of proper nouns. An automatic procedure based on frequencies of lower/uppercased word forms would most likely perform better.

(3) The other common issue was the proper form of lemma for adjectives (it should be masculine and nominative singular). As the morphology of the Russian adjectives is fairly regular, a procedure to fix it automatically would be feasible.

(4) One of the fairly frequent PoS ambiguity in our data was the “Nn”/“Yx” (noun/foreign) case. The manually annotated data, however, show that the real number of “foreign” is rather low, yet it introduces a lot of noise into the annotation process. It would therefore be reasonable to substitute all tags for “foreign” with that of “nouns” in the future annotation.

In the near future, besides the new round of a similar annotation effort with an improved setup, we would like to combine its results with those obtained in the framework of the ensemble tagging experiment.

## 10. Acknowledgment

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# **E-Governance**



# Digital Interaction Values and Platforms Design

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## Abstract

The article reveals the methodology for determining the values that should be taken into account when designing digital platforms that ensure interaction between the state and citizens. An online survey was conducted. Using the obtained data, a network of values is constructed and visualized, supplemented with digital qualities of personality and competence. Their correlations with the indicators of active and passive digital behavior of citizens are calculated. The article reveals the value determinants of the population's governability through the media and during the quarantine period, as well as the frequency of participation in electronic hearings on topical issues of the country's life. The obtained results provide empirical confirmation of the recursive three-element structure of value-oriented design. It is shown that taking into account the value qualities associated with the target result of IT technology allows you to significantly limit their number for use in VSD.

## Keywords

Digital values, value network, civic engagement, digital governability, value determinants, value sensitive design, recursivity

## 1. Introduction

Advances in computing, information and communication technology and the computerization of society have created and continue to generate vast amounts of diverse information and have made it possible to use it economically in a variety of areas of daily life. To take advantage of these benefits requires a digital transformation of "people, data, processes" and institutions across the social and/or organizational hierarchy.

In Russia, digital transformation turned into a practical plane when the Digital Economy of the Russian Federation program was adopted on July 28, 2017. Currently, it is developing in 7 areas. One of them is presented by the federal project "Digital Public Administration", which aims to provide citizens and organizations with access to public services and services in digital form, the development of e-government infrastructure, and the introduction of platform solutions. As expected in the Passport of the project, its implementation "will allow a final transition to electronic interaction of citizens and organizations with the state" and will make it "more convenient".

Key principles and design elements that should be taken into account when creating a digital government are discussed in the World Bank report [1]. Digital platforms are a necessary component in many of them. Let us draw attention to the principle of providing digital government services, including user-oriented service design. It "should reflect the needs of a wide range of citizens and not adapt everything to one template". Perspectives are seen "in individualized services with a high degree of personalization" [1, p. 12].

Let us distract from the "purely" technical or economic aspects of the digital government and look at it somewhat from the other side. The union of computer technologies and knowledge collected in the social sciences forms a new research direction - "Digital Socio-Humanities". In it, we highlight the

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problem of the influence of the socio-political nature of digital technologies on the governability of the public sphere.

As digitalization develops wide and deep, "the platform society" is approved and the "value - centric design" of the digital formats that implement it becomes relevant [2]. If previously the emphasis was placed on achieving the required functionality, then now a recommendation is added to it to take into account the values of the parties involved in the interaction. Taking this into account, the purpose of our publication is to identify the value component of digital interaction between the state and citizens in the context of value-oriented design.

## 2. Literature review

The importance of taking values into account in the interaction of the state and citizens is noted in many publications. Values are the "core of the most important guiding components of political activity", ideology, political culture, political system [3]. Traditionally common political and basic personal values are distinguished.

Political values include: Equality of Opportunity, Economic Individualism, Free Enterprise System [4]; Equal Opportunity, Limited Government, Traditional Family Values, Moral Tolerance [5]; Liberty, Equality, Economic Security, and Social Order [6]. This list is not exhaustive and other groupings can be cited. As an example of basic personal values, we give a list of S. Schwartz, which includes: Power, Achievement, Hedonism, Stimulation, Self-direction, Universalism, Benevolence, Tradition, Conformity, Security [7]. An overview of the work on the relationship between the values of citizens and political behavior is presented in article [8]. Its empirical part also confirms "the relationship between the basic values of [Russian] respondents and their voting preferences [in March 2012]".

Digitalization leads to a greater individualization of relations with citizens, so universal values are detailed to the level of personal traits. The list of their constituent groups and indicators is not constant and can be adapted to the specific problem being studied. Note that we are not aware of studies that reveal the inclusion of "digital" traits in the network of basic personality traits.

The limit case of "digital" individualization is achieved using recommender systems for targeted impact. There are known cases of their use for managing the choice of citizens based on "big" data (for example, [9]). Several publications are devoted to the description of this approach, including computer program [10], as well as recordings of the speech of the former head of the company who applied it [11]. The algorithm predicts the personal types of citizens and their political preferences, which allows you to form psychologically individualized messages in social networks or other forms of electronic interaction. It seemed that " government, internet provider... can infer their personal characteristics more accurately than their closest family members". As a result, there is a risk that "people might distrust or reject digital technologies" [12, p. 1039]. For its resolution, it has yet to be developed "a coherent set of legal, ethical and technical frameworks to regulate the collection, storage and exchange of such [big] data" [9, p. 14]. Given these limitations, our publication uses the detailing of universal values to the level of personal traits.

Digital platforms are a modern tool for implementing electronic interaction. Depending on the area of activity, "platform interactions" cover news and journalism (social media platforms), urban transport (ride - hailing platforms), healthcare ("integration of applications and technologies to provide a customized, end-to-end, Healthcare solution"; see <https://www.fingent.com/healthcare-application-platforms/>), education (online learning platform) and other areas. According to one of the definitions, "a digital platform is a system of algorithmized mutually beneficial relationships of a significant number of independent participants in the economy (or sphere of activity) carried out in a single information environment, leading to a reduction in transaction costs due to the use of a package of digital technologies for working with data..." [13].

The object of our work is electronic interaction between the state and citizens. One of the World Bank's 12 projections of the impact of the latest technologies notes that "more political parties will develop more of their policy and choose more of their candidates through dedicated digital platforms" [14]. Digitalization has led governments to incorporate citizens into their functioning. It realized by online service delivery platforms, open data portals, complaint redressal etc. Very important form of



digital platforms that involves citizens is Digital Citizen Engagement platforms which is «the use of new media/digital ICTs to create or enhance the communication channels» [15]. Russia has such platform called Active Citizen. This project was created as a means for conducting electronic voting on urban development issues among various groups of Muscovites. The Active Citizen platform now (29.05.2021) has 5110682 users, who have expressed 158315212 opinions and been invited to vote on nearly 4954 issues. Smaller systems are developing in other regions of the country. As an example of digital platforms created and introduced in Russia on a national scale, we will call the digital voting system with blockchain. In a single voting day of 2021, remote e-voting will be used in 7 regions.

Theoretical principles of connection between digital technologies and public administration were proposed in the works of L. V. Smorgunov [16] and D. Johnson [17]. The first of them gives "the political ontology of purely procedural fairness of blockchain technology, which relies ... on the technical and social immediacy of cooperation and joint production". In the second publication, digital platforms can act as "a dialogic forum" to increase civic participation, public discussion and democratic competition. Thus, the "danger of neglecting constitutional values" is reduced.

Formal ontologies are used to unify the representation of knowledge about the subject area. By definition, it is "a special type of semantic representations that can be defined as a model of observed reality, or as a hierarchical form of knowledge representations that reflects the structure of observed reality, or as a logical theory that allows you to systematize the categories of reality and / or the values..." [18]. The digital platform reference ontology is supposed to foster "a better understanding of digital platform functionality, better communication between stakeholders and eventually may facilitate future research and development of digital platforms" [19]. Proposed in this work (other materials are also available on the <http://model-a-platform.com> website) ontology generalizes knowledge in UML extension notation. It includes detailed diagrams of the elements of the digital platform (mainly commercial) and the connections between them. They are clearly technical and lack both a value component and such an important element of interaction as recursion [20].

Design techniques and human values are combined within an approach known as "value sensitive design" (VSD) [21]. Its feature is the integration "human values in technologies from the very start of the design process" [22]. Examples of applying VSD include such values as accountability, transparency, democracy and justice [23]. The peculiarity of our work is that it takes into account "digital" restrictions on social interactions and the values of the level of human traits.

We summarize the completed review. Values are an important element in the interaction of the state and citizens. Digital platforms are a modern tool for organizing such interactions. VSD enables values to be incorporated into digital platforms. Thus, it is initially necessary to identify a list of values that are important in a specific area of interaction. A further part of our publication is devoted to this.

### 3. Data and methodology

The work is based on empirical data on the relationship between the value traits of Russian citizens and their behavior in some situations of digital public administration and state governability. The parties to this connection form two main sections of the developed questionnaire. In the auxiliary third part ("hard data") socio-demographic information is collected (sex, age, level of education, income). The list of main indicators is given in Table 3. Let us explain the content and methodology of the first two sections in more detail.

In our study, the list of values is selected from the work [24]. They are expressed through 24 personality traits, which are combined into 4 groups (entrepreneurial (hereinafter - group 1), communicative (2), "a good person" traits ("personal"), (4) and collectivist (5)) of 6 elements each. Following the original methodology, correlations between indicators are first calculated, then they are visualized in the form of a network, finally, its quantitative characteristics are calculated and interpreted. This algorithm is used for reference qualities and self-evaluation.

Further, it is accepted by us as the basis for identifying and building links not only between values, but also their links with interesting indicators of digital public administration. So that the total number of indicators does not become too large and difficult for respondents to perceive, we limited ourselves to the four most important traits in each of the groups. The selection took into account the

experimental results of comparing the network of values of student in cities of federal significance of the Russian Federation.

**Table 3**

List of indicators and their abbreviated names

Indicator groups	Indicators and their designations
<b>Section I. Universal and digital values, digital competencies</b>	
Groups of universal values	<ul style="list-style-type: none"> <li>- entrepreneurial (group 1): Pragmatic; Successful; Purposeful; Leading;</li> <li>- communicative (group 2): flexible, slick, resourceful (Agile); understanding the needs of the other (Understanding); a good communicator (Communicator); "can inspire trust" (Prepossessing);</li> <li>- "a good person" (group 4): adequately assessing himself (Adequate); freedom-loving (FreedomLoving); open person (OpenPerson); Truthful;</li> <li>- collectivist (group 5): caring for others (Mindful); ready to provide assistance (ReadyHelp); professing team spirit (TeamSpirit); Benevolent</li> </ul>
Group of "digital" values	"digital" (group 3): "algorithmic" (Algorithmic); "datacentric" (DataCentric); "Innovative"; "cybermen" (CyberMan)
Digital competencies	information and data literacy (DataLiter); communication and collaboration in a network environment (Comm & Coll); information security (InfoSecur); general level of the respondent's computer skills (CompSkill)
<b>Section II. Impact of digitalization on public administration and governability</b>	
E-participation	passive (online public service, frequency of use of the services, Frequency); active (satisfaction with the completeness of information on the life of the country/city (SatisfInf); frequency e-participation in electronic hearings, (FreqEPart)
Governability of the population through the media	whose opinion (official/informal) dominates the decision of respondents on the following issues: when buying currency or keeping money in rubles (AdvMonSav); at selection or change of place of work (AdvChWork); when voting in elections (AdvVoting); the level of compliance of respondents with the official recommendation to stay at home and other self-restrictions during the COVID-19 "high readiness" period (ImpRecomm)
Opinions on the impact of digitalization on public administration	influence on the control of corruption (ImpCorrup); influence on the ability of the Government to manage resources effectively (ImpEffGov); the current level of development of digital feedback mechanisms from the population to the Russian government (DigtFeedb); influence on change in political governance (ChGvrnAbl)
<b>Section III. General information</b>	
Overview of Respondents (hard data)	age (RespAge); level of education (RespEducat); income (per month, RespIncom)

Taking into account the stated focus of our work, some changes were made to the list of values. A fifth group has been added to the original groups, reflecting "digital" traits (group 3). It includes 3 of 7 attributes of the "digital" culture [25]. Other indicators of this culture are universal, not necessarily "digital". Thus, "agility and flexibility" and "open culture" are already part of the communicative group and "a good person", and "collaboration" - in the model of "digital" competence (see below). The "customer centricity" excluded because business applications are not considered. For better understanding by respondents, the names of the three attributes included in the group and their

explanations are slightly changed. In addition, the "algorithmic" traits is added. Thus, the formed new group contains indicators that concentrate on its "digital" orientation. Their list is as follows:

- "algorithmic" ("step-by-step", if-then-otherwise" type thinking in solving problems");
- "datacentric" ("emphasis on the use of diverse data and analytics in decision-making");
- "cybermen" ("obsessed" with the study and application of new digital technologies);
- "innovative" (the predominance of risky, creative-destructive thinking). Unlike the previous three, this quality is less specialized in "digit".

The resulting list of personality qualities and their designations are given in the Table 3. Such a separation is made for greater clarity. To obtain quantitative values in the questionnaire, respondents were asked to present and evaluate on a scale from 0 to 5 a person who could "act as a positive standard in life or be closest to such a standard... for imitation" ("positive standard"). Then the procedure was repeated for a negative standard (that is, "a person whom the respondent did not want to resemble in any way") and in relation to himself ("I myself").

The first section of the questionnaire also contains questions about the "digital" competence of respondents. They are based on the Conceptual Reference Model DigComp 2.0 [26]. It includes 5 competencies, from which we selected the following: literacy in the field of information and data, communication and collaboration in a network environment, information security. The two remaining areas (digital content creation and problem solving) are priority components of digital competence. However, the relevant knowledge and skills are not yet widespread among the population and therefore are not included in the questionnaire. We limited ourselves to a simpler and more understandable assessment of the respondent's overall computer skills.

The second section of the questionnaire consists of three blocks of questions related to digital public administration and governability. Most of them are chosen in such a way as to include direct relations with citizens. In the first block, they act as passive consumers of various electronic public services and as active participants in electronic hearings on topical issues of state/city/district life. It determined the frequency of use/participation, satisfaction with the services provided and the completeness of the information provided. These issues reveal important components of e-government and "digital" participation. [27]

Another block contains questions related to the governability of the population through the media. It turned out whose opinion (official/informal) dominates when people make decisions in a number of life situations. In particular, when buying currency or saving funds in rubles, when choosing or changing a place of work, when voting in elections. A peculiar case for governability, which is also included in the questionnaire, was the degree of compliance by respondents with the official recommendation to be at home and other self-restrictions during the COVID-19 "high readiness" period.

Finally, in the third block, the opinion of respondents was found out about the impact of digitalization on public administration and governability. This includes questions about indicators from the World Bank list [28], such as control over corruption, the ability of the government to effectively manage resources, the current level of development of feedback mechanisms from the population to the Russian government. In addition, a particular interest was the influence on the change in political state governability.

The developed questionnaire was available online in May - June 2020; 153 people responded; the snowball technique was used. The average age of respondents was 30 years; 50.7% has a higher education diploma.

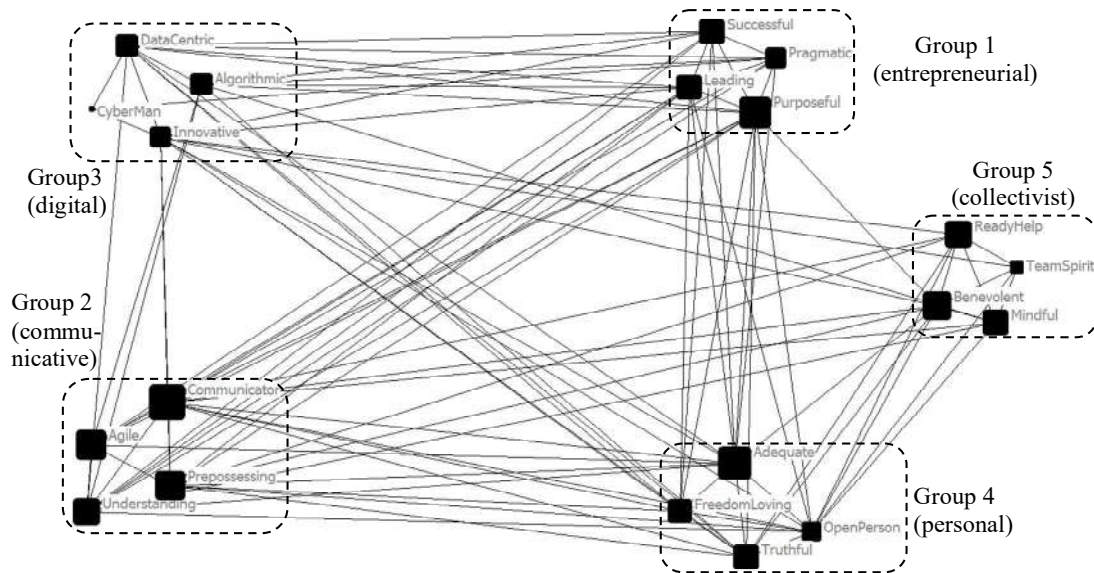
#### 4. Empirical results and discussion

The material in this section is divided into two parts. The first examines and compares value networks. In the second, their connections with public administration indicators are revealed. In both cases, a list of values is defined and discussed in the context of the possibility of their subsequent use in the VSD.

Figure 1 shows the value network for the case of a positive standard. The links correspond to correlation coefficients whose value modules exceed 0.5. The size of the nodes (black squares in the illustration) is proportional to the weight of the traits, that is, the average sum of the points they

scored in the respondents' questionnaires. According to the average values of each group, the groups are ranked in the following order (descending):

- communicative - 4.0;
- entrepreneurial and collectivist - 3.8 each;
- the qualities of "a good person" - 3.7;
- "digital" - 3.4.



**Figure 1:** Value network for positive standard

For the case of self-evaluation, the values of the group quality weights are noticeably smaller and the order changes:

- qualities of "a good person" and collectivist - 3.3 each;
- communicative - 3.1;
- entrepreneurial - 3.0;
- "digital" - 2.7.

As can be seen, in the case of self-evaluation, the total weight of qualities in groups is noticeably less than for a positive standard. A similar observation is true for bond densities. For a positive standard, it is almost 2 times higher than for self-evaluation: 0.542 versus 0.284. Table 1 and Table 1 show the densities within and between groups for the two cases considered. Indicators of "digital" qualities and qualities of "a good person" differ more (in difference between a positive standard and self-evaluation) from other groups, and entrepreneurial ones in the smallest. As for the first two, the "digit" is still being fixed in the structure of values, and is not easy for a "good person" to integrate into the current realities of life. Another thing is entrepreneurial. Here, the differences between the positive standard and self-evaluation, both within the group, and its connections with communicative and collectivist traits are practically absent.

**Table 1**

The density of links within / between groups for a positive standard

	Group 1	Group 2	Group 3	Group 4	Group 5
Group 1	1.000	0.750	0.688	0.688	0.063
Group 2	0.750	0.833	0.313	0.688	0.375
Group 3	0.688	0.313	0.667	0.500	0.250
Group 4	0.688	0.688	0.500	1.000	0.438
Group 5	0.063	0.375	0.250	0.438	1.000

**Table 2**

Density of links within / between groups for the case of self-evaluation

	Group 1	Group 2	Group 3	Group 4	Group 5
Group 1	1.000	0.813	0.125	0.250	0.063
Group 2	0.813	0.833	0.250	0.188	0.188
Group 3	0.125	0.250	0.333	0.063	0.000
Group 4	0.250	0.188	0.063	0.000	0.375
Group 5	0.063	0.188	0.000	0.375	0.667

The results obtained clarify the idea of values, which should first be taken into account. For our sample, they are ranked by weight in descending order as follows (first 5 for a positive standard): "Communicator" ("Good communicator"), "Adequate" ("Adequately evaluating himself"), "Purposeful", "Agile" ("Flexible, agile..."), "Prepossessing" ("can inspire trust"); the values of the remaining indicators quite closely follow the "leaders"; "digital" traits are in the lower third of the list. For self-evaluation, the indicators are different, and their values are less: "Freedom-loving", "Benevolent", "Ready to help", "Truthful", "Mindful" ("Caring for others"); 3 out of 4 "digital" values occupy places in the lower third of the ranked list, and "Algorithmic" - in its middle. It is not yet clear how to use additional information about the centrality of nodes in the value network in VSD (not given here). Knowing the list of ranked "universal" values is useful for customizing existing or creating new affordances of digital systems, regardless of their field of application. In our sample there are no indicators with a wide separation from the rest. Thus, a rather voluminous list of indicators is obtained, which makes it very difficult to take them into account in VSD.

Comparing the results for a positive benchmark and self-evaluation leads us to recursivity. The data for the positive standard "best show the value horizons" [24, p. 188). They "act as a kind of model of vision for themselves in the future, perhaps a projection of their future, that is, what they should strive for and what they should imitate". The observed significant discrepancy between the positive standard and self-evaluation complements the content of the recursive three-element structure of VSD in the sense that it is necessary to recursively take into account the possible "migration" of values during the operation of digital technologies.

A step in the development of value-oriented design in the development of specialized platforms for digital citizen engagement is the identification and consideration of values related to requirements, in addition to the main functionality, required for the digital system. Let us consider what has been said in relation to public administration with examples of increased public engagement in electronic discussions on a variety of important issues of public life and governability in specific situations. For this purpose, as mentioned above, questions were included in the questionnaire.

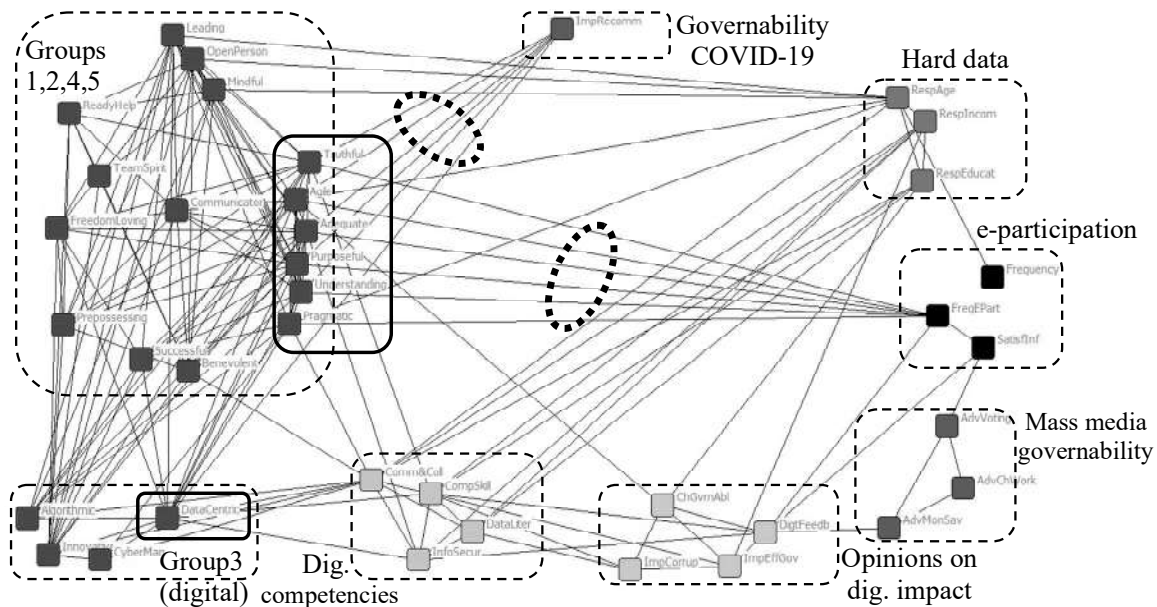
Nonzero for confidence probability +0.95 significant associations (modules of values of correlation coefficients) obtained after questionnaire processing are visualized in Figure 2 (for a positive standard). The following blocks are highlighted (outlined with a rectangular dotted border):

- groups of values:
  - 1, 2, 4, 5 (universal; "Group 1,2,4,5");
  - 3 (digital; "Group 3 (digital)");
- digital competencies ("Dig. competencies»);
- indicators of active / passive electronic participation ("e-participation");
- governability of the population through the media:
  - (1) in typical situations ("Mass media governability");
  - (2) governability of the population through the media in the context of COVID-19 ("Governability COVID-19");
- Socio-demographic data ("Hard data");
- respondents' opinions on the impact of digitalization on public administration ("Opinions on dig. impact»).

As expected, the age of the respondents is related to values, and their income and level of education - to digital competencies (all included in the Hard data block). It is also logical to link the indicators of digital competencies with some universal and "digital" values. In this respect, our results

are consistent with the existing practice of taking them into account in the design of many digital systems. Opinions on the impact of digitalization have proved useful only for descriptive information and are not considered further.

Let's pay attention to the part of the figure that is surrounded by a rectangular continuous frame. This area includes "boundary" values. They are of main interest in our work, since they are directly related to public administration indicators.



**Figure 2:** Linking values to governability and e-participation for positive standard

Let us turn to indicators of electronic participation. First, descriptive statistics about them are given, then their relationship with values is revealed. The values for the passive form are as follows (use of electronic public services): satisfaction with the services provided - 2.8 (close to the grading of the assessment "rather satisfied"); frequency of use - 1.3 (about "rarely"). None of the "passive" indicators is statistically significantly related to the values of the list we use. The values of the indicators of the active form of electronic participation are as follows: satisfaction (completeness of information on state/municipal sites) - 1.7 (the estimate lies between "rather not satisfied" and "uncertain attitude"); frequency of participation is 0.6 (between "never" and "very rarely"). The frequency of participation is inversely associated with the following value traits: entrepreneurial ("Pragmatic", "Purposeful"), communicative ("Understanding the needs of another...", "Agile..."), "qualities of a good person" ("Adequately assessing himself", "Truthful"). These links are highlighted by a dashed oval in the center of the figure. Thus, the initial list of 20 qualities, as in our study, is significantly narrowed. The obvious link between the frequency of participation and the completeness of the information was confirmed. For our respondents, the identified links should be taken into account in the value-sensitive design of digital platforms with an active form of electronic participation. The above qualities (with two highest gradations) are expressed in 73.3%, 71.7%, 69.3% of respondents who are respectively members of the communicative, "a good person" and entrepreneurial groups. That is, the digital platform becomes value-related with a significant audience of users.

Let's move on to the governability of the population through the media. As indicated above, in the questionnaire this issue was clarified for 4 situations: when buying currency, when choosing a job and voting in elections; a case of behavior of people during the "high readiness" period is separately highlighted. There is a high positive correlation between the first three situations. Voting in elections is connected with satisfaction with the completeness of the information provided and here people take into account official opinion to a greater extent compared to two other situations. In general, in the first three cases, there was no statistically significant association between the increase in the proportion of official information taken into account in decision-making and their value traits. It can

be assumed that the population has already developed a certain attitude towards external sources of information.

Separately from these three cases, there is an indicator of governability in the first months of the "covid" quarantine. Compliance by respondents with official recommendations is associated with 6 values. Five of them are similar in sign and direction to those identified for the frequency of active participation (all except "Pragmatic"). The sixth quality was the connection with "Datacentric" which is part of the group of "digital" values. This quality is important for 59.3% of respondents. Figuratively speaking, events in the spring of 2020 "reached the depths of the soul", when the importance of obtaining operational information was keenly felt. In this case, as in the previous case, we can talk about a significant reduction number of values for their inclusion in VSD.

## 5. Conclusion

Thus, the following main results are obtained in the work:

- The content of the recursive three-element structure of VSD is supplemented by a recommendation on the need to take into account the possible shift of values to a positive standard during the operation of the designed digital technologies. It is based on the revealed difference between the positive standard and self-evaluation.
- The VSD approach is supplemented by a provision on the importance of taking into account the values associated with the target result of IT technology; the methodology implementing it is proposed and disclosed on specific cases.
- An empirical sociological study of electronic participation of the population and governability through the media was conducted. It is shown that the implementation of our methodology allows to significantly limit the number of values for accounting in VSD.

The results of the work allow us to propose some areas of further research. So, the question arises what and how values are taken into account in existing digital platforms; are they set initially in the engineering specification or implemented "by default", as a property of used information technologies (for example, blockchain). The next step is to develop recursive algorithms to give digital platforms the desired values with the ability to adapt in the process of functioning to changes in their severity, composition and random effects. Finally, the ultimate case of taking into account values is their use in recommender systems. It is still restrained by ethical and legal restrictions on the use of personal data.

## 6. Acknowledgements

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# Interaction of Authorities and Civil Society in the Context of Information and Communication Technologies` Development (on the Example of the Yaroslavl Region)

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## Abstract

The article presents the results of an expert survey, which is devoted to the attitude of representatives of regional and local authorities to various forms of online and offline civic activity and non-profit organizations in the Yaroslavl region. The experts of the survey, conducted in early 2021, were representatives of regional and local authorities, social institutions. Based on the concepts of public administration, the article focuses on participation, the interaction of the government and NGOs, public associations, the perception and assessment of civic activity, the role of the Internet in governance, as well as the attitude to online forms of activity.

Representatives of the government of the Yaroslavl region continue to maintain relations of cooperation with the non-profit sector, forming a clearer understanding of purposeful interaction with it. The authorities see the benefits of interacting with NGOs and express a fairly high level of trust in NGOs. The most common forms of civic activity are volunteering and volunteering, letters and appeals to the authorities, and civic activity on the Internet. At the same time, "grassroots" civic activity significantly decreased its indicators relative to the level of development and popularity in comparison with institutional forms. According to experts, online activity also declined in 2020, after a three-year trend of its growth. At the same time, the authorities do not perceive civic activity on the Internet as a manifestation of "full-fledged" activity. However, it affects the work of government and administration, contributing to the development of "e-government" procedures.

## Keywords

Internet, communication, authorities, civic activity, NGO

## 1. Introduction

Public administration in modern Russian society is carried out with the involvement of the forces and resources of the non-profit sector, and is also focused on building constructive relations with various forms of civic activity. However, the specifics of the interaction between the state and society aimed at creating public goods depend on many factors, including the level of established relations and building partnerships with representatives of civil society.

Public administration is entirely based on the institution of power, which extends its influence to the entire society and determines the state-power competence on the legal basis of interaction between state bodies and public institutions of society. Under these conditions, public administration exerts not only an administrative coercive influence, but above all a powerful creative, professional, resource, informational and stimulating influence on the consciousness, behavior and activities of people in various spheres of society [1, p. 41].

Of fundamental importance in this aspect is the nature of the relationship between the government and NGOs, as well as citizens. The legislation establishes a number of formats of civic activity as a

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mechanisms of interaction between the government and citizens (and not only as ability of citizens to independently solve existing socially significant problems). One of these formats is an NGO, as a form of citizens' association which can interact quite effectively with the authorities.

At the same time, there is a transformation in the nature of the interaction between the government and citizens under the influence of two factors. One of them is the development of information and communication technologies. It has been observed for a long time, has a significant impact. This factor has already significantly changed the relationship between the government and society. It will continue to affect them.

The second factor is relatively new. This is the COVID-19 pandemic. Its influence is only being comprehended. However, in its significance, it can only be not much less than the influence of the first factor. It is important to note that the development of ICT has made it possible to experience the COVID-19 pandemic less painfully. On the other hand, the COVID-19 pandemic has significantly accelerated the introduction of ICTs into the formats of interaction between government and society.

In this regard, the purpose of this study was to identify the conditions for interaction between government authorities and civil society institutions (on the example of NGOs and civic activity) in the context of the development of information and communication technologies. Therefore, the paper was based on the following logic: at the beginning, the general theoretical framework of the study is given, then the methods of collecting empirical data, the characteristics of the relationship between the government and NGOs, the forms of civil activity, the impact of the COVID-19 pandemic on civil activity, and then the characteristics of the impact of the Internet on the dialogue between the population and the authorities are given. At the end of the paper, the conclusions of the study are formulated.

## 2. Theoretical framework

The effectiveness of government decisions and their implementation are the criteria for evaluating public administration. The system of public administration carries out a regulatory action, while here there is both an external managerial influence of the state apparatus (actor) and self-government of the social system (object), whether it is a separate group, or society as a whole [2, p. 5].

There are many modern approaches to understanding public administration. G. V. Atamanchuk interprets public administration through the practical, organizing and regulating influence of the state (through the system of its structures) on public and private life activities of people for its ordering, preservation or transformation [3, p. 32-33]. At the same time, the mainstay is the "power force" of the state. E. V. Okhotsky complements it with the characteristic of the purposefulness of this organizing and regulating influence on social processes, consciousness, behavior and activity of people [4, p. 120]. The key role is the "organizing and regulating influence" of the State. State regulation is defined as a system of cooperation between different structures (public, private, public) to meet public interests and problems, where the state acts as a partner.

The interaction of government and society, which is carried out through state and public institutions, is a reflection of the models and practices of governance implemented in the state. Effective state and municipal governance today is impossible without broad public support [5, p. 70]. Combining, state, municipal, non-profit and private organizations are a system for ensuring and satisfying public interests, the production of public goods.

Manifestations of self-organization of citizens allow us to talk about the practices of civic activity and its forms: institutional (non-profit organizations) and non-institutional ("grassroots" activism). Often, researchers consider the activities of NGOs and their development as a factor in improving public administration, where state support for NGOs encourages the participation of citizens in the management of society, increases the level of trust in the authorities and legitimizes their management activities. However, according to the researcher R. Hasmatha and his colleagues, the regulation of NGOs is a strategy of the state to have a (corporatist) mechanism that feeds directly into the "grassroots civic space" [6, p. 271].

Within the framework of public administration, there are institutionalized and non-institutionalized dialogues between the state and society. Their development is connected with the modern understanding of governance, which, in contrast to the traditional top-down government leadership, tends to the interaction of power institutions with public ones, to cooperation with self-regulating networks.

However, interaction with networks on the one hand can have a negative impact on the ability of the state to manage, and on the other-to increase efficiency by cooperating in the implementation of policies [7, 133]. L.I. Nikovskaya points to the results of a study of municipal public policy, taken in the context of the network approach, which showed that the growing importance of horizontal networks significantly strengthens the functions of administrative structures in the field of organizing and coordinating the interaction of various networks: they become key actors of network policy and management, while replacing traditional administration with coordination methods and practices of smart, flexible co-management [8, p. 187].

It can be noted that if the authorities use Internet tools mainly to inform citizens, then as the researchers note, civil society activists, in addition to informing, actively seek to organize the mobilization of activists and communication between them [9]. In this regard, such forms of online activity as signing online petitions, discussing socially significant issues on various digital platforms, communicating and supporting each other (opinions, judgments) in social networks are developing.

At the same time, it is important to agree with the classic of Internet research – Yevgeny Morozov, who noted that not every online action is a real civic activity with corresponding actions [10]. His conclusion was confirmed relatively recently by K. Haenschen, who conducted an experiment [11]. He created a Facebook community to protect the historic fountain in Koppingen. More than 27 000 people have joined this community. At the same time, it is important to note that the fountain in reality was not threatened, but in practice, none of the community members took any action offline, and did not even check the accuracy of the information about the demolition of the fountain.

A similar position is demonstrated by Delia Dumitrica and Mylynn Felt. They note that civil society activists are more focused on online actions, expecting them to have a significantly greater effect than they can actually give [12]. At the same time, the Internet can be actively used as a medium for manipulation and misinformation [13].

At the same time, this orientation of civil society activists forces the authorities to become more public, to take steps to create online mechanisms for involving citizens in the process of discussion and decision-making [14].

As a result, the roles of the state and society in public administration and political decision-making are updated, and new repertoires of actions are assigned to them in different societies. Public administration is the interaction of state and non-state structures to meet the interests of society, to find solutions to protect society from various threats. In public administration, "the relationship between the operational, administrative and political subsystems of public administration is traced" [15, p. 105]. They demonstrate different guidelines and decision-making mechanisms, different ideas about management technologies, norms, and alternatives. As G. L. Kupryashin notes, we see power formations (related to the current political regime), technologies and management tools, as well as the results of interactions, negotiations and conflicts of interest groups, coalitions, and power institutions.

The modern management idea of "service value management" is aimed at increasing the participation of citizens and other stakeholders and improving this interaction. According to G.V. Pushkareva, the risks of "failure of public values" in our country are unusually high due to the obvious dominance of the state in the public sphere and the fragmentation of civic activists who have clearly insufficient experience in conducting discussions with an experienced player in the space of political communication [16, p. 320]. Nevertheless, the management of social processes is moving to the rank of the concepts of "co-management" and "complicity" [17, p. 78], where NGOs, public initiatives, stakeholders and the government jointly create a management system.

According to the theory of social exchange, civic participation is an exchange between state institutions and individuals [18]. The citizen here acts not only as a provider of resources, offering physical actions, personal pinions, and / or trust to the government to create public value, but also as a recipient of resources [19]. The built system of mutually beneficial conditions for cooperation, co-management. Their compliance becomes important for maintaining the balance and maintaining these relationships within the framework of state-managed processes. Defining the rules and boundaries of intersectoral interaction, and a common understanding of joint action requires the willingness of both parties.

Modern society dictates the conditions for the total value of information and numbers, which transform both civil participation and public administration. The widespread use of information technology has significantly changed and continues to change the functioning of democratic

institutions. The use of the Internet for the implementation of forms of civic activity is connected with the concept of "electronic participation". A.Chugunov defines it "as a set of methods and tools that provide electronic interaction between citizens and authorities in order to take into account the opinions of citizens in state and municipal administration when making political and managerial decisions" [20].

E-participation helps to increase the effectiveness of public organizations, to create social value, contributing to the establishment of democratic governance, as well as to increase the satisfaction of citizens, the expansion of their opportunities and personal benefits [21]. A.D. Trachtenberg points to the symbolic significance and effectiveness of information technologies, and therefore their implementation is necessary for those structures that strive to have the status of effective and modern. This applies to public authorities that constantly need to legitimize their right to manage and control [22, p. 163].

The involvement of NGOs and civil society activists in the practices of "e-government" is the desire of the authorities to increase the opportunities for citizens to participate in government and take into account their opinions, as well as to improve the administrative procedures of public administration. However, e-participation of citizens depends largely on the political system and the norms and culture of participation that have developed in it. The increasing measures of regulation of civic activity on the Internet, the specifics of the development of civil society, as well as the new conditions of the coronavirus pandemic and their consequences set additional rules for the interaction of the state with the non-profit sector online and offline. Thus, information and communication technologies and digital technologies of e-participation are the infrastructure that promotes civic activity and interaction with the authorities. At the same time, the institutional, organizational, and legal conditions that affect the nature of management are important.

### 3. Methods

In January-February 2021, an expert survey was conducted on the topic "Civil society and the activities of non-profit organizations (public associations) in the Yaroslavl region through the eyes of representatives of regional and local authorities". A total of 101 experts-representatives of regional and local authorities (42 participants were representatives of regional executive authorities, 59-representatives of municipal authorities).

Data collection was organized according to the following procedure. A letter was sent to the state authorities of the Yaroslavl region and local self-government bodies of the Yaroslavl region with a request to participate in the study with an attached questionnaire. The sample of the study included questionnaires received from these bodies and fulfilled the criteria of filling in and representation of the bodies.

The purpose of the study: to determine the attitude of officials of the Yaroslavl region to various manifestations of civic activity and non-profit organizations in the context of the development of information and communication technologies.

The tasks of the expert survey were:

- to identify the characteristics of the current state of civil society;
- to determine the attitude of the government to the non-profit sector and the expert assessment of various forms of interaction between the government and non-profit organizations;
- to identify the value judgments of civil and municipal employees about various forms of civic activity;
- to determine the attitude of local and regional officials to the Internet as a mechanism for the development of civil society and intersectoral interaction.

The survey of experts was conducted using a semi-formal questionnaire and correspondence written data collection. The experts filled out the questionnaires received by e-mail on their own. Statistical data analysis in the SPSS software product was used to process the survey results.

The method of independent characteristics used made it possible to process the collected data in such a way that each described phenomenon received a generalized assessment based on the collected different opinions of independent experts. Within the framework of the study, three stages were implemented. The first stage was to identify and correlate the opinions of experts, the second-to process

the collected data using statistical procedures to determine the positions of experts, the third-to formulate conclusions.

The data obtained in the course of the study characterize the relations and phenomena that took place in 2020. The results obtained in this study were compared with the results of similar studies in previous years.

#### **4. The attitude of the authorities to NGOs, the nature of their relations: trust and practice of cooperation**

The results of the study show that in 2020, the focus on cooperation between government authorities and NGOs and public associations in the Yaroslavl region has not weakened at all. The task of the management to interact with representatives of the third sector is assigned to 89% of experts-representatives of government bodies (almost equally regional and municipal).

Despite the apparent immutability of the government's approach to this issue, in 2020 there was a qualitative transformation of the semantic content of the concepts of "cooperation": from a vague - "in all areas of work" to a clear designation of "individual areas of work". In 2019, only 41.9% of experts had clear boundaries, algorithms and areas of work with the non-profit sector, in 2021 they were 56.4%.

This may indicate a growing understanding of the authorities, especially at the regional level, of the role and practical benefits of non-profit organizations as a tool for improving management efficiency and quality of life.

In 2020, 87.1% of officials at various levels actually interacted with non-profit organizations and public associations (no more than 3% of changes during the year). According to the already established tradition, it was more often done by representatives of the regional authorities, somewhat less often – by the municipal authorities.

Despite the fact that the number of officials involved in the process of interaction with the non-profit sector remained virtually unchanged during the year, there was a decrease in its intensity. If in 2019, 51.4% of government representatives "constantly" and "often" communicated with public activists, then in 2020, 41.6% already did. It can be assumed that the reason is related to the consequences of the spread of coronavirus infection in the region and the country as a whole. Within a few months of the transition to self-isolation, many organizations, including government agencies and non-profit organizations, either stopped or restricted their activities. Taking into account the scale of the consequences of the pandemic, the frequency of contacts between the authorities and civic activists in the Yaroslavl region observed in 2020 can be considered an achievement.

As a year ago, today the absolute majority of experts-representatives of the authorities believe and see real and concrete benefits and benefits for their body/institution from interaction with non-profit and public organizations (97.0% and 84.0%, respectively). This point of view is equally common among representatives of the regional authorities and among the local authorities.

Moreover, 89.2% consider the activities of non-profit organizations useful and effective for society as a whole. Among them, 24.8% of experts are firmly convinced of this and 64.4% are not so unambiguous on this issue, but they do not deny the fact of the positive impact of the non-profit sector on the development of society.

In general, 87.9% of experts said about trust in non-profit organizations and public associations in January 2021 (21.2% "trust" and 66.7% "rather trust"), which is 5.4% less than the value of 2020. The recorded decrease in the level of trust of officials to non-profit organizations was the "flow" of some experts from the group "rather trusting" to the group "rather not trusting". It is noteworthy that the representatives of local authorities spoke more often about the trust in non-profit organizations, as well as about their undoubtedly high importance for society.

The results of the latest expert survey confirmed the earlier conclusion that the indicator of trust in civic activists depends on the intensity of their communication and on personal beliefs about the level of professionalism of the heads of non-profit organizations.

At the beginning of 2021, 81.2% of government experts considered the heads of non-profit organizations to be experts in the field of their direct activities. This is higher than the value of a year ago by 3.9%. This fact is probably the reason that during the 2021 survey, there was not a single expert who felt absolute distrust of civic activists.

Representatives of regional and local authorities have different approaches to the issue of subjective assessment of professionalism of non-profit and public organizations. The latter are a little more critical in their judgments on this issue, but they also perceive the work of non-profit organizations and their practical significance for society more positively.

In general, the responses of experts over the past few years state that there is a pattern between general value judgments about the role and significance of non-profit organizations and the level of the official: representatives of the municipal government are somewhat more positive when answering the question about the meaning, role, general usefulness, trust in non-profit organizations.

## 5. Forms of civic activity

The events of 2020, according to representatives of regional and local authorities, contributed to the development of key forms of civic activity in the Yaroslavl region. Thus, the average expert assessment of volunteerism at the end of 2020 was 6.49 points (on a scale from 1 to 10, where 1 is practically absent, 10 is maximum development). It is important to note that almost every year there is a positive trend in this indicator. As a result, it has increased by 2.29 points since 2013.

The same pattern is observed in the dynamics of the assessment of the development of charity in the region: an increase in the average assessment of experts. The index increased from 4.3 points in 2013 to 5.66 in 2020. At the same time, it should be noted that there is no unidirectional trend for this indicator: in some years, there was a significant decrease in expert assessments.

The positive dynamics of the development of the institute of public control is noted. The index increased from 3.7 points in 2013 to 5.67 in 2020. Every year, there is a slight positive trend.

In 2021, for the first time, experts were asked to assess the level of development in the Yaroslavl region of one of the mechanisms for involving the population in the implementation of local self – government - territorial public self-government (TPSG). As a result, the institute of TPSG is the least developed today among the key forms of civic activity in the Yaroslavl region. At the end of 2020, the average expert assessment of its development was 5.10 points.

Based on the personal observations of experts, in 2020, a whole range of forms of civic activity was used in the region. As in 2019, in 2020, the most common were volunteering and volunteering (71.3%), letters and appeals to the authorities (58.4%), and civic activity on the Internet (46.5%). At the same time, 2020, according to experts, has its own exceptional specifics in the choice of forms of civic activity. First, in connection with the pandemic, residents of the region have become less likely to participate in the activities of public organizations, in the life of their home and entrance. Secondly, the popularity of volunteerism, volunteerism and charity has increased among the population in the region. Third, residents of the region have become noticeably more likely to participate in public actions of political parties (movements) and to show civic activity on the Internet.

Over the past year, non-institutionalized ("grassroots") civic activity has significantly lost its development and popularity. This is evidenced by the dynamics of experts' responses to the relevant question. With a slight increase in the number of experts claiming the superiority of the development of "grassroots activity" (from 6.7% in January 2020 to 11.9% in January 2021, plus 5.2 %) by 5.9 % - from 32.7% to 38.6% - there are more experts who are confident that the "grassroots" activity is lagging behind the institutionalized one. The share of experts confident in the absence of differences in their development decreased by another 12.9 % from 38.5% to 25.7%.

At the moment, local authorities working directly on the ground with citizens, significantly higher estimate the development of "grassroots" civic activity than officials at the regional level.

According to the expert survey, the 2020 pandemic has made its own adjustments not only to the development of the main mechanisms of civic activity in the region, but also to their relevance.

In the Yaroslavl region, after a three-year increase in the popularity of civic online activity (2017-2019), in 2020, there was a "cooling" to this kind of expression of their civic position. Over the past year, the interest of residents of the region to participate in the activities of unregistered associations of citizens has also decreased. While the activities of registered non-profit organizations in 2020, on the contrary, intensified.

Experts are unanimous in the opinion that the authorities at various levels are making attempts to regulate civic activity in the Yaroslavl region (96.9%). According to their assurances, these attempts in

most cases are reduced to measures to monitor civic activity in the online environment (62.2%) and to build a clear interaction with non-profit organizations and civic activists (17.3%). Less often, experts understood the regulation of public activity as various restrictive measures and censorship (media and social network sites). The practice of regulating civic activity through intervention and influence is mostly used by regional authorities and, as already noted, is quite rare.

## **6. Impact of the COVID-19 pandemic on civic activity in the Yaroslavl region**

The coronavirus pandemic has affected literally all aspects of the usual life of citizens around the world — from everyday life to the socio-economic and socio-political spheres. Civic activism was no exception, and the consequences of the pandemic have led to some positive changes in it.

In particular, most experts agree that the coronavirus infection contributed to the activation of volunteer activities in the region (79.2%) and the growth of the popularity of online services among civic activists (51.5%). Every third participant of the survey shares the opinion about the positive impact of the pandemic on the volume of charitable assistance in the region (31.7%) and the content of the work of non-profit organizations and civic activists (35.6%).

Every tenth expert - 9.9% and 10.9%, respectively-spoke about the transition of civic activity to the protest channel and the growing demands of the non-profit sector on the state. At the same time, the increased pretension of civic activists during the pandemic was actually exclusively spoken by representatives of regional authorities.

With positive changes, the pandemic brought new challenges to the "life" of non-profit organizations and public associations, which not all of them were able to cope with on their own. Almost every fourth expert-representative of the government reported that in his practice over the past year, there were cases of appeals from civic activists in connection with problems/difficulties caused by the spread of COVID-19 (22.2%). At the same time, most civil society activists and representatives of non-profit organizations preferred to apply to regional authorities for help in the pandemic, rather than to municipal ones.

In general, speaking about the role of non-profit organizations and civil society activists in solving the problems and difficulties caused by COVID-19, 52.2% of experts noted their unconditional usefulness, 4.4% spoke about the positive and negative result of their work, 1.1% - only about the negative.

41.1% of experts did not notice the contribution of regional non-profit organizations to solving social problems during the pandemic. This view is particularly widespread among representatives of local authorities.

## **7. The role of the Internet in the development of civil society and dialogue between the population and the authorities**

Among regional and local officials, there is growing skepticism about the actions of citizens on the Internet. This trend is observed against the background of a general decline in the popularity of the Internet's opportunities for expressing a civic position.

According to the results of the 2021 survey, 72.7% of experts perceive the actions of citizens on the Internet as "partial" civic activity (in 2020, there were 63.2% of them). 22.2% of survey participants – government representatives don't see any difference between civic activity in the offline and online environment for (in 2020 - 31.1%).

The number of those who do not accept the online activists and their practice in the Internet as a self-sufficient form of manifestation of civic activity during the year remained stable at 5.1%. This view is shared only by municipal officials.

Despite the refusal of many government officials to perceive the expression of civic position on the Internet as a manifestation of "full-fledged" civic activity, it affects the work of most of them (80.2%).

Based on the responses of experts, today this influence is expressed in the concentration of efforts on creating services for working online (51.8%), working with citizens' appeals – accelerating the "reaction" of the authorities to them (51.8%) and interviewing documents (36.5%). Interestingly, online



activity affects the work of regional and local authorities in different ways: the first gives an advantage to the creation of services for working online, the second-the speed of processing citizens' requests.

Only 1.0% of experts are fully confident that this type of civic activity has not affected the work of the authorities in any way.

Most of representatives of regional and local authorities are active Internet users (99.0%). They use it as part of their professional activities to search for reference information and work with e-mail, as well as for studying and just having fun.

This fact allows us to conclude that the authorities are well aware of the possibilities and potential threats of the Internet.

In 2020, the attitude of government representatives to Internet services has not changed, despite their growing popularity during the period of self-isolation. As a year ago, today 20.8% of experts tend to treat them with special respect, 73.3% note their convenience, on the one hand, and the limited use, on the other hand.

Among regional and local officials, there is still an urgent trend to strengthen the positive image of the Internet as a means of simple and accessible means of communication "power-citizen", "power - power", "power – other sectors of society".

They highly appreciate its role in the process of increasing the availability of state and municipal services for citizens and legal entities, simplifying interdepartmental interaction in solving problematic issues of citizens and other civil society actors, improving the effectiveness of the information policy of state and municipal authorities, interaction with citizens and non-profit organizations.

**Table 1**

Distribution of expert responses to the question: "Evaluate your degree of agreement with the following statements regarding the impact of the development of the Internet on the work of state and municipal authorities on a 10-point scale (1-the minimum degree of agreement, 10 – the maximum)?»

Head 1	Average score in 2018	Average score in 2019	Average score in 2020	Average score in 2021
The development of the Internet makes state and municipal services more accessible to citizens and legal entities, including NGOs	8,66	8,02	8,10	8,54
The development of the Internet simplifies interdepartmental interaction in solving problematic issues of citizens and other civil society actors	8,53	7,39	7,94	8,17
The development of the Internet increases the effectiveness of the information policy of state and municipal authorities	8,73	8,09	8,39	8,26
The development of the Internet makes it more difficult for the authorities to transmit the values necessary for the state to civil society	3,85	3,97	3,94	4,09
The development of the Internet makes such traditional "intermediaries" in the interaction of the government and civil society as NGOs in little demand	4,19	4,30	3,80	3,91
The development of the Internet makes it easier for authorities to interact with citizens and NGOs	-	-	-	7,51
The development of the Internet does not change the activities of the authorities in interacting with citizens and NGOs	-	-	-	3,57

Against this background, the general level of concern among government officials about potential Internet threats to society and the country, as well as personal security, is decreasing.

**Table 2**

Distribution of expert responses to the question: "How do you assess your degree of agreement with the following statements about the role of the Internet in the life of modern Russian society on a 10-point scale (1-the minimum degree of agreement, 10 – the maximum)?»

Head 1	Average score in 2018	Average score in 2019	Average score in 2020	Average score in 2021
The Internet is a threat to family values	4,91	5,26	4,98	4,71
The Internet gives great opportunities for self-realization	7,51	7,17	6,84	7,77
The Internet is a threat to political stability in the country	4,00	4,74	4,84	4,69
The Internet-expands the opportunities of citizens to participate in the affairs of the state	6,90	6,33	6,57	7,19
The Internet is used by foreign countries against Russia	4,61	5,66	5,23	4,84
The Internet significantly increases the number of suicides	3,78	5,09	4,93	4,12

The officials' view on the introduction of Internet censorship is also gradually softening, and the number of supporters of a selective approach to the regulation of Internet information is growing. As of January 2021, their share was 68.3%.

## 8. Conclusion

The results of the study demonstrate that the representatives of the Yaroslavl region authorities still maintain relations of cooperation with the non-profit sector. The transformation of their interactions is associated with changes in the government's vision of algorithms for working with NGOs - through the definition of more specific tasks and areas of work with organizations. The identification and establishment of clearer ideas about cooperation and, consequently, the transition to the implementation of targeted interaction are presented as a positive trend for improving and effective management.

The impact of the pandemic could hardly have been reflected in the practice of cooperation between the government and the non-profit sector. Despite the fact that the frequency of interactions between officials and representatives of public organizations has actually decreased, it is worth noting that the involvement and communication with activists has remained at a fairly high level.

The authorities see the benefits of interacting with NGOs both for their body/institution and for society as a whole. This fact demonstrates that the government recognizes the existence of a result from the activities of the non-profit sector, a sufficient level of professionalism to create a public good, as well as to improve public administration in general. Thus, the government's trust in non-profit organizations in the region in 2021 is estimated at a fairly high level. It was revealed that the trust of the authorities is formed in the sum of the frequency of personal interaction with representatives of non-profit organizations, as well as on the ideas about their professional competencies. The practices of officials working with civil society activists consolidated the positive experience and its results in such a way that among the respondents there were no those who completely distrust NGOs (for the first time in 10 years of the survey). It can be stated that in general, the region has a favorable attitude towards NGOs and their role. It is noted that the municipal authorities at the same time more positively assess the benefits of the activities of non-profit organizations, as well as express higher values of trust in them.

The events of 2020, according to representatives of regional and local authorities, contributed to the development of key forms of civic activity in the Yaroslavl region – volunteerism and charity. A little better than in 2019, the tool of public control proved itself. The institute of TPSG is noted as the least developed among the key forms of civic activity.

The most common forms of civic activity were volunteering and volunteering, letters and appeals to the authorities, and civic activity on the Internet. At the same time, in 2020, it was noted that citizens distanced themselves from participating in the activities of public organizations and in solving the problems of their place of residence – at home and at the entrance. However, citizens more often empathized with those in need of help and performed acts of charity through participation in volunteerism, volunteerism and charity. The exclusivity of 2020 was manifested in the increased participation of citizens in public actions of political parties (movements) and the desire to show civic activity on the Internet. This may be due to the general level of increased social tension and protest.

However, representatives of regional and local authorities noted that "grassroots" civic activity significantly decreased its indicators regarding the level of development and popularity in comparison with institutional forms. At the same time, local authorities that directly work with citizens on the ground, significantly higher estimate the development of "grassroots" civic activity than officials at the regional level.

Experts' assessments of the popularity of civic online activity also became a feature of 2020. After a three-year continuing trend of its growth in 2020, the authorities assessed the declining level of expression of civic position in this way by the residents of the region. At the same time, the interest of citizens to participate in the activities of unregistered associations of citizens has decreased. While the activities of registered non-profit organizations in 2020, on the contrary, intensified.

Among regional and local officials, there is growing skepticism about the actions of citizens on the Internet. This trend is observed against the background of a general decline in the popularity of the Internet's opportunities for expressing a civic position. The results of the 2021 survey suggest that experts assess Internet activity as only a partial manifestation of civic activity. In fact, representatives of only municipal authorities do not accept online activity as full-fledged.

At the same time, the development of civic activity on the Internet, as experts point out, affects the work of authorities and management. However, according to the responses, this influence is associated with the development and improvement of the administrative procedures of "e-government".

The regulation of civic activity in the Yaroslavl region, the presence of which was agreed by almost 97% of experts, is implemented by monitoring civic activity in the online environment and building a clear interaction with non-profit organizations and public figures. Less often, experts understood the regulation of public activity as various restrictive measures and censorship (media and social network sites). Thus, it is noted that the online environment is becoming the main source of information about civic activity and a monitoring tool for the authorities. Experts assess the regulatory function as the absence of direct intervention, its implementation through observation and clear interaction.

In general, regional and local officials express a positive attitude to the possibilities of the Internet as a tool for increasing the availability of state and municipal services for citizens and legal entities, simplifying interdepartmental interaction in solving problematic issues of citizens and other civic society actors, improving the effectiveness of information policy of state and municipal authorities, interaction with citizens and non-profit organizations. Against the background of opportunities, as well as personal active use of the Internet, experts do not see it as a threat to society and the country, as well as personal security. In this case, the censorship of information on the Internet should be selective, depending on the type of information.

The responses of the officials demonstrate a tendency to reduce the optimistic assessment of the possibilities of digital tools to improve the effectiveness of interaction with NGOs and civil society activists. If at the initial stage digital tools were perceived as an intrinsic value that can change the essence of interaction, now it has become clear that the «partner» remain the same, their perception of each other is the same. Therefore, changes in relationships are possible not so much due to changes in the tools of interaction, but due to changes in the attitude to each other, the basic values of each of the parties to the interaction. Moreover, the Internet and digital tools create new threats and fears that can reduce the intensity and effectiveness of interaction.

At the same time, each of the parties strives to master digital tools with the greatest benefit for themselves. Each of the parties is trying to understand how digital tools can improve not only the

effectiveness of interaction, but also the effectiveness of monitoring, control and influence on the other side.

Certain limitations of conclusions may be related to the specifics of the data collection method. It can be assumed that in the course of the study, respondents expressed somewhat more socially approved responses than their actual opinions and assessments. Practice shows that the authorities are somewhat skeptical about NGOs and civil society activists. They are not fully open to interacting with them. Therefore, it can be argued that this study presents a slightly more optimistic view of the situation than it actually is.

In this case, we can develop the research in future by interviewing the well-being of NGO leaders and civil society activists, studying their vision of the situation of interaction with the authorities, as well as the effectiveness of digital interaction tools. A separate direction can be the study of bright cases of organizing interaction between the government and NGOs (civic activists) through digital tools.

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# Online Deliberation on Social Media as a Form of Public Dialogue in Russia

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## Abstract

The article presents the results of the analysis of online discussions on acute theme in Russian socio-political discourse correlating with the court sentence to Alexei Navalny. The investigation is based on modified discourse analysis methodology to identify deliberative quality of discourse. The analysis is carried out according to such parameters as argumentation, communication culture, interactivity, dialogicity and the degree of dialogue. Online discussions on the pages of Vkontakte social network of five Russian media are used as an empirical basis for the study. The authors come to the conclusion that online deliberation as a form of public dialogue in Russia is poorly developed and has predominantly entertainment nature. Russian online deliberations are very interactive, the degree of dialogue in them is high but the level of argumentation and culture of communication in online discussions is low which prevents the development of online deliberation on political topics as a form of public dialogue.

## Keywords

Online deliberation, discourse, dialogue, discourse analysis, social media, Russia, media

## 1. Introduction

In recent years, democratic systems and institutions have been increasingly attacked [1]. The integrity of the elections was under threat, the environment in which journalists work and civil society exist has deteriorated [2], problems related to the appearance of fake information regularly arise and confrontation on social networks is intensifying. In such a situation the concept of public dialogue and, in particular, online deliberation as its modern form is becoming more important than ever.

Deliberation is a process of communication between citizens that takes place in a public space through dialogue, discussions, negotiations with the help of which the search for solutions to common problems related to the political sphere is carried out. The concepts of democratic deliberation have been intensively developed as they are aimed at significantly expanding the opportunities for active inclusion of citizens in politics and their participation in it [3].

In general, issues related to the construction of effective dialogue between citizens, society and state are among the most discussed in the context of modern humanitarian knowledge. Nevertheless, Russian science leaves without due attention the problem of dialogical interaction between citizens and state on political issues in the online environment including generally accepted interpretation of the concept of online deliberation and the methodology for its study.

In this article we will analyze the discussions on social networks and try to identify what kind of deliberative potential they have as social media have taken on promising functions in the political context correlating with active development of the processes of political participation and democracy [4,5].

The main goal of the article is to assess the quality of online deliberation in social networks as a form of public dialogue in the modern Russian context. For doing this, a number of parameters such as argumentation, communication culture, interactivity, dialogicity and the degree of dialogue is used.

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## 2. Theoretical basis of investigation

The research presented in this article is based on the concept of J. Habermas. The deliberative model of democracy proposed by the German scientist comprises diverse forms of communication, continuous and maximally broad political discourse in society. The results of it are determined by the strength of arguments [6, p.391]. The concept implies that authentic problems of society are identified and revealed, directions for their solution, optimal ways to achieve goals are determined in the course of collective reflections.

In the theory of J. Habermas we come across with the concept of ideal democratic procedure for negotiation and decision-making which is created in order to achieve reasonable and honest results. According to the researcher's approach, deliberation "takes into account a higher degree of intersubjectivity of the processes of mutual understanding which are carried out, on the one hand, in the institutionalized form of meetings of the parliamentary corps, as well as, on the other, in the communication network of the political community. These subjectless communications inside and outside of political associations programmed for decision-making generate an arena where a more or less rational formation of public opinion and political will about significant for the whole society and need to be regulated topics can take place" [6, p.395-396]. Civil participation in discussions that unfold on various Internet platforms can be seen as a prerequisite for discursive democracy.

Online deliberation on issues of common interest to all participants is one of the most discussed forms of political Internet communication today. It is believed that Internet is a medicine that can help overcome the crisis of Western democracy [7]. Due to the lack of centralized control, Internet as an open communication environment has flexibility and enormous potential to quickly implement multilateral information exchange practically throughout the entire planet which, accordingly, facilitates interaction between citizens [8, p.48-56]. However, it is still not entirely clear whether Internet will contribute to the establishment of the principles of deliberative democracy and if so, how effectively it will be implemented.

It is worth agreeing with T. Davis that online deliberation with emphasis on discussion carries both future opportunities and disappointments: "The opportunity is due to the flexibility of information and communication technologies which allows for online discussion and, even possibly, surpasses the usual off-network form of discussion in cases where access to information, time requirements and other factors limit the availability of direct discussion in the format "face to face". The disappointment, however, is that deliberative activity is definitely not in a rush to gain traction on Internet compared to communication that is more entertainment-oriented and more personal than collective" [9, p.3].

Nevertheless, political institutions have begun to provide citizens with new opportunities for offline and online participation which should ultimately increase the legitimacy and quality of politics [10]. These expectations are reflected in the ideas formulated by theorists of deliberative democracy who argue that consensual rational decisions through deliberation could help overcome the socio-political problems that have arisen in conditions of tension and uncertainty [11-13]. Hence, deliberation is a political model for formulating policies that could potentially be a solution to a smoldering crisis of legitimacy [14].

A number of empirical studies on online deliberation has increased in recent years. As a result, a huge amount of theoretical and empirical literature [15,16,17,18] became available but this triggered difficulties in defining what deliberation is [19] and stretched the concept. It resulted in that many authors understand deliberation as almost every type of communication [20].

More often than not, researchers define deliberation first and then speak about online deliberation using the same definition and linking it to usage of electronic communications. For example, Dennis Friess uses the concept of "deliberation" to refer to "thoughtful, attentive or prolonged consideration" by individuals and "formal discussion and discussion" in groups, so he is primarily interested in reasoned, focused and interactive communication [10]. The term "online" in combination with the concept of "deliberation" can be used to refer to discussion between participants using electronic communication technologies that enhance the ability to see and hear distant from us in time or space information.

In this paper we understand online deliberation as a process of public purposeful, reasoned, rational and equitable discussion between citizens with prevalence of a dialogical form of communication and

usage of electronic communication technologies aimed at solving common problems and achieving mutual understanding.

The point of view of D. Walton who considers deliberation as a form of dialogue in which each side presents its own view of solving a practical problem is also important for our research. Deliberation is a collective process of dialogical solution of common problems by participants of communication, therefore, the purpose of deliberative dialogue is to reach agreement on procedures and actions that can be considered as a solution to practical problem; the choice must be made between two or more mutually exclusive options [21].

Also, we will rely on the American School of Dialogue (Dialogue Group) by physicist D. Bohm who has developed a comparative description of genuine and rhetorical dialogues, i.e. "discussions" [22].

### 3. Quality of online deliberation on Russian social media: case of A. Navalny

On February 2, 2021, the Simonovsky Court of Moscow held hearings in the case of Alexei Navalny. During that meeting the issue of replacing the conditional term with a real one was considered. As a result, the accused will spend 2 years and 8 months in a general regime colony. This news gave rise to a lot of discussions on social networks about the fairness and injustice of the decision, critical statements towards both A. Navalny and the Russian authorities.

For the analysis we selected online discussions on the subject of A. Navalny's court verdict on the pages of VKontakte social network of leading Russian media: print («Komsomolskaya Pravda», «Meduza», «TASS») and television («Channel One», «Rain») dividing them by political affiliation: independent («Rain», «Meduza»), pro-state («Channel One», «Komsomolskaya Pravda» (KP.RU)) and neutral «TASS». Posts with news about the court decision and user's comments below them were posted from 2 to 6 February 2021.

A total of 1165 comments were analyzed. Table 1 presents online discussions on selected five online platforms in terms of their source, political affiliation, article title, material, post date and time, number of likes, reposts, comments and links on discussions.

These online discussions were selected based on three factors. Firstly, the discussions corresponded to the stated topic (the court verdict of A. Navalny). Secondly, each contained at least one hundred comments which, as our experience shows, is a prerequisite for encoding them using a machine learning program. Thirdly, discussions were conducted by ordinary citizens on various media platforms. The discussions were moderated and comments were removed by administrators of online media groups whose loyalty to government structures varied. The discussions were not in any way initiated or led by the authorities. We studied and compared such parameters of online deliberations as argumentation, communication culture, interactivity, dialogicity and the degree of dialogue in order to identify the specific features of Russian public dialogue in the form of online deliberation on a current political topic. We used a modified discourse analysis technique developed by Yu. Misnikov which is described in detail both in the works of its author and in other works of the authors of the article [23,24,25,26,27]. Yu. G. Misnikov developed «Deliberative Standard to Assess Discourse Quality» [28] and described seven thematically different discourse parameters corresponding to specific research questions to guide the process of coding the messages of Internet discussions. These parameters are participatory equality, argumentation, communication culture, validity of statements, interactivity, dialogicality, thematic diversity. Each parameter contains a set of specific empirical characteristics designed to reflect certain discursive qualities.

Discussion materials were collected using parsing and loaded into Excel spreadsheets. When coding discussions, the following data was entered into an Excel spreadsheet: author's ID, author's link, author's first and last name, author's gender, link on author's image, link on comment, comment date and time, comment text and number of likes to the comment.



**Table 1**

List of analyzed discussions on media pages on social network «VKontakte»

Sources	Rain	Meduza	Channel One	KP.RU	TASS
Media type	Independent		Pro-state		Neutral
Article title, material	The suspended sentence was replaced with a real one for Navalny. Taking into account the time spent under house arrest, Navalny will spend two years and eight months in the colony.	Will Navalny be replaced with a real one? We follow what is happening in the court - and around it.	The Moscow City Court sentenced Alexei Navalny to 3.5 years in prison and a fine of 500 thousand rubles.	The court sentenced Alexei Navalny to 3.5 years in a general regime colony.	Navalny's lawyer said that her client will spend about 2 years and 8 months in the colony.
Post time	02.02.2021 (20:46)	02.02.2021 (18:34)	04.02.2021 (14:03)	02.02.2021 (21:24)	02.02.2021 (21:20)
Number of likes	499	154	116	177	92
Number of reposts	152	71	33	41	25
Number of comments	602	155	160	148	100
Link on discussions	<a href="https://vk.com/tvrain?w=wall-17568841_6487755">https://vk.com/tvrain?w=wall-17568841_6487755</a>	<a href="https://vk.com/meduza-project?w=all-76982440_4791700">https://vk.com/meduza-project?w=all-76982440_4791700</a>	<a href="https://vk.com/1tv?w=all-25380626_2610268">https://vk.com/1tv?w=all-25380626_2610268</a>	<a href="https://vk.com/kpru?w=wall-15722194_5300931">https://vk.com/kpru?w=wall-15722194_5300931</a>	<a href="https://vk.com/tassagency?w=all-26284064_3720193">https://vk.com/tassagency?w=all-26284064_3720193</a>

First, the attitude of online discussion participants to Alexei Navalny, his sentence and the actions of authorities was analyzed. At the first stage of the study, positions of users were analyzed in two categories:

1) «For» (support for A. Navalny, condemnation of the court verdict and criticism of the authorities, their actions).

2) «Against» (negative attitude towards A. Navalny, support for the court decision, agreement with the actions of the authorities).

The total percentage of positions "Against" was 85.2%, "For" - 14.8%. In online discussions of all five media at least 2/3 of users spoke out against Navalny supporting the court's verdict, although some people disagreed with him claiming that the term was insufficient but they still supported the actions of authorities. The highest percentage of negative attitude towards politician was illustrated in online discussions of pro-state media (92.75%), the lowest on platforms of independent media (75.35%); neutral TASS is in the middle: the percentage of "Against" positions was 87.5%. Considering each source separately we note that the largest share of negativity towards A. Navalny was recorded on the Vkontakte pages of Komsomolskaya Pravda (93.8%) and Channel One (91.7%). Participants of online deliberation on the Rain page (32.6%) were most positive about politician. Need to add that that data may not be entirely accurate as some user's comments have been removed. In addition, in the discussions of some media there were few opinions about the stated problems which to a certain extent limits the representativeness of results. Moreover, some participants in the course of online discussions

indicated on presence of bots and trolls which could leave an imprint on data obtained and discussion in general due to the fact that the bots were difficult to identify.

Simultaneously with the analysis of participants' positions in discussions the argumentation forms were identified.

The following positions were included in the analysis of argumentation [28]:

- 1) facts and numerical indicators of factual nature;
- 2) numeric data;
- 3) examples, cases, comparisons, events, citations;
- 4) references to political figures;
- 5) conclusions, generalizations;
- 6) recommendations, suggestions, calls to action;
- 7) links on various online sources.

The overall percentage of argumentation was 44.8% (see Table 2), however, we need to add that some comments had several types of arguments and some only one. The highest indicator of argumentation was recorded in discussions on the platforms of independent media (51.6%), the lowest on the neutral source "TASS" (35%); in discussions on pro-state media the percentage of argumentation was 47.7% which did not differ much from the percentage of argumentation in the discussions of independent media. The largest indicators of argumentation were found both in the discussions on page of independent source ("Rain" - 63.8%) and pro-state one ("Komsomolskaya Pravda" - 63.5%). The lowest percentage of using arguments was demonstrated in the discussion on Channel One (31.9%).

**Table 2**

Argumentation analysis (results presented in percentage)

	Independent		Pro-state		Neutral	
	Rain	Meduza	Channel One	KP.RU	TASS	Final data
Facts and numerical indicators of factual nature	8,3	8,2	2	5,3	2,9	5,34
Numeric data	1,1	3,3	2	1,1	5,7	2,64
Examples, cases, comparisons, events, citations	0,8	0	0	2,1	2,9	1,16
References to political figures	31	44,3	35,3	31,9	28,5	34,2
Conclusions, generalizations	53,6	42,6	58,7	56,4	60	54,26
Recommendations, suggestions, calls to action	2,3	0	2	3,2	0	1,5
Links on various online sources	2,9	1,6	0	0	0	0,9
General % of argumentation	63,8	39,4	31,9	63,5	35	44,8

Turning to the analysis of specific forms of arguments, the most popular types of argumentation were 1) conclusions, generalizations, inferences (54.26%), 2) mentioning politicians (34.2%); least popular: 1) recommendations, suggestions, calls to action (1.5%), 2) examples, cases, events, comparisons, quotes (1.16%) and 3) links on online sources (0.9%). Most of conclusions and generalizations were shown in the discussions on the TASS page (60%) and on the pages of pro-state sources (Channel One - 58.7% and Komsomolskaya Pravda - 56.4%). Speaking about mentions of

political figures one should highlight the discussion on the Meduza page (44.3%). It is interesting to observe that in the discussions on independent media in comparison with other media, arguments of factual nature were used most of all (Rain - 8.3% and Meduza - 8.2%) and links on online sources (Rain - 2.9% and Meduza - 1.6%). For example, not a single pro-state source and a neutral one did not use links on additional online resources as arguments. If we talk about suggestions and recommendations, then pro-state media showed one of the highest indicators (Komsomolskaya Pravda - 3.2 %, Channel One - 2%). Most of arguments in the form of numbers (5.7%) and examples, comparisons, cases from life (2.9%) were used in the discussion on TASS page.

We analyzed the culture of communication ("civility") in online deliberations on the subject of the court verdict of A. Navalny accordingly to following positions:

1) posts are directly addressed to other participants with mention of name or personal appeal but at the same time they do not relate to topic, problematics, i.e. they are personalized (this category includes only phrases or sentences indicating interpersonal characteristics and any other communications (including neutral));

2) posts mentioning a name of participant but rude and offensive in relation to him, his nationality, religion, ideology, etc. (including sarcasm);

3) posts mentioning a name of participant but rude and offensive in relation to the object of discussion;

4) polite and respectful posts in relation to a person with a mention of his name (may contain irony, humor, sarcasm in a positive aspect);

5) posts without mentioning a name of participant but rude and offensive in relation to him, his nationality, religion, ideology, etc. (including gross sarcasm);

6) posts without mentioning a name of participant but rude and offensive in relation to the object of discussion;

7) polite and respectful posts towards a person without mentioning his name (may contain irony, humor, sarcasm in a positive aspect).

The overall percentage of communication culture ("civility", politeness) was 47.44% (see table 3) but we need to add that in some comments there could be several positions, although most often one. It is curious that the percentage of communication culture (47.44%) is slightly higher than the percentage of argumentation (44.8%) but not significantly. In turn, this suggests that in the discussions analyzed, priority is given to the form of opinion expression and not to its content which, in our point of view, characterizes such deliberations from a negative side since the main thing in deliberation is the essence of position, its argumentation and not in what form it is presented, although this is no less significant as well.

Consequently, such discussions are more irrational than rational. However, if you look at the general indicators of communication culture, you can see that its main array is made up of off-topic comments that have an interpersonal character or are abstracted from main issue (38.8%). We add that the total percentages of rough communication culture, i.e. impolite, rude attitude towards participant as well as object of discussion strongly prevail over polite ones, especially the percentage of rude attitude towards other participants in the discussion which further distracts from constructive dialogue, topic in general, for sake of discussion of which online deliberation is carried out. The total percentage of intolerant attitude towards participant was 4.46%. It was calculated by adding the percentage of posts with and without mentioning a name, on topic but rude in relation to the participant (9.4%, 6.4%, 3.8%, 2.7%, 0%) and dividing by 5 as we analyzed the comments of five discussions.

The general percentage of intolerant attitude towards subject of discussion is 3.84%. It was calculated in a similar way, only posts were taken with and without a name, on topic but rude in relation to subject of discussion (2.5%, 2.6%, 4.4%, 6.7%, 3%). Such indicators characterize Russian culture of communication in the Internet environment as low, immature, intolerant and focused off the topic of discussion.

**Table 3**

Communication culture analysis in Russian online discussions (in percentage)

	Rain	Meduza	Channel One	KP.RU	TASS	Final data
Thematically empty posts with participant name's mention, only interpersonal communication	50	41,9	42,8	22,3	37	38,8
Posts with participant name's mention, discussion on topic, but rude towards participant	9,1	4,5	2,5	2	0	3,62
Posts with participant name's mention, discussion on topic, but rude towards object of discussion	0,7	0,7	3,1	2	2	1,7
Posts with participant name's mention, discussion on topic in a polite, tolerant way	0	0	0	0,7	1	0,34
Posts without participant name's mention, with discussion on topic, but rude towards participant	0,3	1,9	1,3	0,7	0	0,84
Posts without participant name's mention, with discussion on topic, but rude towards object of discussion	1,8	1,9	1,3	4,7	1	2,14
Posts without participant name's mention, with discussion on topic in a polite way	0	0	0	0	0	0
Total % of negative civility towards participant	9,4	6,4	3,8	2,7	0	4,46
Total % of negative civility towards object of discussion	2,5	2,6	4,4	6,7	3	3,84
Total % of civility	61,9	50,9	51	32,4	41	47,44

Speaking about specific discussions and media it can be seen that the highest percentage of communication culture (61.9%), posts of personal and abstract nature (50%) as well as a rude, offensive attitude towards participant (9.4%) was installed in the discussion on Rain page (50%). The highest percentage of coarse culture of communication in relation to topic, object of discussion was recorded

in the discussion of Komsomolskaya Pravda (6.7%). Comparing culture of communication in discussions of independent and pro-state media, we emphasize that in the discussions on pages of independent media there were the highest rates of posts of personal and abstract nature (45.95% (for comparison on pro-state - 32.55%)) as well as coarse culture of communication in relation to participant (7.9% (on pro-state - 3.25%)), while the largest indicator of coarse communication culture in relation to topic, object of discussion was demonstrated in discussions on pro-state media (5.55 % (for comparison on independent - 2.55%)).

Let us turn to analysis of interactivity, dialogicity and the degree of dialogue. As mentioned above, we adhere to the theory of J. Habermas and Bohm's dialogical approach. Based on comparative characteristics of dialogue and discussion, we were able to determine the degree of dialogue, i.e. striving for consensus.

First of all, interactivity was analyzed (see table 4), i.e. all mentions of participants by other users in the process of communication. To calculate interactivity, you need to divide a number of all mentions of participants (by name or without) by number of all posts. You can see that the highest proportion of interactivity was presented in the discussions where there were 155 comments and above. This group includes Rain (66.6%), Meduza (65.8%) and Channel One (64%). Interestingly, the most highly interactive discussions were on the platforms of independent media (66.2%), respectively, they turned out to be the most highly dialogical (62.2%). Next, we calculated dialogicity (see table 4). To do this, we divided a total number of mentions of participants by name by total number of posts. In all discussions, the percentage of dialogicity was lower than the percentage of interactivity but insignificantly. Indicators of dialogicity cannot be higher than indicators of interactivity but they can be equal. As already mentioned, the most highly dialogical discussions were on the pages of independent media (Rain - 63.1%, Meduza - 61.3%) as well as on one pro-state source (Channel One - 62%). If we talk about ratio of interactivity and dialogicity, then the smallest gap in percentage between them was demonstrated in discussions on pro-state media (Channel One - 64% and 62%, Komsomolskaya Pravda - 52% and 51.4%, respectively) and neutral TASS (57% and 55%, respectively).

To determine the degree of dialogue, it is necessary to take all posts where an interaction between participants was recorded and analyze them guided by Bohm. As a result, we can assert (see Table 4) that in Russian online discussions the degree of dialogue is high: 55% on the page of neutral TASS, 54.3% on the pages of independent media, and 52.15% on pro-state media, and in all discussions, the degree of dialogue significantly dominated the degree of discussion, polemics (their indicators range from 2 to 14.1%) which confirms our hypothesis. This is a positive pattern but if we take into account the indicators of argumentation and culture of communication in Russian discussions, then it immediately becomes clear that the dialogue was predominantly not on topic of discussion but was more entertaining or abstract from discussion of main topic and political issues in general. Therefore, the Russian public dialogue in form of online deliberation can be characterized as entertaining, politically immature and of poor quality; accordingly, one can hardly speak of constructive role of such a dialogue in the field of interaction with state and adoption of joint political decisions based on deliberative discussions of political issues by citizens.

The highest indicator of the degree of dialogue was found in the discussion on Channel One (57%) despite the fact that a number of interactive posts there is not the largest (64%) compared to other discussions. However, returning to nature of dialogue, we argue that it is of low quality since despite the fact that the percentage of coincidence of positions was one of the highest (91.7% but few opinions were presented on topic of the particular court verdict of A. Navalny), accordingly, the degree of discussion, disputes is low (7%) with 57% of the degree of dialogue, the percentage of argumentation was the lowest (31.9%), and the percentage of posts of interpersonal nature, off-topic - one of the highest (42.8%). The smallest degree of discussion, controversy was in the discussions of TASS (at least 2% or less) and Komsomolskaya Pravda (at least 4.7% or less) while in the discussion of Rain it was the highest (at least 14 %). This is obvious as opinions of participants split in the following ratio: almost 1/3 for Navalny and against his sentence (32.6%), 2/3 against Navalny and for his sentence (67.4%). The smallest degree of discussion, controversy was in the discussions of TASS (at least 2% or less) and Komsomolskaya Pravda (at least 4.7% or less) whereas in the discussion of Rain it was the highest (at least 14%). This is obvious since opinions of participants split in the following ratio: almost 1/3 for Navalny and against his sentence (32.6%), 2/3 against Navalny and for his sentence (67.4%).

**Table 4**  
Interactivity, dialogicity and the degree of dialogue analysis (in percentage)

	Independent		Pro-state		Neutral
	Rain	Medusa	Channel One	KP.RU	TASS
Interactivity	66,6	65,8	64	52	57
Total % of interactivity		66,2		58	
Dialogicity	63,1	61,3	62	51,4	55
Total % of dialogicity		62,2		56,7	
The degree of dialogue	52,5	56,1	57	47,3	55
Total % of the degree of dialogue		54,3		52,15	
Number of posts	602	155	160	148	100

Speaking about quality of public dialogue in form of online deliberation on Rain, we note that ambivalent tendencies are noticeable: on the one hand, such a dialogue is better than others since the highest percentage of argumentation was recorded there (63.8%) due to the fact that there is a division of opinions, different positions are presented in the above ratio, on the other hand, of poor quality as the percentage of posts not discussing the main issue (50%) and with a rough culture of communication in relation to participant (9.4%) were the biggest. In our opinion, public dialogue of better quality compared to others can be traced in the discussion of Komsomolskaya Pravda as it is more aimed at discussing A. Navalny's court verdict. For example, the percentage of coincidence of opinions ("against") was the highest (93.8%), respectively, the degree of discussion, disputes, polemics was small (4.7%), with 47.3% of the degree of dialogue; the percentage of argumentation was one of the highest (63.5%) while the percentage of off-topic posts was the lowest (22.3%), although with rough culture of communication in relation to topic, subject of discussion is more than the rest (6,7%), which, in turn, could give rise to controversy and debate on the part of participants, to some extent, offended by this form of expression.

Based on several examples it can be concluded that in form of dialogue a discussion is much more effective than in form of discussion, polemics as participants are less distracted by clarifying relationship between each other, they show less rude attitude towards other participants and object of discussion and more direct efforts to search for new arguments, conclusions, truth. Although there are situations when it is a discussion that is useful, as, for example, in the discussion on Rain page because this can generate more motivation from participants to find the truth and, therefore, more arguments. However, if these efforts are not aimed at reaching agreement and discussion of topic but on participant, then the likelihood of escalation of interpersonal conflict increases which, in general, can harm the discussion reducing the degree of its deliberation and the quality in general and alienate participants from reaching the truth and rational consensus.

#### 4. Conclusion

All in all, online deliberation as an implementation of dialogical relations between citizens can take a form of both dialogue and discussion. In either case, it will be a public dialogue but the quality of discussion will be different: online deliberation in form of cooperative dialogue is much better and more effective than in form of discussion.

To assess nature and quality of online deliberation as a form of public dialogue, one should analyze 1) positions of participants, to what extent their opinions coincide and differ; 2) general level of argumentation in discussions, 3) culture of communication, especially in terms of posts of personal

nature, off-topic, as well as a rude, intolerant attitude towards participant and object of discussion and 4) the degree of dialogue, discussion, disputes, polemics as a form of communication. These are not all but main parameters for analyzing the quality of public dialogue.

Definitely, online deliberation does not always resolve all disagreements in society and reach a rationally based consensus.

As indicated in other studies including ours, a type of media plays a role in achieving results of discussion [29]. That is, pro-state and open government media hold discussions in support of government policies and actions. Likewise, media outlets that are independent of government control are more critical of authorities. However, influence of media identity has its limits. The study's findings support findings of those studies that argue that when it comes to political conversation, citizens are more likely to talk with like-minded people than with others. However, these are only general observations that require more research.

Further studies include a need to study online discussions in foreign countries for comparative analysis. So far, we can only assume that in countries with established democratic traditions, the quality of online deliberation as a form of public dialogue is higher than in Russia. In our country, at the moment, online deliberation as a form of public dialogue is poorly developed and is largely entertainment in nature. Russian online deliberations are interactive, the degree of dialogue in them is high but levels of argumentation and communication culture in online discussions are low which prevents development of online deliberation on political topics as a form of public dialogue.

## 5. Acknowledgements

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# **Internet Psychology**



# Possibilities of Automatic Detection of Reactions to Frustration in Social Networks

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## Abstract

This study aims to create a method for the reliable detection of frustration-derived reactions in social media texts. Based on the results obtained earlier while automating the categorization of Rosenzweig Picture-Frustration Study responses, a method was created to automatically classify the reactions to frustration found in social network posts and comments. The experiment results show that the E, E', M reactions can be reliably detected with fair precision and recall, although we have obtained lower F<sub>1</sub> scores for other reactions because those classes are very small. The results prove that Rosenzweig's types of frustrating responses can also be applied to the study of social media behavior. Moreover, the language used to express a particular reaction to frustration is not related to the content of the situation. The elaborated method currently works only for two genres: answers in Rosenzweig's test and comments or posts in social media. Recognizing the types of reactions to frustration in other genres may require a new algorithm adjustment.

## Keywords

Reactions to frustration, Rosenzweig Picture-Frustration Study, machine learning, social networks

## 1. Introduction

Rosenzweig Picture-Frustration Study (RPFS) was created in 1945 by S. Rosenzweig and long entered the "golden fund" of psychodiagnostics. Decades of using the technique in many countries, including Russia, have shown its high effectiveness in identifying personal peculiarities of responding to obstacles and accusations. The method is considered semi-projective but not challenging to master, so, for example, most psychology students already master it in their psycho-diagnostics practical classes. This is probably because the test has good clarity of assessing the ways of responding to an obstacle proposed by the author, and these reactions' language expressions are distinct. Examples of typical responses are often given in the guidelines for using the technique, and some authors provide detailed lists of such examples (for Russian-speaking subjects, see, for example, [1]). However, there is still no systematic description of speech reactions to frustration in psychology.

In the last decade, the elaboration of automatic text analysis tools and text classification methods based on machine learning has become very intensive. With these methods, one could adapt well-established psycho-diagnostic techniques for use in the information society, where people produce a large flow of texts. Social networks have become data banks of hundreds of millions of users, including their speech reactions to various negative and positive circumstances.

In work [2], we solved the problem of elaborate a tool for automatically classifying the responses of subjects in the RPFS. A corpus of 462 RPFS protocols was collected, and the psychologist processed these texts identifying subjects' reactions to frustration. At the next stage, the linguist worked with the

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marked-up corpus, and the linguistic descriptions were formalized and applied to construct a feature description of text fragments. Finally, the feature descriptions were used to build a classifier of reactions to frustration utilizing machine learning methods. It was found that the resulting linguistic patterns form a high-level feature description of text fragments that allows for high completeness ( $R$  is not less than 0.8) identifying statements related to different types of reactions. Four of the nine types of reactions: M, M', I, E, can be reliably distinguished ( $F1 > 0.7$ ) without considering the context of the statements. It was noted that for psychology, the technology of linguistic patterns acts, on the one hand, as a means of professional reflection, and on the other as a tool for verifying the data of projective text techniques, and allows us to develop tools for automatic analysis of the respondents' speech, including online discussions. It was suggested that further work with the elaborated linguistic patterns could be aimed at testing the hypothesis of their universality concerning frustrating situations. In other words, the results allowed us to assume that such speech responses will occur in any frustrating situation, and not just in the ones presented in RPFSS.

A team of psychologists, linguists, and artificial intelligence specialists tested the effectiveness of the elaborated algorithm for automatically detecting reactions to frustration in the texts of online discussions. Note that the technology of the linguistic pattern developed by the authors [3] involves the participation of a psychologist (or any socio-humanitarian scientist: historian, sociologist, political, etc., interested in the text researching), a linguist, and an artificial intelligence specialist. The pattern technology can be considered a new method for modeling the reasoning of an expert who evaluates texts within the framework of the categorical scheme adopted in their discipline.

The second step of our study is devoted to testing the algorithm's effectiveness in social media texts, which would make it possible to automatically classify subjects' responses in the Rosenzweig test to a particular type. In that step we deal with the following research questions.

1. Can the Rosenzweig's types of frustrating responses also be found in social media behavior? The speech design of such reactions as an accusation, complacency, justification, or the willingness to solve the problem independently is not too diverse. Therefore, the linguistic means used by users of social networks should be about the same as the means used by subjects when performing the Rosenzweig test.
2. Is the linguistic means used to express a particular reaction to frustration are not related to the content of the frustrating situation? If so, regardless of the subject of discussion, communicants who describe their frustrating reactions use universal mechanisms of expression (speech patterns), making it possible to identify the type of reaction to frustration in a wide range of contexts.

## 2. Related work

Attempts to analyze the emotional states of social networks users are popular, including active efforts to identify the features of texts written in a state of stress, frustration, or grief [4-6]. In our study, we try to identify text features of social network user frustration, comparing posts by calm and well-being users and messages by the same users in a state of tension [7]. However, we have not found any studies devoted to detecting reactions to frustration identified by S. Rosenzweig. Plenty of works are devoted to detecting sentiment, mood, or affect in social networks, which seems quite close in terms of valuable features and approaches. Those studies often consider only shallow lexical features; for example, Thelwall presents [4] TensiStrength, a system to detect the strength of stress and relaxation expressed in social media text messages. TensiStrength uses a lexical approach with lists of terms related to stress and relaxation. Those terms are synonyms for stress, anxiety, and frustration and terms related to anger and negative emotions because stress can be a response to negative events and can cause negative emotions. Thelwall claims that the effectiveness of TensiStrength depends on the nature of the messages, with the texts that are rich in stress-related terms being particularly problematic. The experiment results show that TensiStrength works well enough to be applied for applications that need to use stress information.

The paper [8] presents a study more complex case. In this paper, the researchers propose a method to detect sarcasm. Sarcasm is a form of text in which individuals state the opposite of what is implied. The researchers utilize theories from behavioral and psychological studies to construct a behavioral modeling framework tuned for detecting sarcasm. That presumes using more complex features.

Namely, they observe that sarcastic texts sometimes have a specific structure wherein the author’s views are expressed in the message’s first few words. Simultaneously, in the later parts, a description of a particular scenario is put forth. To reveal possible syntactic patterns arising from such text construction, researchers use the POS tags of the first three words and the last three words in the texts. They also include the position of the first sentiment-loaded word and the first affect-loaded word as a feature. To capture differences in syntactic structures, they consider POS tags present in the message. Namely, they build a probability distribution over the POS tags present in the current text and POS tags in past messages and use the Jensen-Shannon divergence value between the two distributions as a feature. They also use lexical density, which is the fraction of information-carrying words present in the text (nouns, verbs, adjectives, and adverbs).

Complex linguistic features are also used in the paper [9] for hate-speech detection. Researchers collected more than 2M texts, comparing discussion actors around neutral topics to those more likely to be hate-related. They combine word embeddings, sentiment, and emotional features, lexis, and POS tags and apply bidirectional Long-Short-Term Memory (LSTM) [10] because the training corpus was big enough.

There are also several works related to cognitive distortion detection. The primary problem here is the lack of training corpora. For example, the paper [11] presents an approach to classify text into one of 15 distortion categories. They compared several machine learning-based classifiers, such as Logistic regression, SVM, recurrent neural networks (Gated Recurrent Units) [12], gradient boosting on decision trees (XGBoost) [13]. The best-performing model is again logistic regression because the dataset was relatively small.

An example of the practical application of sentiment, mood, or affect detection methods is presented in the thesis [14]. In this thesis, Primetshofer uses sentiment analysis to detect frustrating conversation situations. He claims that it is helpful for chat-bot systems. Such a system should check the sentiment of the user’s input message and clarify the current situation. The proposed method analyses several types of features like lexemes, POS tags, and syntax dependences. Then it uses a machine learning technique for analyzing the opinion. He uses the method to detect the moments when systems stumble and fail to answer the request. They require a human agent’s help and intelligence; in this situation, a transition from the machine to a human agent is one of the core features.

To summarize, frustration-derived reaction detection requires representative datasets to train the classification models with rich contextual linguistic features. However, the creation of such a dataset involves a lot of manual data collection and annotation. Unfortunately, the most complex classification models lack interpretability, which is important for psychodiagnostics. Therefore, in this work, we focus on context-aware but pretty simple models and classification features, which can be easily interpreted and verified.

### 3. Pikabu Frustration Dataset

We selected the text material among the messages posted on the entertainment site Pikabu.ru without considering the subject of the discussion [15]. Namely, the discussions included in the analyzed corpus were selected according to the maximum representation of the types of authors’ reactions to frustration. The experimental dataset contains 528097 sentences manually annotated with 11 classes. Two categories have been added to the nine original types of frustration response: 1) informing (in their comments, people sometimes, along with one of the reaction types, give quite detailed information about the discussed situation, attracting their knowledge in the field of law, history, technology, etc.); and 2) instruction (information about how such a conflict situation should, or can, or must be resolved in a particular society or community).

In total, the texts of 1943 unique post and comment authors were analyzed. After marking up the building, psychologists identified 3,490 cases of responding to frustration, including: E: 1579, e: 200, E': 390, I: 64, i: 129, I': 79, M: 147, m: 41, M': 201, informing: 528, instructing: 132.

Those messages are related to various controversial topics. We collected those messages in such a way to make each class (reaction) multi-topical to avoid the use of topic-related lexis by the frustration-derived reactions classifier. We have been guided by the linguistic description from section 4 when labeling. Because of the texts' nature, the dataset is severely imbalanced. Namely, the 'E' class is more

than a dozen times bigger than the second-largest class. In addition to pure texts, the dataset contains information about relationships between the messages (post-comment), making it possible to catch the context for each message.

#### 4. Linguistic patterns

Below we present the linguistic descriptions, which have been created during the "manual" analysis of the RPFS subject responses and then served as guidelines for the automatic analysis of online discussion texts. In total, the linguist compiled 60 rules, some of which were a set of more specific rules, and some a cliché list or a word list.

Language indicators of E'-reactions:

1. Impersonal sentences with the main member expressed by a predicative. The predicative set of the group E' is outlined quite clearly: *грустно, досадно, жалко, обидно, паршиво, печально, плохо* (*sad, annoying, miserable, upset, lousy, bad*), etc. (the linguist provided the AI specialist with a complete list of words in this role were found in 426 protocols of RPFS).
2. Nominative sentences belonging to an evaluative-beingness group. When the main member expressed by a noun in the nominative case, emotional-expressive particles is often used.
3. Interjections used as separate independent utterances. Their set in the class E' is finite and is provided by the linguist in the form of a short word list.
4. Sentences with the subject expressed by the personal pronoun *я* (*I*) (less often by a noun in the nominative case), and the predicate expressed by: a) a short adjective, b) a short passive participle. The adjective or participle has the semantics of a negative emotional state. The attribution of these sentences to the class E' or to the class E is determined by the totality of the individual subject's reactions.
5. Two-part sentences with the subject expressed by the anaphoric pronoun *это* (*this*), and the predicate expressed by a negative-evaluative a) noun, b) adverb (the adverbs are the same as in impersonal sentences). Differentiation of such statements between E' and E can be carried out according to the composition of predicates.
6. Two-part and one-part sentences with the predicate expressed by the conjugated form of a verb denoting a negative emotional state or if it has the semantics of a negative evaluation.

Language indicators of E-reactions:

1. Definitely-personal sentences with the main member (predicate) expressed by: a) a full-significant verb in the imperative mood (often with the negative particle *не* (*not*), b) the connective verb *быть* (*to be*) in the imperative mood *будь, будьте* (-), and the nominal part by an adjective in the short form or in the form of the comparative degree.
2. Sentences with the compound verb predicate including: a) the modal verb *мочь* (*can*) in the subjunctive mood *мог бы, могли бы* (*could*) and an adjacent infinitive, b) impersonal-predicative words with the modal meaning: *нужно, надо, можно, следует, стоит, нельзя, хватит* (*need, have to, may, should, worth, cannot, enough*), and an adjacent infinitive.
3. Sentences with the predicate represented by words of the negative-evaluative semantics (nouns, adjectives, participles, adverbs) or the negative-action semantics (verb sentences). These include:
  - a) N1-N1: The subject is a noun or a personal pronoun in the nominative case, the predicate is a noun in the nominative case. In the role of the subject, the anaphoric pronoun *это* (*this*) is often used, too;
  - b) N1-Adj: The subject is a noun in the nominative case, the predicate is a full or short form of an adjective;
  - c) Inf-Adv: The subject is an infinitive, the predicate is an adverb. The subject is regularly represented by the anaphoric pronoun *это* (*this*);
  - d) N1-PartIshort: The subject is a noun or a personal pronoun in the nominative case, the predicate is a short passive participle with the semantics of a negative emotional state as a result of an action;
  - e) N1: Nominative sentence. The main member expressed by a noun in the nominative case;
  - f) N1-Vf: The subject is a noun or a personal pronoun in the nominative case, the predicate is a conjugated form of a verb.

There is a group of sentences with verbs of a negative emotional state: *злит, бесит, расстроило* (*makes/drives smb. angry, crazy, sad*).

4. Sentences of different structures with the contextual meaning of confrontational negation. Their indicator is the negative particle *не* (no). They are used to: a) refute an opinion or position of the interlocutor; b) express a reproach or claim.

5. Rhetorical questions or rhetorical exclamations with the pronominal adverbs *как, почему* (*how, why*), and its synonyms *на каком основании, по какой причине* (*on what purpose, for what reason*); *куда, зачем* (*where, why*), and its synonym *к чему* (*for what*); *причем, где, сколько* (*what, where, how long*); the pronouns *кто, что, какой* (*who, what, which*), etc. expressing the semantics of denial, indignation, perplexity. Before the pronominal adverb, the conjunctions *а, и* (*but, and*), and the particle *да* (*let*) are often used.

6. Interrogative sentences of the confrontational semantics with the particle *что ли* (*or what*).

7. Communicative fragments, i.e., “ready-to-use pieces of language material” (B.M. Gasparov). In principle, they can be specified in a list.

Language indicators of e-reactions:

1. Interrogative sentences with the compound verbal predicate including the modal verb *мочь* (*can*) in the subjunctive mood *мог бы, не мог бы, могли бы, не могли бы* (*could, could not, would, would not*) and an adjacent infinitive. In these sentences, the subject is expressed by the second person pronoun *ты, вы* (*you*). In some cases, it can be omitted. This is an indirect speech act expressing a request in the form of a question. Meanwhile, the narrative sentences of this structure (graphically not having the question mark at the end) no longer express the request, but a condemnation, a reproach and enter the class E (see above the E-pattern).

2. Interrogative sentences with the compound verb predicate including the modal verb (*с*)*мочь* (*can*) in the indicative mood *можете, можешь* (*can*), and an adjacent infinitive. The subject (in some cases it is omitted) is again usually expressed by the second person pronoun *ты, вы* (*you*). This indirect speech act, as in the previous case, expresses a request.

3. Interrogative sentences with the main member expressed by impersonal predicative words *можно* in the meaning “possible”, *нельзя* (*impossible*), and an adjacent infinitive. Sometimes the predicative unit *я могу* (*I can*) acts as a synonym for a word. The speech act expresses: a) a request to perform the action indicated by the infinitive; b) a request to allow or to permit the speaker himself to perform the action indicated by the infinitive (it is assumed that the addressee will give one's permission, i.e., on one's part will perform the required action); c) a request to provide the information the speaker needs.

4. Interrogative sentences with the semantics of motivation expressed by the future tense form of a verb in the presence of the introductory words *может быть, может, возможно* (*can be, maybe perhaps*), or less often the word *можно* in the meaning “allowed, permitted”.

5. Sentences with the verb predicate in the imperative mood, expressed by a combination of the particle *пусть* (*let*) with a verb of the 3rd person singular and plural future tense.

6. Definitely-personal sentences with the predicate expressing a motivation for joint action by combining the particles *давай, давайте* (*give, let's*) with a verb of the 1st person plural future tense.

7. Verbs *скажи, скажите, подскажи, подскажите* (*tell me*) as key words in the main part of a complex sentence with the explanatory subordinate part.

8. Sentences with the predicate expressed by a verb of speech (most often the verb in the performative use, i.e., in use meaning the performance of an action called the verb), and an adjacent infinitive as the complement.

9. Definitely-personal sentences in which the main member (predicate) is expressed by a full-significant verb in the imperative mood. Whether such sentences enter the class e or the class E, is determined by the totality of the subject's reactions.

10. Sentences with the compound verb predicate, expressed by the predicative *должен* (*must*), and an adjacent infinitive. Whether such sentences enter the class e or the class E, is determined by the totality of the subject's reactions.

11. Sentences with the main member expressed impersonally-predicative words *надо, нужно, необходимо, следует, придется, стоит, пора, лучше* (*need, have to, ought to, necessary, should, be to, it's time for, better*), and an adjacent infinitive.

12. Reproducible phrases like *будьте добры* (*please*) + infinitive, *мне нужно* (*I need*), etc. (the complete list has been created).

Language indicators of I'-reactions:

1. Subjective-predicative sentences with the predicate expressed by a verb with the negative particle *не* (no), if there is the combination *все равно* (*all the same*) as a particle.
2. Compound sentences with a subordinate explanatory, in which the main part is an impersonal sentence with the predicates *радует, отрадно, хорошо, отлично* (*please, gratifying, good, great*).
3. Other cases of using the word *хорошо* (*good*) as a predicate.
4. Sentences with the predicate *убережь* (*save*).
5. Sentences with the predicate *рад* (*glad*).
6. Using the comparative degree of the adverb *хороший* (*good*) – i.e., *лучше* (*better*).
7. Using the combination of conditional conjunctions *если, раз* and the particle *уж* (*if so, once so*).
8. Using the negative conjunction *зато* (*but, although*).

Language indicators of I-reactions:

1. Predicative units directly expressing regret, guilt *извини(те), прости(те), прошу прощения, прошу меня извинить, извиняюсь, приношу свои извинения, виноват, сожалею, мне нет прощения* (*I'm sorry, excuse me, I apologize, beg your pardon, forgive me, I regret, I am beyond redemption*). Such units account for 55% of all recorded reactions.
2. Predicative units that are reproduced in a ready-made form and semantically diverse reporting the on the unintentional nature of the committed action, or its recklessness, or the readiness to correct what happened, to be punished, or the intention to correct yourself, or contain a promise not to commit such actions again (a list of 13 cliches).
3. The idea of the unintentional nature of the committed action is expressed by the verbal predicates *хотеть, знать, заметить, (но)думать, (у)видеть* (*want, know, notice, think, see*) in the form of the past tense with the negative particle *не* (*no*), as well as the reproducible phrases [*вышло*] *по неосторожности* (*it came out by negligence/accident*).
4. Sentences with the subject expressed by the pronoun *я* (*I*; can be omitted), and the predicate by a short or full adjective. The predicate contains lexemes denoting the subject's features, the manifestation of which he indirectly apologizes.
5. Impersonal sentences with the predicatives *жаль, жалко, стыдно, неловко* (*sorry, pity, ashamed, embarrassing*).
6. Commissives (speech acts by which the speaker assumes certain obligations) containing the performative *обещаю* (*I promise*).
7. Statements and single words expressing the speaker's agreement with the charge against him *вы правы, да, действительно, согласен, признаю* (*you are right, yes, indeed, I agree, I admit*).

Language indicators of i-reactions:

1. Subjective-predicative sentences N1–Vf, in which the function of the subject is performed by a 1st person singular or plural pronoun of the *я, мы* (*I, we*), and the function of the predicate is performed by a verb in the form of the future tense. Sentences of this type form the absolute majority of speech i-reactions.
2. Subjective-predicative sentences with the subject expressed by a 1st person pronoun, and the compound verb predicate expressed by the modal verb *мочь* (*can*) (less often by the verb *хотеть* (*want*)) in the form of the 1st person singular or plural of the present tense *могу, можем, хочу* (*I can, we can, I want*) and an adjacent infinitive.
3. Subjective-predicative sentences with the subject expressed by a 1st person pronoun, and the compound verb predicate, expressed by the short adjective *должен* (*must*) and an adjacent infinitive.
4. Impersonal sentences with the main member expressed by the predicative *надо, стоит, придется* (*necessary, should, have to*) and an adjacent infinitive.
5. The particles *да, ладно, хорошо* (*yes, okay, well*) expressing an agreement with the interlocutor, or an intention to give in to him.
6. The particle (*ну*) *что ж* in the meaning "I have to agree".

Language indicators of M'-reactions:

Indicators are communicative fragments (speech units reproduced in the ready-to-use form) *ничего, ничего страшного, не страшно, не беда, всё в порядке, всё обошлось, всё нормально, всё хорошо,*



я в порядке, всё отлично, не беспокойтесь, не переживайте, без проблем, бывает, ладно (*nothing, nothing terrible, not scary, it doesn't matter, everything is in order, everything worked out, everything is fine, everything is well, I'm fine, don't worry, no problem, it happens, okay*) etc. (the full list contains 44 cliches). In this case, it is impractical to highlight syntactic models, since we are dealing mainly with cliched speech reactions. Often a phrase contains two different communicative fragments: *Все нормально, ничего страшного (It's okay, don't worry)*. It should also be taken into account that in M<sup>2</sup>-reaction, the frequency of the use of speech etiquette formulas (words and phrases *спасибо, спасибо за беспокойство, до свидания, всего доброго (thank you, thank you for your concern, goodbye, all the best)*, etc.) is increased.

Language indicators of M-reactions:

1. Using the predicates *случаться* and *бывать* in the meaning "to happen", usually in the impersonal use, sometimes as the predicate of a two-part sentence.
2. Sentences with negation containing words with the root *-вин-*: *вина, виноват(ый), винить (a guilt, guilty, to blame)*. In most cases, these are subjective-predicative sentences with the subject expressed by a personal or negative pronoun.
3. Communicative fragments (reproducible fragments of language matter) expressing the ideas that a) everything happened by accident, without intent or because of circumstances have arisen; b) the reason for everything is fate, predestination; c) nothing can be changed.
4. Sentences with a subject expressed by the pronoun *я (I)*, and a predicate expressed by the verb *понимать (understand)* implicitly conveys the idea that the speaker has no complaints about the interlocutor.
5. Subjective-predicative nominal sentences N1-Adj, i.e., with the subject expressed by a noun in the nominative case, and the predicate expressed by an adjective or a pronoun-adjective. In context, they implicitly express an idea that the cause of a trouble is in circumstances, and not in the person actions *Жизнь такая; Это часы такие (This is the life; It's a useless watch)*.
6. Subjective-predicative nominal sentences N1-N1 with lexically matching subject and predicate *Дети есть дети; Правила есть правила (Children are children; Rules are rules)*. In the context, they imply the absence of claims against anyone.
7. Definitely-personal sentences with the verb-predicate *не волнуйтесь, не огорчайтесь (don't worry, take it easy)*.
8. Statements with the word *ничего (nothing)* as a particle in the expression of consent, acceptance of what happened, as well as with the phrase *ничего страшного (nothing terrible)*.
9. Using the words (*ну и*) *ладно, что ж (All right, well)*, the phraseology is *Бог с ним (Literally, God with it = Well, never mind, whatever)* when expressing consent or concession.

Language indicators of m-reactions:

1. Sentences with the verb-predicate *подождать (wait)* in the form of the 1st person plural future tense *подождем (we'll wait)*, sometimes in combination with the particle *давай(те) подождем (let's wait)*. Such sentences regularly include dimensives (components with the meaning of measure). They account for 25% of all obtained m-reactions, and this is quite natural.
2. Statements with introductory words expressing the uncertainty *возможно, видимо, вероятно, может, может быть, должно быть (perhaps, apparently, probably, maybe, should be, possible)*, or less often the confidence *наверняка (for sure)* in what is being said, and the motive (and therefore the implicit meaning) of these statements is to explain and justify someone's actions. Since the speaker is looking for an explanation for the actions of a third person, the noun *причина (reason)* is regularly used. Thus, the marker of these statements is one of the specified introductory words in the presence of the noun reason.
3. Using temporatives with the meaning "after a while": *позже, позднее, в следующий раз, в другой раз, при встрече (later, sometime later, next time, another time, when see)*.

## 5. Methods of the frustration detection

Because of the severe class imbalance, we had to use down-sampling. For this, we took the two most voluminous classes ('E' and 'inf'), and for each of them, we built random subsets of objects, which were smaller than the original class size (30K samples for the class E, and 20K samples for the class

“inf”). We also applied the following pre-processing for the texts. First, all texts are divided into tokens-words, tokens are reduced to lower case, punctuation is removed.

Second, we extracted the pattern-based features, high-level features built with the linguistic patterns from section 4. The cornerstone of the patterns is the relational-situational model of a clause, a heterogeneous semantic network (HSN) of syntaxemes with a specific structure [16]. We define the context-free patterns as a list of HSNs that matches parts of the clauses with implementations of a particular reaction. Those HSNs can be partially defined if some linguistic feature (lemma, grammar case, etc.) of a syntaxeme is not essential for the classification.

We have built 60 such patterns based on the cognitive-communicative action markers revealed for the specific reactions by psychologists and linguists. The pattern-based feature-set generation is a process, which analyzes the message clauses with the dependency and SRL parsers [17] and matches them with the context-free patterns. If a pattern contains lemmas, we utilize the pre-trained Fasttext model [18, 19] to perform the fuzzy comparison between the text and the pattern; therefore, misspellings and synonyms can be processed. Eventually, each clause can be represented with a binary vector, which encodes if the clause matches the patterns.

Further, we build lexical features. For each text, we remove stop words and build *tf-idf* vectors of token unigrams and bigrams. Eventually, models are trained on the obtained vectors. We trained pretty simple models with a sliding window approach to catch the context of the messages. Those models are based on linear support vector machines (SVM), logistic regression, Random Forest, and Gradient boosting to classify the reaction types.

## 6. Experiment Results

All models were trained with weights to balance the classes. We used  $F_1$ -micro metric and stratified 5-fold cross-validation to select the values of the hyperparameters, including the size of the window for context extraction. The best result is 0.73  $F_1$ -micro score for the Gradient boosting trained on the combination of the patterns and lexical features. The pure lexis provides 0.48  $F_1$ -micro only.

Models were evaluated on the holdout sub-corpus with the same class distribution as the original dataset. We use standard classification scores to assess detection reliability, which are precision, recall, and F1-score. Let describe them in more detail.

- $tp$  is the number of correctly detected sentences containing particular type of reactions;
- $fp$  is the number of sentences that do not contain particular type of reactions but are incorrectly assigned to this type by the classifier;
- $fn$  is the number of the sentences with particular type of reaction incorrectly assigned to other types.

The precision (P) is the share of correctly identified sentences from all sentences marked by the classifier as a particular type of reaction. Recall (R) - the proportion of correctly identified sentences of a particular type of reaction and  $F_1$ -score – harmonic mean of precision and recall (1).

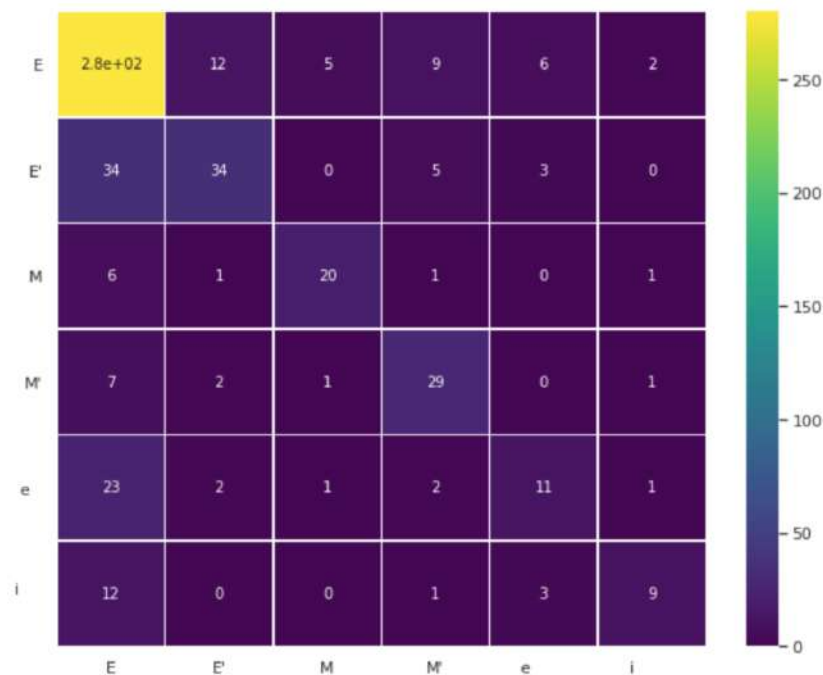
$$P = \frac{tp}{tp + fp}, R = \frac{tp}{tp + fn}, F_1 = \frac{2PR}{P + R} \quad (1)$$

Table 1 shows the results for the classification on the test subset for the best model and features combination (for well represented classes).

**Table 1**  
Performance of the reaction detection on the labeled dataset

Reaction	P	R	$F_1$ -score
E	<b>0.77</b>	<b>0.89</b>	<b>0.89</b>
E'	<b>0.67</b>	0.45	0.54
M	<b>0.74</b>	<b>0.69</b>	<b>0.71</b>
M'	<b>0.62</b>	<b>0.72</b>	<b>0.67</b>
e	0.48	0.28	0.35
i	<b>0.64</b>	0.36	0.46

It is worth noting that the method extracts *E*, *M*, *M'* types pretty accurately. The precision scores are fair for all the types except *i*. Fig. 1 presents the final distribution of the predictions.



**Figure 1:** Confusion matrix

The most share of misclassification is related to the *E/E'* and *E/e* pairs. We believe that is partly because of imbalance of the data; therefore the accuracy for those types can be improved when we extend the corpus. The obtained result could be achieved on such a complex material as social media text due to two conditions: the accuracy of Saul Rosenzweig's typology and the linguistic "formulas" as a "tutor" in machine learning.

## 7. Conclusion

Based on the results obtained earlier while automating the categorization of Rosenzweig Picture-Frustration Study responses, the algorithm was created to automatically classify the reactions to frustration found in social network posts and comments. The methods of machine learning applied to the corpus of network discussions previously marked up by psychologists allowed us to obtain a tool for automatically distinguishing reactions to frustration in posts and comments of social network users. However, we should point to the constraints of the genre of the analyzed text as the limitations of the created method. The method currently works only for two genres: answers in Rosenzweig's test and comments or posts in social media. Recognizing the types of reactions to frustration in online counseling texts or nonfiction or fictional texts may require a new algorithm adjustment.

It is worth noting that the corpus of texts on which the training took place is not large enough and is collected from discussions posted only in one of the popular Russian-language social networks. Further development of the created tool will require expanding the corpus by attracting material from other social networks.

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# Teaching Cyberpsychology: Today and Tomorrow

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## Abstract

Internet psychology, or cyberpsychology, while only rarely recognized as a special discipline within psychology, is nevertheless acquiring popularity among students; actual existence of this popularity is a good enough reason to start teaching cyberpsychology for those educationalists who are highly sensitive to the needs of knowledge consumers. Due to such a demand, over a dozen world-wide universities are suggesting programs aiming at learning and getting a degree (most often, Master's) in cyberpsychology. It is more than likely that the number of such educational programs will be rapidly growing in the nearest future. Thus, the time has come to start discussions related to particular ways of teaching cyberpsychology first to psychology students, and probably second, to computer science students as well.

The paper includes a brief review of the impact of digital technologies on human beings' personality and cognitive processes. Diverse views on the likely risks related to such an impact are mentioned, as well as organizational measures targeted to lessen the risks. Among other points of view, the well-known Socrates' argumentation is discussed: the ancient thinker believed that human memory loses a lot in its functioning with the advance of alphabet and writing. On the contrary, Vygotskian psychology states that sign systems such as alphabet, as well as much more sophisticated semiotic theories lead human mnemonic mechanisms to enrichment and psychologically useful transformations.

After it has been stated that the views on the usefulness of digital technologies for functioning of human brain and psychic processes are differing, it is once again concluded that the whole content related to cyberpsychology is highly actual. In fact the cyberpsychology classes are already taught in diverse universities; the pioneers are several Irish and British universities. A few universities in Russia have opened such programs as well. The currently available textbooks are briefly analyzed in the paper: particular positive provisions in these textbooks are discussed. Finally, public attention was drawn to the non-numerous ways of teaching cyberpsychology at the bachelor' and master's levels.

## Keywords

Cyberpsychology, teaching, Google effect, psychological impact, risks, human-computer interaction, cyberpsychology in Russia, teaching cyberpsychology world-wide

## 1. Introduction

The impact of digital technologies on human beings' cognitive processes is undeniable. Not everyone accepts this fact optimistically; concerns are more common. For example, critically minded experts have not once argued that online, or computer supported learning does not allow children to develop adequately functioning brain structures for remembering items and retrieving them from memory. Critics often point to the so-called "Google effect" [1]. According to this somehow controversial effect, the use of the Internet changes the way we remember diverse items: the memory mechanisms of people who are active in the use of search engines start to change functioning: it is not the useful content itself that is remembered, but the way (i.e. files, websites, sequences of requests to a database) to reach the area in which the needed information is located. Thus the structure of mnemonic processes becomes changed, while computers, gadgets, smartphones and the cyberspace itself turn into a kind of

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"external memory." Some social and psychological transformations of this type were predicted long time ago by McLuhan [2], who passed away shortly before the rise of the digital revolution.

## **2. Digital Technologies and Human Brain: Positive or Negative Collaboration?**

Similarly to the abovementioned transformation of psychological processes responsible for memory functioning, thinking-related operations and volitional processes get modified as well. Besides, the haptic mechanisms of tactile sensitivity may suffer due to excessive symbolization, which replaces processes regulating the acquisition of proprioceptive sensitivity while doing screen work, even when 3D systems are used. In addition, it is often argued that social relationships in an online environment are not equivalent to real-life relationships of liking, friendship, antipathy, love, or dislike due to a lack of experience in online empathy or incomplete knowledge related to its acquisition as well as delayed formation of emotional intelligence. Usual squabbles between teenagers, often short-lived, may become presumably stagnant, embrace a large audience, and turn into cyberbullying or cybermobbing mixed with patterns of hate speech. Taken younger students, the skills responsible for mental arithmetic calculations stay underdeveloped due to the easiness of calculations mediated by the smartphone's "calculate" option. Finally, success in popular video games correlates with prolonged gaming sessions; that means, effectiveness of studies at high-schools or universities suffers, while the interest to mastering a particular profession becomes delayed. At the same time, in the absence of the necessity to take accurate and long notes by hand, fluent shorthand skills become impaired and fine motor skills stay insufficiently developed.

Dozens of such "horror stories" as well as real-life warnings referring to the so-called "Digital Dementia," partly supported by results of refined neuroscience experiments are presented in the monograph by a German scholar M. Spitzer [3]. His views have been supported by numerous educationalists. Many arguable considerations on the theme, based on diverse perspectives, have been expressed recently [4, 5, 6]. Patterns of peculiar folklore have developed around the intrusion of digital technologies into everybody's private life – school studies, work, recreation, gaming, fact-checking and information retrieval, small talk, etc. These patterns may insert a touch of mysticism; for example, some websites are believed to be associated with biographies of people (actually, females) who were either never born or happened to mysteriously disappear [7]. A huge number of people, mostly young or very young, deal with fantasies, with historic or futuristic content when they play Massively Multiplayer Online (MMO) Games. An abundance of magical content gradually passed from the still far-off times when their parents or older brothers/sisters enjoyed playing text-only role-playing games called MUDs – this abbreviation means either multi-user dungeon, or multi-user dimension together with multi-user domain, and most likely, all the three interpretations together [8].

Attempts to develop adequate psychological mechanisms for multitasking are often argued to lead, for the most part, to slower performance of work activities, since "simultaneously" and "concurrently" performed actions are in fact performed in turn, while the attention mechanisms perform frequent cognitive switches [9, 10]. At the same time, an opposite viewpoint on multitasking – being a rare personal ability or a skill highly developed within the representatives of the youngest generations – is widely presented and substantiated in the current literature [11, 12].

In fact, many caveats are debatable, except that cyberbullying has become a real problem that is difficult to solve, and the dangers of the Internet addiction (the preferred term for the latter is nowadays the "problematic" use of the digital technologies) are becoming a reality [13]. Namely, in 2018 the World Health Organization (WHO) selected the addiction to video games (but neither an addiction to interactions via social media or other types of addictive behavior in the cyberspace) and included a corresponding section in the revised International Classification of Diseases (ICD-11 handbook. The American Psychiatric Association, which is responsible for updating the Diagnostic and Statistical Manual of Mental Disorders (DSM) handbook, has not yet included neither video gaming nor any other type of cyber addiction in the revised DSM-5 handbook, while the WHO has recognized this possibility admissible in the near future.

A number of negative aspects of computers, smartphones, gadgets, and the Internet use cannot be investigated and tested until members of the generations who became accustomed to digital

technologies in their childhood have matured. Those of them who have already walked this path and managed to describe and reasonably evaluate their experiences have already presented and shown themselves as a highly educated and hardworking generation [14]. Just like other generations and regardless of the use of a particular social medium, they occupy social positions, which they deserve, within long-established human networks [15].

### 3. Memory and its Instruments – Culture Perspectives

With all disagreements between contemporary scholars in the details referring to the impact of the modern rapidly developing technologies on human mind, the story actually goes far into the cultural traditions of humankind. Socrates who certainly personified oral culture of truth-seeking techniques, openly expressed his anxiety related to the idea that human beings may use sophisticated means, such as written signs, to proceed in philosophical dialogues and get prepared to win in *maieutike* discussions. Plato who certainly personified an opponent culture, namely epistolary tradition, reported his guru’s concern that acquisition of written culture may bring problems, including psychological problems, to human mind.

Coming back to Socrates it is worth to quote a well-known point in the Plato’s dialogue “Phaedrus.” Namely, the Egyptian king Thamus replies to Theuth, the inventor of signs which enable processes of writing and reading: “In fact, it will introduce forgetfulness into the soul of those who learn it: they will not practice using their memory because they will put their trust in writing, which is external and depends on signs that belong to others, instead of trying to remember from the inside, completely on their own. You have not discovered a potion for remembering, but for reminding; you provide your students with the appearance of wisdom, not with its reality. Your invention will enable them to hear many things without being properly taught, and they will imagine that they have come to know much while for the most part they will know nothing. And they will be difficult to get along with, since they will merely appear to be wise instead of really being so” [16, 551-552].

It is quite easy to admit that king Thamus’ concerns did not play an important role throughout the history of civilization. Indeed, our culture has been enriched with various artefacts mediating human cognitive processes such as remembering, perception, differentiation, thinking and decision making, imagination, recognition of visual, haptic and oral (especially verbal) stimuli, etc. It was rather rarely that scholars would come across “practitioners of mnemonics” in terms of Umberto Eco who recalled several old-time stories referring to people who lacked the strength to refrain from remembering all the stuff they had a misfortune to bump into [17]. Moreover, Eco criticized the habit common to the younger generations of our contemporaries, namely of making hundreds of photographic images depicting different events or notable places and saving these digital (only rarely printed) images instead of memorizing landscapes or persons in order to get pleased afterwards when and if recall them mentally.

A thorough psychological study of a Russian mnemonist Shereshevsky, briefly called in textbooks as S., was presented in a popular book by Alexander Luria [18], a first-generation follower of Lev Vygotsky – the founder of the cultural psychology theory. Both Eco and Luria insisted that the set of mental processes mentioned above needs to be enlarged and include techniques for forgetting, not only remembering. Umberto Eco sounds critically about processes which may be called the “Google effect” - he stands against “the loss of memory”, the process he corresponds with the advance of digital technologies [17]. On the contrary, Lev Vygotsky’s theory stands as a basis for investigations of the “Google effect” as well as diverse similar effects. Thus, the cultural psychology is a basis, at least relating to what is being done in Russia, in the field of the Internet psychology or cyberpsychology [19, 20], namely in psychological studies aimed at finding out the numerous effects inherent of intensive investigations of human behavior when it is mediated by all sorts of digital technologies.

The discussion of positive and negative impacts – actual or prospective – of digital technologies on psychic processes needs to go much further; nevertheless, we will not proceed in full depth since this is not the main theme of the current paper. The brief review concentrated exclusively on mnestic processes (rather than many other higher psychological functions, in Vygotsky’s terminology) had no other purpose than to illustrate some trends in philosophical, psychological and physiological debates

coming from the ancient times, with quite a good perspective of turning into an eternal scholar discussion.

#### **4. Development of Cyberpsychology in Russia and Abroad**

The cultural history of the Internet development in Russia, mainly parallel to socioeconomic, political, entrepreneurial and legal changes, has been traced in the works of numerous authors and from diverse perspectives, to mention just a few [21 – 25]. The main areas of research, methodology and variety of behavioral content in the cyberspace related psychological studies, held in Russia, have been presented and discussed elsewhere [20, 26, 27]. Psychological studies referring to the Internet mediated behavior may be collected under an umbrella term cyberpsychology. Taken the worldwide scale, volume and quality (which may very likely called high quality) of relevant publications, the studies referring to cyberpsychology are close to form a mainstream both in modern psychology and in the neighboring disciplines [28 – 32].

The Introduction to the most recent volume on cyberpsychology, which brought together an international team of authors, starts with the words saying that cyberpsychology is the "discipline of understanding the psychological processes related to, and underlying, all aspects and features of technologically interconnected human behavior" [32, p. XV]. The chapters collected in the handbook present an up-to-date image referring to the development of cyberpsychology.

The stages of development and the current approaches within the cyberpsychology related research in Russia have been recently overviewed and described [20]. Four stages have been marked. The first stage was pre-Internet one: rather few experts in telecommunications and cybernetics were doing their best to unite the existing computers via networks; psychologists failed to find a better use of their abilities than to study the behavior of specialists united via local area networks (LANs) due to inexistence of global ones. The second stage was characterized by accidental and non-systematic access to global computer networks; at this stage the Vygotskian culture psychology was undoubtedly used as the leading theoretical platform. The third stage coincided with full access of Russian users to the global Internet services; that means, psychologists got a chance to construct reasonably large samples of research participants, and besides, they made a try to apply a variety of theoretical approaches: for example, several studies have been done within the methodology of positive psychology. Finally, the current stage can be characterized as the right time for mass studies of both adults and children, including preschoolers; theoretical variety is widely expanded, compared to the third stage; new areas of research have been developed, such as online addictions or virtual/augmented studies; the cyberpsychology got its place within the bundle of neighboring disciplines, including computer science, education, media studies, medicine, philosophy, communication studies, sociology, culture studies, etc. One of the consequences says it is time to start learning and teaching cyberpsychology.

In the following sections we will briefly discuss the results of our search aimed at identifying institutions that could certainly be named pioneers in teaching cyberpsychology; the main features of appropriate educational programs will be discussed as well. To the best of the author's knowledge there are still not many colleges and universities which provide classes in such a newborn discipline. Nevertheless, it is worth to add that in the last two or three years a certain leap is taking a place: nowadays we can name substantially more such educational institutions than before the specified time. Most usually, the pioneering universities suggest MS degrees and accept students with diverse bachelor's backgrounds – often in media or computer science, education, social care, business administration, etc. That means, the applicants for a master's degree in cyberpsychology may hold diverse BS degrees, not necessarily in psychology. Quite likely, the cyberpsychology curricula should vary according to the specialty the students received earlier. Right now though, this particular aspect cannot be fully covered.

#### **5. Teaching Cyberpsychology**

Teaching cyberpsychology seems to be a totally new world-wide experience; generally, this is true but not without a single exception, namely the Cyberpsychology Master's program at the Dun



Laoghaire Institute of Art, Design and Technology (IADT) in Dublin (Ireland): this program is active for over ten years. Prior to making attempts to get a MS degree, Irish students may take an undergraduate BS program in Psychology and Computing (which is close to being a prerequisite for cyberpsychology as the next degree) from the University College Corc (Ireland).

For almost a decade, the IADT was staying the only spot specializing in teaching cyberpsychology. Currently, there are newer educational options too, mostly from British universities: along with Ireland, the UK is leading the way in training cyberpsychologists. For example, after a short break, the second old Master’s program in cyberpsychology is active at the Nottingham Trent University (Nottingham, UK). Given high qualifications of professors and lecturers in the two institutions (IADT and NTU) – they have the priority in teaching cyberpsychology – the quality of knowledge acquired while mastering the fundamentals of the discipline can be considered well advanced.

Other relevant programs in the UK include Bachelor’s/Master’s in Cyberpsychology from the University of Wolverhampton, the University of Bolton, the University of Buckingham, the University of Central Lancashire in Preston and the Bournemouth University. In the United States, the Cyberpsychology Master's program has been offered at the New Jersey Institute of Technology (NJIT) in Newark (NJ); NJIT is recognized as one of the nation's oldest and best engineering and science schools. Two universities in Virginia must also be mentioned: the Regent University in Virginia Beach and the University of Norfolk. Several specific programs within the relatively broad field of cyberpsychology are suggested elsewhere within the American universities. A program Cyberpsychology and e-Health is open at the University of Sydney, Australia.

Outside the English-speaking world, students too have chances to master cyberpsychology. For example, this specialization is open at the Izmir Bakırçay University in Turkey. The Academic Institute of Psychology (Akademisches Lehrinstitut für Psychologie) at Lübeck, Germany together with the University of Applied Sciences for Management & Communication in Vienna (FHWien der WKW) – the latter recommends itself as «the Austria's leading university of applied sciences for management and communication» - is promoting an MS program «Cyber Psychology of Online Communication». In fact the education under this program is not limited to topics dealing exclusively with social media and online communication: the curriculum includes for example the fundamentals of artificial intelligence, online gaming, e-business and e-commerce – thus covering several most important themes within cyberpsychology. The process of education is conducted exclusively in English, it lasts three semesters with the final exams at Vienna (FHWien der WKW), and – what should be specially mentioned – is operated online: web ads say that this is «a 100 % distance learning degree program, making it easy for you to study while working». The two abovementioned collaborating institutions emphasize that while the successful students will get a master’s degree in «Cyber Psychology of Online Communication», they will not get enough competences to apply for a position of “psychologist”.

A program Cybertherapy and Neurocognitive Rehabilitation is offered at the University of Lusofona in Lisbon (Portugal): it is related to the use of virtual and augmented reality systems in clinical psychology to perform therapeutic and rehabilitative tasks. The title of this special program corresponds to several problem areas, common for the international community of cyberpsychologists, including psychologists, physiologists and neuroscholars, social workers and specialists in engineering and computer science (primarily in the development and application of virtual and augmented reality systems). Cyberpsychologists are fully involved in research and in applied work of the iACToR members. The community – namely, the International Association of CyberPsychology, Training, and Rehabilitation (iACToR: <https://iactor.ning.com/>) – organizes annual world-wide working meetings as well as local and/or narrow-topic conferences, when and if there is no threat of pandemia: due to the risks of infection, the last-year annual conference was not held in 2020.

Since the universities in Ireland and in the United Kingdom are leading in terms of training cyberpsychologists, it is not surprising that in these countries there are professional associations which unite educationalists and researchers in the field. Thus, within the Irish Psychological Society there is an offshoot for professionals who study the impact of media, cyberpsychology and additionally art psychology (<https://www.psychologicalsociety.ie/groups/Special-Interest-Group-in-Media-the-Arts-and-Cyberpsycholog>). The British Society of Psychologists also contains a

Cyberpsychology Section (<http://cyberpsychology.org/about-us/>). Indian experts within the Cyber Psychology Association suggest various courses dealing with cybersafety and cyberpsychology. Cyberpsychologists in the United States (foreigners are also allowed) are mostly united in the 46th division of the American Psychological Association (APA), called the Society for Media Psychology and Technology of the American Psychological Association (<https://www.apa.org/about/division/div46>). At the same time, American and international psychologists studying human behavior in cyberspace have not created any global professional associations; many of them are members of the Association of Internet Researchers ([www.aoir.org](http://www.aoir.org)) along with specialists in social or computer science, sociology or media studies.

Thus, we can state some positive shifts in regional educational policy: cyberpsychology is now being taught; there are already university graduates and alumni in Ireland having an academic degree in cyberpsychology; in addition, recently several associations of cyberpsychologists began to be formed within national psychological societies.

### 5.1. Prospective Ways of Teaching Cyberpsychology

It is reasonable to start discussing what are (and should be) the ways of teaching the totally new discipline, what is the particular content to be lectured and to be learned by cyberpsychology students? There are several prospective ways, regarding the current teaching and learning perspectives; two of these ways are supported by the published textbooks.

One of the handbooks [28] is an extended version (marked as the second edition) of the textbook on Human-computer interaction (the first edition) – written by Kent Norman. The Human-Computer Interaction (HCI), also known as Computer-Human Interaction (CHI) is a well-developed discipline which is traditionally taught world-wide as a part of computer science programs. Two scholar associations – HCI and CHI – organize in turn yearly conferences with thousands of participants: the discipline is quite a popular research and teaching/learning field. The extended second edition of the handbook [28] include (along with fundamentals of cognitive science, artificial intelligence, software engineering, usability and design of interfaces) purely web behavior content related for example to specifics of personal traits, social media and elements of social psychology, video gaming and digital entertainment, assistive technologies, use of virtual and augmented reality for psychological rehabilitation, etc. Thus in the second edition the author has made a wide step towards the most current issues in cyberpsychology. The Norman's textbook [28] may be universally useful as the major source for teaching cyberpsychology to competent students holding a bachelor degree in computer science.

Another textbook on cyberpsychology was published by psychologists from the Dun Laoghaire Institute of Art, Design and Technology [29]. The Introduction to the book says that a reader may misunderstand “what the difference is between human computer interaction and cyberpsychology. This book focuses on the latter, namely on the psychology of how people behave in a technologically connected environments” (p. XV). While there are indeed good reasons for misunderstanding, the difference from the Norman's attitude towards teaching cyberpsychology is evident. Particularly, content related to HCI is limited to only one (out of 21) chapter, description of cognitive processes is limited to methods of distraction when online, large chapters deal with self-concept, group dynamics, online relations, cyberpathology, cyberpsychological therapy and rehabilitation. Besides, the authors discuss legal issues related to cyberpsychology, as well as specifics of working processes or education online, major issues of online marketing, most popular themes such as psychology of cybersport and gaming. The use of virtual/augmented reality and artificial intelligence systems in psychology is too examined in detail.

It is easy to come to the conclusion that the latter textbook [29] is limited to discussions of web effects, particularly the Internet mediated interaction, cognition and entertainment (including video gaming) and is not designed to cover the ideas and models worked out for human-computer interactions. Not surprisingly, the materials related to the web effects and web behavior are more fully represented in the latter textbook. The materials presented in the former textbook [28] may hardly been taught during rather short time (usually two or three years) of learning to get a Master's degree: that means, this textbook may be used for teaching BS and MS level grades consistently. The latter

textbook [29] is not covering the HCI materials; it can be used parallel to the abovementioned handbook [28] for example to teach Master's degree curriculum in cyberpsychology to students holding a bachelor degree in computer science or in human-computer interaction, or else to other students who are competent in computer science. It is useful to mention that the textbook under discussion [29] is enriched by several monographs and edited collections of papers [33, 34] which often present more specified and targeted content than the major textbook does. The basics of cyberpsychology may be also learned from a small but thoughtful popular book by Amichai-Hamburger [35]. The author's possible futuristic speculation prompts that new textbooks may appear soon enough.

Lastly, the third way of teaching cyberpsychology is not fully covered by textbooks since it is based on the programs of particular lecturers' courses with *ad hoc* literature sources, such as monographs, collective monographs or edited collections of chapters, and journal articles. Supposedly, the most part of world-wide lecturers prefer exactly this way of teaching cyberpsychology. The author, for example, is teaching in the Moscow University an introductory course of cyberpsychology to general psychology students (they are learning to receive an equivalent of a Master's degree) during the last 26 years; needless to mention, the main components of the course have been several times seriously updated, following the innovations in digital technologies and in the changing ways the human beings use new technologies (what is sometimes called Web 2.0.). It is possible to notice that even definitions and terminology have changed a lot during this rather long time period: the fact of numerous changes has been thoroughly confirmed in a structured review [36] of the academic sources published from 1994 up to 2019 on the themes close to the use of social media, also known as «virtual communities» and «social networks», while the starting point was the shortly used and long-time ago forgotten term «computer-supported social networks». At the same time, it is reasonable to draw attention to a recent attempt to give a somewhat ambiguous name «cognitive gadgets» [37] to several evolutionary cognitive mechanisms which ensure our rational and intelligent social and cognitive behavior.

## 5.2. Teaching Cyberpsychology in Russia

Like the whole world, Russian educationists noticeably lag behind from the Dun Laoghaire Institute and from several British universities in teaching cyberpsychologists and in uniting specialists in cyberpsychology within professional communities. At the same time Russian universities do not lag behind educational institutions in the USA, European Community, Australia and other countries: during the last two years several universities in Russia have already started to teach cyberpsychology to psychology students. In particular, Master's programs in cyberpsychology are already open at Moscow (namely, at the Moscow Lomonosov State University and at the Russian State Social University) as well as at least two cities with high scholar traditions, such as Nizhny Novgorod (the Lobachevsky State University) and Stavropol (the Stavropol State University); besides, several more universities in Russia are about to start teaching this discipline in the Fall, 2021. To the best of the author's knowledge, similar specializations are being also opened at several universities and colleges in the nearby former Soviet states: Belarus (in Minsk), the Ukraine (in Odessa), Moldova (in Kishinev).

This initiative is reasonable: on the one hand, the accelerated development of digital technologies and the daily use of smartphones, computers, tablets and/or various gadgets, give reasons for concern that intensive digital life may lead children and adults to unexpected social and psychological risks; on the other hand, it is easy to mark a noticeable enthusiasm and fandom attitudes towards gadgets which increasingly replace traditional ways of implementing communicative, labor, cognitive, entertaining (such as video gaming or YouTube/Netflix watching) and other types of activities, mediate dyadic or group relationships and act as a new sort of media. All this increases the importance of conducting psychological research aimed at identifying the real pros and cons of the daily use of digital technology products. To carry on such investigations and to mark recommendations referring to the age related and cognitive/mental development related specifics in the use of digital technologies, there is a need in a growing number of professionals in cyberpsychology.

Neither of the first two prospective ways of teaching cyberpsychology, mentioned in the previous section, is being used in Russia, mostly due to the fact that no textbooks in Russian language are available. To the best of the author's knowledge, all the Master's current and planned would-be cyberpsychology programs are targeted on teaching bachelors in psychology and/or neighbouring disciplines in social sciences or humanities – or at least those who had previously got education in engineering but acquired strong interests in a psychology-centered field of knowledge. Thus, students in computer science and applied mathematics as a rule are not systematically taught fundamentals of cyberpsychology.

The catalogue of scientific and educational disciplines which are being developed in Russia does not include such points as “Human-computer interaction” (HCI) or “Computer-human interaction” (CHI) – the disciplines that are well-developed outside Russia [28]; research work within these fields has been done (if any) by non-numerous enthusiasts at best [20, 27]. As a result, there is no way that the newcomers into the Master's programs (the programs last 2-3 years) in cyberpsychology can be taught the full course of HCI/CHI: the volume of material to be necessarily taught may be compared to acquiring additionally to the introductory and advanced courses in cyberpsychology also full education in computer science.

That means, the approved way of teaching M.S. in cyberpsychology in Russia is the third of abovementioned ways, i.e. teaching to comprehend and probably correct patterns of web behavior – individual or group – and explain web effects but not advanced models common for such disciplines as computer science or HCI/CHI. Practice will show which way of teaching and learning cyberpsychology will become the most up-to-date in the close time period. Right now, the Russian lecturers in cyberpsychology lack textbooks and construct *ad hoc* programs; students follow the lectures and read diverse literature sources, i.e. research books and papers recommended by the lecturers.

This approach to teaching and learning cyberpsychology has already been criticized by Ukrainian experts from the Laboratory of Crisis and Disasters Psychology at the Ukrainian National University of Civil Protection. They mark that the «leading scholars from Europe and North America» have come to a consensus saying that «academic and practical field of cyberpsychology is much broader than Internet psychology or web psychology and is including interaction between man and machine, in particular human – computer interaction (HCI)» [38, P. 145]. Instead, as the Ukrainian experts mark, the «Russian school of cyberpsychology stays ... at an earlier stage of equating cyberpsychology and Internet psychology» [38, P. 146].

Thus, as it is easy to notice, views differ, which is a positive fact. Indeed, any differentiation of views brings society closer to following different or even opposite educational paths, checking their effectiveness and making obviously identified corrections aimed at building sound educational directions, ultimately – at offering particular students who keep genuine interest in cyberpsychology the most suitable trajectories of receiving high-quality education. Anyway, it is the first time in the history of our civilization that such a new field as cyberpsychology, or the Internet psychology has started to be a regular course taught world-wide at colleges and universities, both on the bachelor's and master's level.

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# Generation Z Social Capital as a Result of Digital Socialization

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## Abstract

The purpose of the article is to reveal the features of the social construction of reality by representatives of generation Z and to assess, on the basis of the data obtained, the evolution of the social capital of modern society. Based on generational analysis, social constructivism, and research on social capital, the authors surveyed 201 students enrolled in higher education institutions in St. Petersburg. The focus of research attention was such characteristics of respondents as independence in decision-making, the ability to maintain rational thinking and conduct critical discussion, interaction with real and virtual spaces, and the cognitive foundations of social communications. Based on the data obtained, a number of important conclusions were drawn about the loss of social capital and the weakening of social ties, on the need to differentiate between social, cultural and civil capitals, on capital compensation in a virtual environment, as well as on the influence of modern technologies on the way of building social ties. This work is a continuation of the work of a team of authors on the study of the features of Generation Z, begun in 2019.

## Keywords

Generation Z, social capital, virtualization, phygital reality, digital behavior

## 1. Introduction

The loss of social capital is becoming a problem in modern society, and Generation Z follows these trends with the peculiarities of their behavior and construction of reality. In general, it can be recognized that the “digitization” of social interaction reduces social capital every year.

Generation Z is currently a fairly small group. The total number of Russian “digital natives” today is approximately 22 million. (for comparison: “millennials” outnumber “buzzers” by about 1.6 times [1]). There is every reason to believe that Gen Z are more socially isolated from the mile than other generations. This is confirmed by the following social trends: the number of single parents in 2017 amounted to a third of all Russian families, and the number of single mothers over the past 20 years has increased 3 times [2]; it is also worth noting the low level of trust of Russians to each other - 56% of young people initially regard strangers with distrust (compared with an average value of 48%) [3].

The decline in social capital, especially characteristic of the youth environment, does not apply to the description of exclusively Russian reality. Generation Z, as noted by K. Trinko [4], is the loneliest generation in the United States. Cigna conducted a survey showing that about half of American citizens sometimes or always feel lonely, and one in five Americans surveyed reported that meaningful face-to-face meetings occur less often than once a week. At the same time, the survey did not reveal a significant difference in the levels of loneliness between those who often or, conversely, rarely used social networks [4].

A 2017 report for Senator J. Michael Lee of Utah described the following indicators of declining social capital in American society: Monthly church attendance has declined from the early 1970s to the present - from 50% to 57% up from 42% to 44% now; in 1974, a third of Americans communicated

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with their neighbors several times a week, while in 2017 only 19% do it; people spend less time on casual conversations with colleagues, going from an average of 2.5 hours a week in the mid-1970s to just under an hour in 2012; families are also getting smaller, and the percentage of children raised with or without a parent has doubled, from 15% to 31% [5].

Perhaps the problem of social capital has a solution in its transformation - it flows from the physical world to the virtual world. D. Hessekil notes that generation Z has a much larger global network of connections and friends, which is worth learning from them [6]. Growing social disunity may well be accompanied by an increase in social connections in the digital world. At the moment, it is difficult to give unambiguous answers to questions about the pace at which the transformation of social capital is taking place, whether it is appropriate to compare social and virtual capital, and what are the possible consequences of these processes. However, in any case, the study of the specifics of the social capital of generation Z is necessary in the context of this topic.

## 2. Literature review

The study of the social capital of generation Z is based on the structuralist-constructivist theory of Bourdieu. The special type of reflexivity that is characteristic of Generation Z is in fact a form of cultural capital. Cultural capital in Bourdieu's interpretation is the sum of all the cultural resources of an individual [7]. Bourdieu identifies several types or states of cultural capital - incorporated, which involves the accumulation and creation of cultural potential by an individual, objectified, that is, capital in the form of cultural things, and institutionalized, that is, certificates of academic qualifications issued by various institutions [8; 9]. Among the followers of Bourdieu, we are most interested in the concept of "reflective habitus" by Sweetman [10], from the point of view of which reflexivity as a form of social capital is an advantageous property for more financially secured and educated students. Bourdieu's concept of cultural capital is effectively used to interpret the characteristics of youth [11]. Attempts are being made to quantify cultural capital [12; 13].

An important conclusion from Bourdieu's concept of cultural capital is that cultural capital is highly dependent on education and the introduction of innovations in society requires an impact on the individual's habit. Bourdieu noted that cultural capital flows from habitus [14]. Habit, in turn, turns out to be extremely dependent on the external social environment [15]. Creation of an environment favorable for the implementation of innovations is a promising direction for the development of social technologies.

R. Putnam's concept of social capital turns out to be very close to understanding cultural capital in Bourdieu's concept as part of a reflective habit. This theoretical analogy is especially important, since there are different interpretations of social capital and this concept itself was introduced into scientific circulation 6 times with different semantic shades [16]. Putnam understands social capital as social connections, networks, and norms that involve a relationship of reciprocity and trust. The characteristics of reciprocity and trust strongly influence the nature of social capital. In particular, in the book *For Democracy to Work*, Putnam cites the results of a study of Italian society, in which there is a significant difference between the north and south of the country [17]. The more economically successful northern regions of Italy are characterized by a large number of different communities and associations. In the south, on the contrary, mutual distrust is more widespread; nepotism and corruption flourish in society. Obviously, this situation is the result of certain cultural characteristics of the community, and in this interpretation, Putnam's social capital is close to the concept of Bourdieu's cultural capital.

In the context of the increasing virtualization of social interaction in the generation Z environment, the concept of Bourdieu's social capital is becoming extremely relevant. It demonstrates significant heuristic value for both theoretical interpretation and empirical study of the characteristics of the digital generation.

## 3. Theoretical and methodological foundations of the study

This article represents the second phase of Gen Z research. A series of studies in this area began in 2019 (DTGS-2020). This time, the focus of the study was the question of the formation of social capital in Generation Z in the context of the social construction of reality. The author's questionnaire was



compiled, which made it possible to identify the characteristic features of generation Z in the process of constructing social reality. The questionnaire assumed work with a random sample of 201 first and second year students from four universities in St. Petersburg. The sample size in this study was not large due to the difficulty of accessing students in a pandemic. In addition, the project itself involved working with three different questionnaires, which ultimately increased the volume of work to 600 observations.

The research program and the questionnaire were developed taking into account the theoretical concept of social construction of reality by P. Berger and T. Luckman, which is an expression of the theoretical and methodological approach of social constructivism. Interpretation, which is characterized by the inductive logic of research, laid the foundations for the epistemological orientation of our research. Interpretation of facts is based on the concepts of analysis of social capital by P. Bourdieu, R. Putnam, as well as theories aimed at analyzing generations by N. Hove, W. Strauss, J. Palfrey, D. Stillman, D. Tapscott, M. Prensky, Tolstikova I.I., Mamina R.I. and others.

This article presents the stage of the research associated with the analysis of the features of the social construction of reality by generation Z, therefore, as a research method, a questionnaire survey of 201 students was chosen, the choice of which met the requirements of representativeness, since it repeated the sex and age structure of society characteristic of the age cohort of 15-19 years old. those. 49% of men and 51% of women [1]. The sample is dominated by representatives of young people aged 18-19, their number is 74% of the total number of respondents. Analysis of the survey results and their interpretation allows us to establish a clear connection between the features of the social construction of reality by generation Z and the formation of their social capital.

The limitations of the study were related to the specifics of the object. It is difficult to separate the features of perception and changes in reality by generation Z, associated with the specifics of this cohort, from the process of primary and secondary socialization under the influence of social institutions. We understand these limitations.

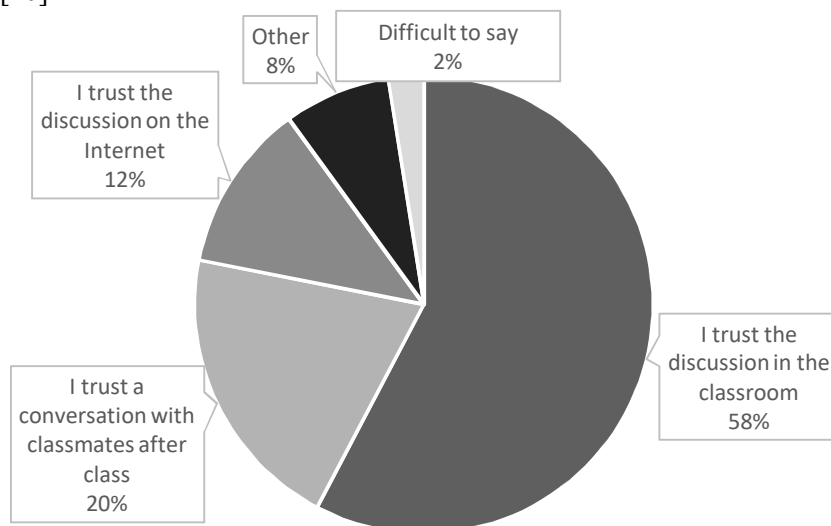
#### **4. An empirical analysis of the social construction of reality in Generation Z**

The formation of social capital is one of the keys to a successful career, which is an important goal, especially for representatives of generation Z, who are gradually becoming equal members of society. This process proceeds simultaneously with the development of the surrounding world by young people, which means not just the assimilation of social values and norms, but also a conscious transformation of reality. The studies of the first stage (2019-2020) showed that despite the dominance of individualistic values in the profile of representatives of generation Z, he was also not free from the collectivist values of mutual assistance and empathy, which generally reflects the specifics of Russian culture [18].

The survey on the social construction of reality was presented by a series of fourteen questions reflecting the most important aspects of this social-cognitive process. So to the first question of the informational part of the questionnaire about the peculiarities of understanding the meaning of the concept of patriotism, the following answers were received. 48.8% of the respondents answered that they would find out the content of this concept on their own, either on the basis of experience or on the basis of reasoning. 25.9% of respondents (representatives of generation Z) answered that they would be guided by the opinion of experts. And only 9% of respondents would discuss this issue when meeting with friends or online. Thus, the frequency distribution of these responses allows us to conclude that generation Z predominantly seeks to penetrate the meaning of basic concepts either independently or based on the opinion of experts, which means that it is capable of making independent and balanced decisions. When asked how representatives of generation Z interpret such abstract concepts as "homeland", "religion", "humanism" 36.3% of the respondents answered that they do it with the help of concepts and formal logic; 27.9% visualize these concepts; 22.9% try to present these concepts intuitively and 11.4% represent some kind of visual and sound object. Thus, we can conclude that Generation Z has a penchant for analytical thinking, but not in the overwhelming majority. The hypothetical situation regarding the preparation of a report on the topic of comparative analysis of market and command economies assumed the identification of a tendency towards independence in the formation of a new product of knowledge. 40.3% of respondents answered that in order to prepare this

material, they will read some serious books and refer to primary sources. 33.8% of respondents answered that they would limit themselves to reading articles on the Internet. 15.9% of respondents said they would read books "diagonally". 5.5% will base their talk on short retellings of books. Based on this distribution, we can conclude that, in general, students strive to gain solid knowledge for presenting a report on a new and complex topic, however, due to time constraints, they make rational decisions about preparing reports based on more accessible sources from the Internet.

The next question in the questionnaire concerned decision-making in conditions of diametrically opposite points of view. It was formulated in relation to the acceptability of euthanasia, which was "discussed" in classroom and online. The question was how the panelists define a valid point of view. According to the answers of the respondents, 57.7% of them will adhere to the results obtained during the discussion in the group, 20.4% of the respondents trust the results of the discussion with fellow students after classes. And only 11.9% will rely on the results of online discussion. Thus, in spite of their "phygital" characteristic [19], most representatives of generation Z build an idea of the world and make judgments obtained as a result of real interaction and discussion, where the presence of social capital plays an important role. The question of discussing the problem of animal welfare assumed the identification of the position of representatives of generation Z regarding the possibility of multiple opinions. The situation when many opinions appeared in the course of the discussion may be associated with the possibility of the simultaneous existence of several correct opinions. This was the answer of 39.8% of the respondents. 26.9% of respondents came to the conclusion that any opinion can only be partially true. 25.9% of respondents answered that opinion is always subjective and it is pointless to seek the truth. And only 7% said that there is always one correct opinion. This distribution allows us to conclude that the young generation is ready for discussion and the development of deliberative democracy [20].

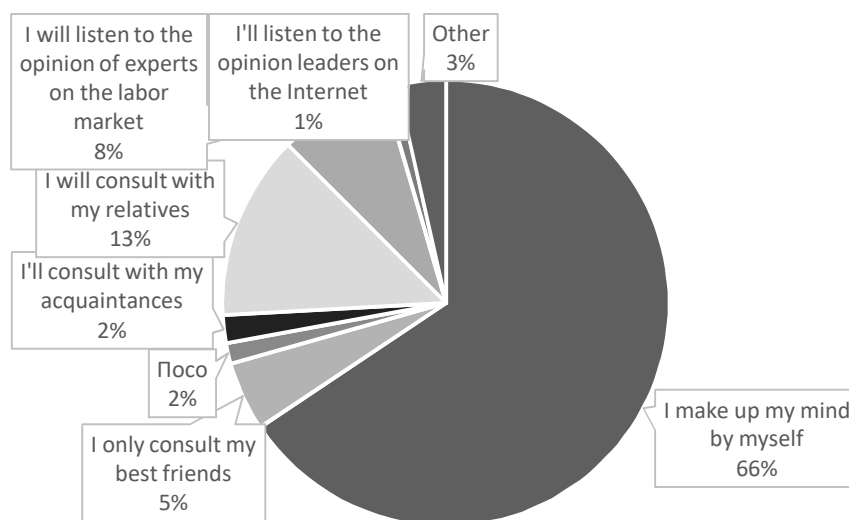


**Figure 1:** Trust in the Results of the Euthanasia Discussion

When asked about the acceptability of the ideologies of the past for modern society, 44.8% of the respondents concluded that, in general, these ideologies are suitable, but they need significant transformation. 38.3% of respondents concluded that they are suitable only in certain cases. 9.5% came to the conclusion that they are not like. 6% of the respondents said that these ideologies are completely suitable. Thus, we can conclude that the student part of generation Z is developing critical thinking, and they are ready for a conscious transformation of the social reality surrounding them in the present and the future.

Our empirical results confirm that representatives of generation Z consider the independence of decision-making to be the most significant setting, the importance of the opinions of friends and experts depends on the importance of the subject under consideration. So, when analyzing the answers to the question of what happiness is and how to find an answer to it, it was revealed that the majority of the surveyed representatives of the phygital generation (62.2%) prefer to independently determine the main

content of the concept of "happiness" based on their own experience and based on their reasoning. Zoomers are not afraid to follow their dreams, their ideas about "happiness" as their ideal are formed independently, since they are free from psychological clamps, prejudices and stereotypes: they do not delegate decision-making to experts (18.9%), although there is trust in expert opinion (8.5%) and least of all (5%) are inclined to discuss with friends. Independence in decision-making is clearly traced in the answers to questions about choosing a specialty for planning a career and about the possibility of using soft drugs - the absolute majority (65.7% and 78.6%, respectively) will make a decision on their own. The complexity of their perception of expert opinion can be traced in the answers to these questions. They will listen to the opinion of experts only on drug use (15.9%), and the opinion of experts on the labor market (8.0%) will be less preferable for them than the opinion of their relatives (13.4%), which indicates the importance of the role family, its values for Generation Z, as well as distrust of experts in the labor market.



**Figure 2:** Choosing a future career

In general, this confirms the results of the empirical study of 2019-2020 that we obtained, which determined that "the predominance of individualistic attitudes (self-expression, building a career) in the profile of a typical representative of generation Z in Russia allows us to speak of the formation of "generation I" in Russia, but with Russian specifics, since the behavioral profile is not free from collectivism attitudes (mutual assistance - 24%, empathy - 13%), which ranked second and fourth in the value system of representatives of generation Z, respectively" [18, p. 109]. The answer to the question about the importance of the opinions of other participants in the interaction testifies to the independence of the younger generation, and confirms the results obtained in the 2019-2020 studies, when, according to the survey, 74% of the participants took into account the opinion of others when making a decision, but put their own opinion [18, p. 109]. And, what is important, it destroys the myth about the priority of the importance of Internet communication in their lives - according to data from 2020-2021. from 1% (with people of varying degrees of closeness) to 5% (with close friends) are ready to discuss personal problems on the Internet.

Freedom of buzzers from psychological clamps, prejudices and stereotypes, the desire to find their own special new paths, as well as a lack of inclination to take risks, make them prone to organic growth and smooth transformations. Especially important for them are the values they share, including ecology, tolerance, etc. At the same time, their trust in official information has not yet been finally formed, and in answers to the question about making a decision about getting a job in a company with opposite characteristics - on the basis of official data and the opinion of acquaintances (48.8%) or a view of the problem of a representative of their generation (35.8%), - priority opinions are practically not defined. The time has come for a new generation, which itself chooses an employer, people for whom not only and not so much a brand is important as reputation, attitude to the values shared by Generation Z.

Many theories of the problems of integrating buzzers into business processes are built on one of the most common myths about Gen Z. We are talking about the so-called "translation difficulties" associated with the fact that zetas have a different perception of the communication process itself due to access to unlimited communication in social networks. But the Z-generation, communicating with everyone on an equal footing and highlighting this as a value, nevertheless understand the framework and boundaries of the hierarchy, which is expressed, in particular, in relation to the use of slang outside of subcultural communication, which was shown by the data of our survey. The majority of the surveyed students (76.1%) showed an understanding of the inadmissibility of using subcultural words as a deviation in the changing conditions of interaction on the example of using slang in a conversation with a teacher. An understanding of the presence of linguistic cultural norms of interaction was shown by many students (15.9%). Since it is culture that determines the participants in communication, the choice of topics and communication strategies, the context, the way of transmitting messages, the way of encoding and decoding, etc., understanding the regulated norms and those not recommended demonstrates the involvement of Z representatives in the general cultural context and removes the question of "translation difficulties". In the collision of cultural manifestations, both verbal and non-verbal, specific features that are not recognized in intracultural communication become obvious. This confirms the system of factors A.A. Leontiev, determining the national-cultural linguistic specifics (factors associated with cultural tradition: permissions and prohibitions, stereotyped, reproducible acts of communication; etiquette characteristics of universal acts of communication, role and socio-symbolic features of communication; factors associated with the social situation and communication functions: functional sublanguages and etiquette forms; factors related to the social situation in the narrow sense; factors determined by the specifics of the language of a given community) [21].

Also of interest is the relationship to political ideology and economic policy. As the study showed, the phygital generation is not positively oriented towards these topics, their interest is rather unstable, which can be characterized not only by the preferred answer for 34.3%: "If there is a mood, then I can read about something like that", but also specific answers about interest in articles on these topics on the Internet (26.4%) and books (18.4%); In total, 19% reported varying degrees of "no interest" or, which means roughly the same, view them "diagonally". This is vividly illustrated by K. Sobchak's interview with the popular tiktoker Danya Milokhin, 19 years old, 10 million subscribers, on YouTube on December 20, 2020. The presenter asks him the question: "Why doesn't your generation go to rallies?" To which Danya replies: "I am not against them, but not for them either. I stand on the sidelines and do not want to climb, I am not interested in. I do not try to understand this and do not want to fill my brain with this unnecessary information" [22].

The study of students of St. Petersburg universities showed that extremism and radicalism are also not typical for generation Z. As noted by 64.7% of respondents, "such statements are inadmissible as much as they are inadmissible in real communication." The results of the survey confirm the conclusions of the study "Russian "Generation Z": Attitudes and Values" conducted by the Friedrich Ebert Foundation: "Political apathy is widespread. Many young people (almost 60%) are not interested at all or are very little interested in politics. At the same time, they practically do not have confidence in the national institutions of power. Only 26% trust the government, 16% trust political parties, 25% trust the State Duma. The level of confidence in the president of the country is relatively high (42%)" [23].

The study of students showed that the level of trust in close friends is high - 66.2% are ready to share personal problems, in contrast to 18.4% of those who answered that they would not discuss it with others. At the same time, only 5% of respondents will share their personal friends on the Internet. In general, the myth about the priority or parity of the virtual world in comparison with the real world is destroyed by the answers of the surveyed students - representatives of generation Z - only 5.0% will discuss the philosophical question "what is happiness" with friends on the Internet; 5.0% - personal problems; 1% will listen to opinion leaders on the Internet about choosing a career path.

The conducted empirical research reveals positive trends in the formation of the reflective habit of generation Z. The digital generation demonstrates greater independence in the development of meanings in the process of social construction of reality. In doing so, they rely on serious literary sources and expert advice if they need to form an opinion on an important issue. Virtualization changes Gen Z communication, but does not have a significant negative impact on it. Advice from "opinion leaders" on the Internet is decisive for only a small proportion of young people.

## 5. Features of the construction of social reality by generation Z

The study of the features of the social capital of representatives of the "generation of gadgets" in the context of the increasing digitalization of social interaction was carried out on the basis of Bourdieu's theory. The main term in Bourdieu's theory that is most useful for interpreting social interaction is milieu. Since this term can be successfully used in interdisciplinary research, it has significant epistemological value for the study of the characteristics of the younger generation. The term "milieu" was used in his works by Durkheim [24, p. 233], however, Durkheim interpreted milieu from the standpoint of a systems approach, assessing the number of elements of this system and the nature of their interconnection.

From the point of view of Bourdieu, milieu is a more multifaceted term that combines both social characteristics and the characteristics of physical space [8]. According to Bourdieu, milieu consists of several types of capital. It combines traditional, financial capital with symbolic or cultural capital and social ties, which are also a kind of capital. This concept is integrative, since one type of capital allows one to interpret only a certain narrow aspect of the social characteristics of an individual. For example, if a person is very rich, but he does not have a sufficient level of education, then he will not become a full-fledged participant in communication among rich individuals. These three aspects of the social characteristics of the individual, combined by Bourdieu into a single concept of "milieu", form a certain generalizing characteristic of the individual. In the publications of European scientists, the term "milieu" is often used synonymously with the concept of lifestyle. Throughout the sociology of Bourdieu, the term "milieu" occupies a central place, also combining such terms as habit and reflexivity.

The multifaceted nature of the term "milieu" makes it a suitable tool for studying the characteristics of a generation of gadgets, since this generation lives in conditions of both virtual and traditional social interaction. From the point of view of Generation Z, there is no dichotomy of "real" and "virtual", these two spheres form a single communicative space. At the same time, in order to study real-virtual social interaction, it is necessary to have some point of contact between these communication spaces, and in Bourdieu's sociology, such a point is habitus, which is understood as "systems of stable, interchangeable dispositions, structured structures predisposed to function as structuring structures, that is, as principles that generate and organize practices and representations" [25, p. 153].

One of the main features of habitus is the purposeful nature of its formation. Living in society, the individual intentionally acquires certain objective and subjective characteristics. For the generation of gadgets, digital characteristics, the image of an individual in virtual space, become the most important characteristics of habit.

Another reason why the concept of "milieu" is successful for studying the features of interaction between representatives of the generation of gadgets in a virtual environment is the increasing role of cultural differentiation.

If in traditional social interaction vertical characteristics play a decisive role, that is, an individual's belonging to a certain class and stratum, his place in the hierarchical structure of inequality, then in conditions of virtual interaction, the vertical characteristics of an individual are not obvious. In the context of digital interaction, a representative of generation Z can mislead interlocutors, present himself as a richer and more status member of society. In these conditions, the horizontal characteristics of the individual begin to play a much greater role, that is, his certain cultural characteristics are not associated with inequality.

Bourdieu's sociological legacy contains the concept of social fields, which may also be useful for studying Generation Z in the context of digital interaction. Under the social field, Bourdieu understood a certain area of social reality, which is characterized by the predominance of a certain type of social capital. So in the conditions of the political social field, social ties will prevail, while in the academic field, the symbolic type of capital will become the predominant type - knowledge [26]. In relation to each other, social fields can be relatively independent since the participants in each field have specific goals and interests. When studying any social processes or interactions, it is important to understand in which social roles they occur.

Representatives of certain groups or social classes will interact in a special way in different social fields. The difference between the virtual space lies in the fact that it forms, as it were, a single social field in which the differences between representatives of certain classes decrease. For this reason, the

most important aspect of the milieu in the virtual space is the cultural capital of the individual. Since we are witnessing an increasing digitalization of social interaction in all spheres of social life, it is logical to assume that cultural capital, as part of the milieu, will play an increasingly important role in the life of every individual. For representatives of the generation of gadgets, this circumstance opens up great prospects. Although they do not have significant financial capital or high social status.

## 6. Discussion, conclusion, perspectives

The research results give a very clear picture of the construction of social reality by representatives of generation Z. The data obtained in the course of the study represent the image of the “zoomer” as a “good citizen”, inclined to independence in decision-making, rational-critical discussion and gaining knowledge. The knowledge, abilities, skills and perceptions acquired by “digital natives” as a result of interaction with physical reality turn out to be more significant than the same competencies, but acquired in the virtual world. Gen Z representatives generally do not support extremist ideas, and the authority of teachers and educators is practically unshakable.

On the other hand, the research results reveal a number of social disfunctions of representatives of generation Z, in particular, the lack of self-criticism. The respondents show a readiness to criticize others, information from the Internet, the actions of authorities and economic agents, but, apparently, do not criticize themselves and their own opinions, their position, their actions. This probably speaks of a general trend associated with the humanization of public relations and greater concern for the protection of human and civil rights and freedoms, but it also speaks of the prevailing model of perception of social reality that corresponds to a certain generally accepted standard. The survey focused mainly on students, who probably consider studying at a university as a necessary and important process in the formation of a personality, so important that it is not questioned. This may also be related to the age of students, which largely depends on the opinions of parents and teachers. But this is largely due to digitalization - the possibility of self-expression through social networks. Self-PR excludes self-criticism.

An uncritical attitude towards self-promotion means opens up almost unlimited trust in "smart" devices and platforms. “Digital natives” deserve such a name, since the fusion of oneself with the technical world gives rise to a curious phenomenon – a phygital or, more precisely, psychotechnical reality, a view of society and the world around us through the prism of an information bubble that surrounds a person. These are full-fledged socio-technical systems in which natural and artificial intelligences mutually enrich each other.

It is difficult to answer the question of how such a situation will affect the quantity and quality of various types of capital, if we follow the ideas of P. Bourdieu. While social capital flows from the physical to the virtual world, civil and cultural capital can increase. Individualization and atomization can foster an increased focus on civic engagement and creativity. An increase in the level of education can also lead to participation in cultural production and reproduction, which affects the level of cultural capital only positively.

Also, at the moment, there is no definite answer to the nature of the mutual influence of the involvement of representatives of generation Z in the virtual world on innovative activity. On the one hand, the growing volumes of information used by "buzzers" should create a positive dynamic of creative capital. However, on the other - and probably more important - side, the choice of the information consumed, the quality of the content is of fundamental importance, and here, most likely, the fundamental influence of the Internet on creativity will not be found.

Summing up the research, it should be noted that the topic of social capital of generation Z is far from being completed and developed. A more detailed and detailed study of the social capital of generation Z is the scientific task of the team of authors in the near future.

## 7. Acknowledgements

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**PART 2.**  
**Young Scientists Symposium**

**Digital Transformation  
and Global Society**



# Dialogue vs deliberation: a case of discussions on social media

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## Abstract

In the article relationship between the concepts of dialogue and deliberation, in particular online deliberation, is considered in the context of the concept of deliberative democracy and the theory of communicative action of J. Habermas; online discussions on the topic of D. Trump's second impeachment in the social networks of American media are analyzed by such parameters of the deliberative standard for assessing the quality of discourse as dialogicity and the degree of dialogue.

## Keywords

Deliberative democracy, deliberation, online deliberation, dialogue, social media

## 1. Introduction

The growing importance of political communication on the Internet inevitably causes fundamental changes in traditional public communication [1]. Since the 1990s researchers have begun to study in more detail the role of the Internet, information and communication technologies in discussing political problems and making decisions on certain political issues [1, 2, 3, 4]. Research works in the field of political science, communication studies, sociology started focusing on the impact of Internet access on voting [5], the use of websites as a way to reach voters [6, 7], the role of the Internet as a means of political communication during election campaigns [8, 9], the study of the prospects for digital democracy and the role of new media [10, 11, 12, 13].

The development of the Internet and ICT allows individuals to communicate with each other, freely exchange messages of a political nature, receive necessary information, produce and disseminate it on various platforms while authorities can see this information and react constructively to it. Thanks to the active exchange of opinions, views, positions on various socio-political issues, a public dialogue, public political discourse can be formed.

These days, dialogue is becoming a key to understanding and comprehending processes in various spheres of social life, especially in politics. In view of the high axiological status of the dialogue, it can be put on a par with such fundamental political values as freedom, equality and democracy [14]. Mastering the art of dialogue, especially in the political sphere, is a necessary and basic condition for the successful functioning and development of modern society.

The development of public dialogue between citizens, institutions of civil society and the state in the Internet environment is facilitated by online deliberation which is exceedingly broadly defined and covers all types of communication in the virtual space [15]. It allows all participants representing different geo-graphic locations to interact, expand opportunities for civic participation, citizens' involvement in the political process, access to information and discussion of a wide range of topical issues where individuals can disclose their individuality, freely present their opinions and interests.

The article will further reveal a research of discussions on socio-political themes of current interest on social media. As an example, the discussions in the American segment of Facebook regarding the impeachment of Donald Trump will be analyzed. The main purpose of the article is to understand based on the theory of the German philosopher J. Habermas how the concepts of deliberation and dialogue correlate in theoretical and practical aspects.

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The main research questions to be answered:

- Q1. How do the concepts of deliberation and dialogue correlate in the context of Habermas theory?  
 Q2. What parameters should be analyzed to reveal the relationship between dialogue and deliberation in online discussions?  
 Q3. What is the form of online deliberation on political topics in social networks?

## 2. Theoretical basis

For our research presented below, it seems necessary to consider several concepts correlating with the phenomena of deliberation and dialogue.

First of all, it is based on the concept of deliberative model of democracy pro-posed by Jurgen Habermas. It focuses on diverse forms of communication, continuous and maximally broad political discourse in society, the results of which are determined by the strength of arguments [16].

Referring to the concept of deliberation which is the center of the concepts of deliberative democracy, researchers note that there is no unified definition [17, 18]. However, most of them believe that citizens involved in the deliberative process must make political decisions themselves based on arguments which, in turn, are reflectors of the needs and moral principles of individuals [19, 20]. Indeed, deliberation is built primarily on an argumentation exchange between citizens and their discussion of various statements in order to ensure the common good. In the process of this discussion, an agreement on procedures, actions or policies that best contribute to the achievement of the common good can be reached [21]. Accordingly, all of the above applies to online deliberation the main difference of which is the online environment.

Touching on the concept of dialogue, we emphasize that in accordance with the principles and postulates of verbal communication, there are two main types of communicative interaction: cooperation and confrontation (conflict) which indicate the coincidence or non-coincidence of the interests and goals of the communicants. We adhere to the point of view of the Russian linguist M. M. Bakhtin who defined dialogue as a way of interaction of consciousnesses, as a result of which understanding arises [22]. According to Bakhtin, dialogical relations are considered as a practically universal phenomenon that permeates all human speech, everything that has meaning and significance. A person cannot experience another consciousness that limits the possibilities of understanding. It is possible to communicate with other people's consciousnesses only dialogically because they do not lend themselves to analysis and contemplation, therefore common coexistence with "Other" is a source for communication and organization of the world.

The concept of D. Bohm which is important for our further reasoning lies in the same aspect. Bohm separates "genuine dialogue" and "rhetorical dialogue" or "discussion" (Table 1) [23].

**Table 1**  
 Distinctions of dialogue and discussions according to D. Bohm

Dialogue	Discussion
Based on cooperation of participants.	Built on opposition as two sides oppose each other.
The goal is to create a common foundation.	The goal is the victory of one side.
One participant listens to the other to understand, find meaning and agreement.	Participants try to find weak points and put forward counterarguments.
The original positions are disclosed for their reassessment.	The original positions are defended as true.
Induces an introspection of own position.	Causes criticism of another position.

Opens up the possibility of achieving a better solution than any of the original ones.	Defends the position of one participant as the best solution and excludes other solutions.
Creates a relationship of openness to changes and mistakes.	Creates a closed relationship.
Broadens the horizon and can change the point of view of the participant.	Affirms the point of view of one participant.
Everyone brings up their best idea for discussion, knowing that other people's opinions will help improve it.	Everyone puts forward their best idea and defends it against attempts to show that it is wrong.
Everyone is looking for fundamental agreements.	Everyone is looking for indicative differences.
Everyone is looking for strengths in the positions of others.	Each looks for flaws and weaknesses in the positions of the other.
Implies genuine concern for another person, excludes resentment or alienation.	Implies opposition, challenge to another, without any attention to feelings or relationships and often leads to belittling or condemnation of the other person.
Assumes that many people have a part of the answer, and together they can add these parts into a working solution to the question.	Proceeds from the fact that there is a correct answer and one has it.

We also consider the concept of political dialogue [24] which does not mean a conversation between two or more people on political issues, but a certain configuration of interaction, the negotiation process and partnership based on the principles of discursive equality between the subjects of political communication, striving for mutual understanding and achieving mutually beneficial a result that takes into account a wide range of existing opinions and interests [14]. Such conditions as the presence of political pluralism, the possession of political tolerance by the subjects of dialogue, their communicative competence which consists in the ability to listen, understand and support each other for the sake of maintaining peace, stability and overcoming disagreements, act as necessary conditions for political dialogue which can be regarded as the norm of civilized cooperation, democratic interaction of the parties implying the presence of versatile, alternative points of view, views, positions and even forms of social, political and state structure.

Habermas's theory puts forward a number of issues that are significant for the conceptualization of political dialogue related to the possibilities and boundaries of dialogical discourse in politics, the specifics of the rationality of political communicative actions, the intersubjective nature of political interests, the potential of dialogue in coordinating political interests, the role of a free reasoned consensus in the course of deliberative generalization of interests, the ontological and conceptual status of political dialogue the concept of which is worked out by Habermas in an ambiguous and controversial way. On the one hand, the German philosopher defends the ideal of a state-free dialogue from which we borrow the idea of genuine consent [25]. On the other hand, he writes that Socratic dialogue is impossible for everyone and always. The fuzzy relationship between the concepts of dialogue and deliberation aggravates the controversial aspects of Habermas' understanding of political discourse. Therefore, the purpose of the article is to determine how the concepts of dialogue, in particular political, relate to the concept of deliberation.

Speaking about the connection between the concepts of dialogue and deliberation, it is also important to refer to the opinion of the South Korean political scientist J. Kim who considers informal and casual everyday conversations about politics as a practical form of dialogical deliberation which ultimately form the foundation of deliberative democracy [26]. The point of view of D. Walton who considers deliberation as a form of dialogue in which each side presents its point of view on the solution of any practical problem is important in analyzing the relationship between the phenomena of dialogue and

deliberation, types of dialogical forms [27]. Deliberation is a collective process of dialogical solution by communication participants of common problems for them. The goal of deliberative dialogue is to reach agreement on actions that can be seen as a solution to a practical problem. Also, it is necessary to make a choice between two or more mutually exclusive options.

As D. Walton notes, at first glance it may seem that deliberative dialogue and critical discussion are identical to each other. But, in fact, these are two different types of dialogue since critical discussion pursues the goal of resolving a conflict of opinions and is a type of dialogue-persuasion where each side tries to convince the opposite that it is right, giving certain arguments for this. In a deliberative dialogue, according to Walton, the positions of the participants are much less antagonistic, their goal is to jointly search for an optimal line of behavior for all taking into account specific circumstances and long-term consequences [28].

The object of the research presented below is the concepts of deliberation and dialogue in the context of the concept of deliberative democracy by J. Habermas while the subject is communicative parameters of deliberation and dialogue. Accordingly, our main hypothesis (H1) is that there are several approaches to the relationship between the concepts of deliberation and dialogue. On the one hand, they are equated; on the other hand, the concept of deliberation is broader if we consider dialogue as a form of communication but if we compare the concept of deliberation and political (public) dialogue, then the concept of deliberation will be narrower. To see how the concepts of dialogue and deliberation interact in practice it is necessary to analyze online deliberation in terms of such parameters as dialogicity and the degree of dialogue in the discussion.

### 3. Research approach and data

To achieve the goals of our investigation we used discourse analysis which is simultaneously a key moment and a method of online deliberations' research. Our analysis is based on a modification of the methodology developed by the UN expert Yu. Misnikov (in line with the ideas of J. Habermas), already tested by us earlier and presented in previous publications [3, 17]. The scientist has generated «deliberative standard to assess discourse quality» where thematically different discursive parameters of the deliberative standard, corresponding to specific research issues and using for guiding the process of encoding messages of Inter-net discussions, are described [27].

The empirical material for the discourse analysis was online discussions on the second impeachment of US ex-President Donald Trump on Facebook pages of the leading American printed and TV media distributed into three categories in dependence of affiliation to political parties (conservative and liberal). We have selected two media sources for analysis: the conservative Washington Times and Fox News, the liberal New York Times and MSNBC, as well as additionally we took a neutral Wall Street Journal. In the Facebook accounts of these media, discussions were chosen on the topic of the second impeachment of the American ex-president in connection with the attempted capture of the Capitol on January 6, 2021. A total of 2,931 comments were analyzed.

In this paper we analyzed the positions of the participants "for" and "against" impeachment as well as two parameters of the deliberative standard that can show us how the concepts of dialogue and deliberation relate. The first of these is dialogicity. In a narrow sense the definition of dialogicity is used as a category of text that characterizes its focus on the addressee. The interweaving of various voices into the text makes it dialogic. To define it, it is needed to divide the number of participants' mentions of each other by the total number of posts. We can say that this is a mechanical and quantitative indicator.

Based on the theory of Habermas and Bohm's dialogical approach we modified the methodology of Yu. Misnikov supplementing it with such a new parameter as the degree of dialogue, i.e. striving for dialogue (consensus), and try to determine its degree in a particular discussion. The discussion can take place in various forms including not only dialogue but also debates, discussions, polemics, etc. Since we are talking about the relationship between the concepts of dialogue and deliberation we focus on the study of the degree of dialogue and not discussion, polemics, etc. In this case these parameters are less relevant for us but if their percentage totality exceeds the degree of dialogue, then it becomes necessary to study them in detail. Although in this case the discussion will not be a deliberation as it is based on a dialogical form of communication.

## 4. Research results

To understand whether dialogical communication between the participants is possible, what degree of dialogue is present in the discussion, it is necessary to analyze the opinions of the participants, how much they differ from each other.

According to the aggregate analysis of all media, 53.5% of users are against Trump and for his impeachment while 46.5% are for Trump and against his impeachment, excluding bots' posts (Table 2). If we take into account the posts of bots, then the data is 55.8% and 44.2%, respectively, which to a small extent but gives an advantage to demos and supporters of the opinion about Trump's removal from the presidency. Bots could be identified manually as a) they were pointed out by some users to whom these bots responded to the comment with their message; moreover, users went to the Facebook pages from which bots responded to the comment and indicated on the lack of information about users; b) the messages of bots were constantly duplicated and without changing the text which immediately prompts the idea of them. Based on the analysis of all positions, we can see that the American society is split into two camps in almost equal proportions.

**Table 2**

Attitude to D. Trump and his second impeachment (in percentage)

	Liberal		Conservative		Neutral
	MSNBC	The New York Times	The Washington Times	Fox News	The Wall Street Journal
<b>For</b>	2	24	71	66	51 (including bots' posts)
<b>Against</b>	98	76	29	34	49
<b>General data</b>					
<b>For</b>	13		68.5		58 (without bots' posts)
<b>Against</b>	87		31.5		42

It is relevant to notice that the data we obtained practically coincide with the data of opinion polls (for example: YouGov (support 50%, oppose 42%), Ipsos (sup. 51%, opp. 35%), Axios/Ipsos (sup. 51%, opp. 49%), Politico/Morning Consult (sup. 44%, opp. 43%), Avalanche Insights (sup. 58%, opp. 34%)) and with the results of voting in the Senate [4]. On February 13, 2021, the Senate voted against impeachment with 57 votes in favor and 43 votes against. A minimum of 67 votes in favor was required for a successful impeachment [4].

From the analysis of dialogicity (see Table 3) we can see that it was not particularly high (did not even reach 50%) but the degree of dialogue dominated in the discussions. The remaining few statements could be in the form of discussion, polemics, etc. We assume that there is no dialogue in 100% form, it is, as a rule, mixed which was shown by the data obtained. For example, according to D. Walton, this format of dialogue simultaneously includes polemics, disputes, attempts to convince each other, that is persuasive, negotiation and deliberative normative types of dialogue with the dominance of a deliberative dialogue [30]. It is important to study the degree of dialogue in order to understand what kind of discussion is presented before us. If, for example, the degree of other forms of communication would exceed the degree of dialogue, then such a discussion could not be called deliberation as it is based on the dialogical form.

For example, speaking about online discussion on MSNBC we noticed that the degree of dialogue is high (13% out of 14%) since the positions of the participants are almost completely the same (98%).

It can be assumed that like-minded people basically conducted a dialogue with each other, did not enter into a discussion, polemics with other participants whose opinions differ. In the case of the neutral The Wall Street Journal we see that the camps of opinions are divided approximately in the same ratio as well as the degree of dialogue and discussion (23% and 18% respectively), despite the fact that, in comparison with other discussions, this degree of dialogicity is one of the highest (41%). In such a discussion it is much more difficult to achieve general agreement and this is shown by the analysis of the positions of the participants and the forms of their communication.

**Table 3**

Dialogicity and degree of dialogue in online discussions (in percentage)

	Liberal		Conservative		Neutral
	MSNBC	The New York Times	The Washington Times	Fox News	The Wall Street Journal
Dialogicity	14	34	41	16	41
Degree of dialogue	13	21	37	12.3	23
Discussion, polemics and etc.	1	13	4	3,7	18

## 5. Discussion

After conducting the research, we propose for further scientific discussion the following statements concerning the relationship between the concepts of deliberation and dialogue:

1. A sign of equality can be put between the concepts of dialogue and deliberation if they are considered as forms of interaction, means of achieving consensus which are similar to each other because both phenomena affect the subject-subject relationship allowing joint activities; active participation of communicators in a discussion based on the power of arguments in order to achieve understanding, consensus; communication between parties is based on their equality which may imply an equal right to express position, reasoning and voice. Participants are open to mutual influence; therefore, they can change their minds in the process of communication. Respectively, a different result of discussion may appear that can influence both the development and decision-making which means that participants can be heard. The essence of dialogue and deliberation is not in the exchange of meanings but in the construction of a new common meaning that can transform participants in the process and their lives, i.e. participants can unleash their potential, enrich themselves with new knowledge about the world and self-actualization.

2. If we interpret dialogue as a form of communication between participants, then the concept of deliberation in this case will be broader as dialogue is one of the conditions for deliberation.

3. If we consider political (public) dialogue – a dialogue between citizens, between civil society and state as a form of discursive interaction where the purpose is to achieve public consensus, then here the concept of deliberation will be narrower since it serves as a form of such interaction where people can come to understanding, agreement on various issues. Accordingly, all that has been said applies to online deliberation. The main difference and advantage of online from offline deliberation is the online environment which allows participants to interact more effectively with each other.

However, we believe that in this case it would be more correct to say about deliberative dialogue and not about dialogical deliberation as the basis of deliberation is dialogue and without it deliberation is impossible. Perhaps, the concept of dialogical deliberation is used in the literature to characterize the high level of dialogic deliberation, i.e. the addressing of the participants to each other by name, but this is to be learned in further research.



## 6. Conclusion and future research

To sum up, we can confirm our main hypothesis and provide an answer to the first research question (Q1). Deliberation is understood as the process of communication between citizens that takes place in a public space through dialogue, discussions, negotiations with the help of which the search for solutions to common problems related to the political sphere is carried out. Mutual understanding, consensus, an equal reasoned discussion based on respect for the positions of the participants and taking into account their interests are seen as important mechanisms of this process. The study showed that, firstly, an equal sign can be put between the concepts of deliberation and dialogue as both phenomena as forms of interaction between individuals are similar to each other, pursue the goal of mutual understanding, cooperation; secondly, the concept of deliberation is perceived more broadly since dialogue is one of the components of deliberation which is studied as a form of communication.

Analysis of the participants' positions, dialogicity and the degree of dialogue in online deliberations made it possible to identify how the concepts of deliberation and dialogue relate in practice (Q2). It was noted that online deliberation takes place in a mixed format which includes disputes, discussions, polemics but with the dominance of the dialogical form which is one of the significant conditions for deliberation (Q3).

On the basis of these conclusions, in the future we can talk about such a concept as a deliberative dialogue, try to identify its features and conditions for its occurrence. In the process of searching for literature we noticed that there is also the concept of dialogical deliberation which we consider not entirely correct since deliberation is a dialogue, it is based on a dialogical form of communication without which deliberation is not deliberation.

It will be useful to analyze online discussions in countries with different political regimes (democratic and authoritarian) and compare such parameters of discussions as dialogicity, degree of dialogue. Also, we are going to analyze Russian online deliberations on theme of Aleksey Navalny arrest on popular Russian social media of hybrid media and compare the results to American ones in order to identify what deliberations contain more dialogue. Also, we are going to analyze a degree of dialogue in online discussions in dependence of platforms (for example, forums and social media can be compared).

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# Experience of Applied Researches in Online Deliberation: an Analysis of Civility in American Online Discussions

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## Abstract

In this study research focus is on the culture of speech in online discussions, therefore, the purpose of the paper is to analyze the civility (culture of speech) in online deliberations on political topics. Civility in American online discussions is analyzed according to the criteria of the deliberative standard developed on the basis of the Habermas theory by Misnikov. It reveals what criteria are used to describe the culture of online communication and what factors can potentially influence it. To assess the level of communication culture it is necessary to analyze how participants relate to each other, their positions and comments towards objects of discussion. The author comes to conclusion that American discussions can be characterized positively from the point of view of civility and called rational as small percentages of rude attitude were recorded.

## Keywords

Deliberative democracy, deliberation, online deliberation, social media, civility.

## 1. Introduction

In recent decades, the concepts of democratic deliberation have been intensively developed as they are aimed at significantly expanding the opportunities for active inclusion of citizens in politics and their participation in it [1]. As a result of democratization, individuals and communities were empowered and became key figures in political decision-making. In the theory of deliberation politics does not focus on state centrism and political representation but primarily concentrates on social power associated with the ability of reflexive citizens to make responsible, reasoned decisions in everyday life [2].

Since in a deliberative democracy citizens play the main role in socio-political processes it is assumed that they should be both political actors and bearers of a certain set of abilities, namely, have the qualities of a political leader. For instance, the ability to conduct a dialogue, articulate and take into account interests, values of other citizens, to analyze, discuss and feel responsibility for the problems of society as well as the desire to implement decisions reached in practice. Accordingly, high levels of political and legal literacy of population, its desire to take part in a political process are one of the main conditions for the viability of a deliberative democracy.

Thanks to the analysis of online discussions, it is possible to determine not only what participants think on a particular issue, how they argue their positions, what format of communication they develop, how the dialogue between them is constructed but also the culture of civic communication, the levels of development of politeness, the tolerance of the participants in relation to each other and the statements of other communicators. It is important to take these parameters into account as they allow to assess the level of development of society, the mechanisms of communication that exist in it as well as the quality of citizens' participation in politics.

The article will further reveal a research of American discussions on socio-political themes of current interest on social media. As an example, discussions were on Facebook and dedicated to the

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second impeachment of Donald Trump. The main purpose of the article is to show the civility (culture of communication) between participants of online discussions on relevant political themes.

The main research questions to be answered:

Q1. What exact criteria allow to determine the culture of communication in online deliberations?

Q2. How can American discussions be characterized in terms of a culture of communication?

Q3. What factors determine the communication culture of participants in online discussions on political topics?

## 2. Theoretical basis

To understand what role online deliberation on political issues plays in improving the quality of citizen participation in politics and decision-making, turn to various foreign studies conducted by J.S. Fishkin, V. Price, R. Cavalier., M. Kim, Z.S. Zaiss, J. Kelly, D. Fisher, M. Smith, A. Lev-On, B. Manin, D. Schloss-berg, S. Zavenoski, S. Schulman, P. M. Shane, T. Ohlin, J. Wung Ri, Y. Mi Kim, S. Wright, G. Leshed, M. Trenel, K.S. Ramsey, M.W. Wilson.

J. S. Fishkin [3, 4, 5] examines the historical background and theoretical foundations of "deliberative polling", analyzes the results of polls conducted using the voice interface. The researcher notes that the results of online survey are broadly similar to the "deliberative weekend" in which participants meet face-to-face. We suppose that the author of this article came to approximately the same conclusion in his studies devoted to the analysis of citizens' discussions on raising the retirement age in Russia in which the results of online deliberation and a sociological survey were compared. We believe that online deliberation is more convenient and flexible as well as low cost compared to opinion polls. Based on this we optimistically assert that this method can be extended to longer periods of time, more issues discussed which will ultimately lead to better political judgments.

V. Price [6, 7] demonstrates the results of two of his extended surveys of invited contributors to online writing on presidential elections and health policy. He was able to establish a positive correlation between the participation of individuals in these sessions and their political involvement. Based on the results obtained, it can be assumed that online text chats contribute to a more even distribution of the participation of individuals in the discussion than face-to-face format. Indeed, based on our analysis of civic discussions on social networks, we can say that participants are approximately equally involved in online deliberation.

R. Cavalier, M. Kim and Z.S. Zaiss [8] are conducting analysis in the field of structured online deliberation and they used a multimedia environment where participants of discussion communicated with the moderators via audio and video channels. Experiments have shown that there are no significant differences in the values of the measured dependent variables compared to face-to-face discussions constructed in a similar way.

J. Kelly, D. Fisher and M. Smith [9] analyzed the debates unfolding in the politicized newsgroups of the Usenet network, which is part of the Internet. They found that such groups are usually ideologically heterogeneous and that most commentators are more inclined to debate with opponents than deliberate with like-minded people.

H. Lev-On and B. Manin [10] are considering whether the Internet is conducive to network clustering of like-minded people. Based on their empirical data, they believe that communication on the Internet generates mixed trends in the context of online deliberation. People are trying to filter out content that is foreign to their views and with the help of various tools that help isolate opposing opinions.

Another group of studies is devoted to the tools that the state uses to involve citizens in online discussions of political decisions made by it and tries to establish how it can improve the effectiveness of civic participation in decision-making and making both at the local and regional levels. For example, D. Schlossberg, S. Zavenoski and S. Schulman [11] in their study did not find any fundamental differences between the comments of citizens on bills submitted to government agencies in electronic form and in the traditional (paper). At the same time, they tend to believe that the websites of authorities have potential, though underestimated because they contribute to the receipt of suggestions, comments from specific individuals who, in certain cases, can have a greater impact on politics than comments

presented in format of letters by organizations whose ambitions and efforts are aimed at mobilizing their voters.

P. M. Shane [12] believes that the potential of online public consultation allows the modification of government work towards the cyber-democratic model of Empowered Participatory Governance (EPG), which was proposed by A. Fang and E.O. Wright [13]. In their view, the model seeks to "broaden the ways in which ordinary people can more effectively influence the policies that shape their lives." P.M. Shane simultaneously analyzes the technological and inertial barriers to the development of both "empowered government" and a more advanced form of online public consultation than the one practiced by the US federal government and concludes that it is necessary to apply local efforts to push the US federal government towards a new model that allows for more inclusive and wider citizen participation in lawmaking and policy making. This point of view should be taken into account, since it may be relevant at the present time for the Russian authorities both at the federal and local levels.

T. Ohlin [14] analyzes the outcomes of a public consultation using a combination of face-to-face formats and networking, in which many senior citizens of one of Stockholm suburbs actively participated in the discussion of priority areas of urban planning.

We will pay special attention to research devoted to various ways of promoting deliberative forums and the introduction of factors on which their quantitative and qualitative characteristics depend. This group of papers can answer questions about whether moderators influence the course of discussion, what is the impact on the discussion of such variables as anonymity, the composition of the deliberation group and the system of reward, reward of participants.

Joon Wung Ri and Yoon Mi Kim [12] analyzing the results of online field experiment with the electorate who participated in the Korean general election in 2004 concluded that moderation reduced the number of voter posts in the forum, anonymous participants were more active and the system incentive points for participating in the discussion had a positive effect.

Scott Wright [15] touches upon the problem of moderating discussion forums initiated by the authorities. He notes that such moderation can take many different forms and based on the results of previous studies argues that the functions of filtering messages (censoring) and facilitating discussion should be differentiated between different moderators, and the function of deleting messages in case such a need must be fulfilled by independent body in accordance with publicly available rules, regulations.

Gilly Leshed [16] presents the results of a natural experiment in which the company's management drew on the possibility of anonymous employee participation in the internal online community of the organization after a series of inappropriate messages emerged. It can be noted that the results obtained by Jun Wung Ri and Yoon Mi Kim are to some extent confirmed, and the author himself points out a noticeable decrease in the number of posts and dialogues due to the removal of anonymous commentators in the online community.

Matthias Trenel [12] based on an analysis of a field experiment conducted in an online forum where the future of the territory (where the World Trade Center was located in New York) was discussed came to the conclusion that a more pro-active approach, i.e. facilitating discussion may involve under-represented categories of participants.

Kevin S. Ramsey and M.W. Wilson [12] criticize the current practice of online consultation and offer recommendations on how to increase the ability of panelists to critically reflect on the information provided to them during the discussion.

In our research an important role is played by the concept of deliberative democracy by J. Habermas, his theory of communicative action and discursive ethics [17, 18]. We assess the quality of deliberative discourse in order to identify characteristics, patterns, models thanks to which the process of deliberation, in particular online deliberation, can be improved both between citizens and between civil society and the state. In this study focus is on the culture of speech in online discussions, therefore, the purpose of the paper is to analyze the civility (culture of speech) that develops in online deliberations on political topics. The object of the research is the quality of online deliberation and the subject is the culture of speech in online discussions. Accordingly, our main hypothesis (H1) is that American discussions are civil, i.e. participants are polite, tolerant, neutral towards each other, statements of other participants and objects of discussion. Accordingly, we assume that the main factor determining the culture of communication in online discussions is the political development of the country, especially the level of democracy.

### 3. Research data

The empirical material for the discourse analysis was online discussions on the second impeachment of US President Donald Trump on Facebook pages of the leading American printed and TV media distributed into three categories in dependence of affiliation to political parties (conservative and liberal). We have selected two media sources for analysis: the conservative Washington Times and Fox News, the liberal New York Times and MSNBC, as well as additionally we took a neutral Wall Street Journal. In the Facebook accounts of these media, discussions were chosen on the topic of the second impeachment of the American president in connection with the attempted capture of the Capitol on January 6, 2021. A total of 2,931 comments were analyzed.

### 4. Research approach and findings

To achieve the goals of our investigation we used discourse analysis which is simultaneously a key moment and a method of online deliberations' research. Our analysis is based on a modification of the methodology developed by UN expert Yu. Misnikov (in line with the ideas of Yu. Habermas), already tested by us earlier and presented in previous publications [19, 20]. The scientist has generated «deliberative standard to assess discourse quality» where thematically different discursive parameters of the deliberative standard, corresponding to specific research issues and using for guiding the process of encoding messages of Internet discussions, are described.

In Misnikov's methodology civility is a synonym for speech culture which is used to characterize the qualitative nature of a public online discussion and is associated with demonstrating a tolerant attitude towards the participant in the discussion, his position and the object of discussion. Data about it are not so easy to interpret since there is no universal approach to its definition [16]. There are situations when messages contain both polite and impolite speech aspects which causes difficulty in post's coding. In addition to the use of harsh language that clearly demonstrates willful impoliteness, some messages may only imply unpleasant connotations, irony and sarcasm. If we talk about polite messages, then they can have a special purpose and be addressed to certain participants in a more personalized manner both with the mention of the name and with emphasis on some aspects of the topic which contributes to more involvement of people in the discussion in dialogic form.

We analyzed the civility recorded in the discussions on the topic of pension reform from two positions (see Table 1):

- interpersonal character = posts are directly addressed to another member with a mention of the name or personal appeals:

- (a) posts do not relate to issues, i.e. they are exclusively personalized;
- (b) posts are clearly rude and offensive in relation to a person, his nationality, religion, ideology, etc. (distinguish from irony, humor, sarcasm);
- (c) posts are clearly rude and offensive in relation to the objects of discussion;
- (d) posts are clearly polite and respectful towards a person (may contain irony, humor, sarcasm in a positive aspect);

- posts do not include an explicit mention of the participant's name, can be directly or indirectly addressed to a specific person, someone else or all people:

- (e) posts contain rude, offensive language, vocabulary in relation to the participant (irony, humor and sarcasm are excluded from this category);
- (f) posts contain rude, offensive language, vocabulary in relation to the objects of discussion;
- (g) posts are clearly polite and respectful (include deliberate politeness, irony, humor, non-offensive sarcasm).

According to the results of the analysis of civility (see table 1), we can see that their percentages are not high (they do not even exceed 10%), respectively, the general indicators of negative civility are low which means that such discussions can be called rational. According to the aggregate calculations, users on republican media were more polite than users on democratic media, however, the lowest percentage of overall negative civility was recorded on a neutral platform, where, on the contrary, opinions polarized in approximately equal proportions clashed. It is interesting that the participants practically did not distract from the discussion of the topic, did not discuss each other and the percentages of rude

attitude towards the participants were minimal while more negative and intolerant statements were directed towards the objects of discussion (D. Trump, his supporters, Biden, the Democratic Party, N. Pelosi and politicians in general).

**Table 1**

A civility analysis in American online discussions (in percentage)

	Liberal		Conservative		Neutral
	MSNBC	The New York Times	The Washington Times	Fox News	The Wall Street Journal
Thematically empty posts with participant name's mention, only interpersonal communication	0	0,1	0	0,8	0
Posts with participant name's mention, discussion on topic, but rude towards participant	0	0,8	0,75	0,2	0,5
Posts with participant name's mention, discussion on topic, but rude towards object of discussion	0,2	1,2	0,75	0,8	1,9
Posts with participant name's mention, discussion on topic in a polite, tolerant way	0,6	0,1	0	0	0
Posts without participant name's mention, with discussion on topic, but rude towards participant	0	0	0	0,2	0
Posts without participant name's mention, with discussion on topic, but rude towards object of discussion	7,1	4,4	2,8	7,2	1,4
Posts without participant name's mention, with discussion on topic in a polite way	0	0,1	0	0	0,1
Negative civility towards participant	0	0,8	0,75	0,4	0,5
Negative civility towards object of discussion	7,3	5,6	3,55	8	2,3
Average negative civility in dependence of parties		6,85		6,35	2,8
Total civility	7,9	6,7	4,3	9,2	3,9

## 5. Conclusion

To sum up, we can confirm our main hypothesis and provide an answer to the first research question (Q1). To assess the level of communication culture it is necessary to analyze how participants relate to each other, positions and comments of other participants, objects of discussion. It is important to clearly and specifically formulate the criteria in order to assess the diverse palette of cultural interaction which has been demonstrated in this work. American discussions can be characterized positively from the

point of view of civility and called rational as small percentages of rude attitude were recorded, moreover, in relation to the objects of discussion. In general, Americans are neutral and without excessive respect for each other, insults to participants in online deliberation are kept to a minimum. Mostly, abusive behavior was demonstrated in cases where the participant's position was different and when the participant did not understand the other's point of view despite different forms of argumentation. Then, instead of a rational force, an emotional one appeared, manifested in the form of a non-rude or very rude insult towards another participant. It is significant that the participants focused on the discussion of the problem and not on meaningless interpersonal communication distracting from the topic for the sake of which people gathered (Q2).

It can be assumed that such indicators of civility and such a culture of communication, especially in relation to the participants, are justified not by the heterogeneity of positions, indicators of the quantity and quality of argumentation, dialogicity, the degree of dialogue but by factors correlating with the mentality, socio-psychological attitudes, values, upbringing, education and culture in general, including political, the level of political development, especially democracy. We cannot determine with 100% accuracy which factors influence the level of civility but we can definitely understand the culture of communication and interaction of participants based on the analysis of this parameter which is important when studying online deliberation as a form of civil interaction (Q3). If the participants are able to conduct a discussion based on respect for the positions and personality of each other, especially if this is a format of discussion, polemics where participants are trying to win and not come to a consensus and mutual understanding, then, no doubt, there are wide opportunities for genuine public dialogue between representatives of civil society and government authorities in the development and adoption of decisions on significant political issues.

In the future we will analyze Russian discussions on acute political topics in social networks according to various parameters of the deliberative standard for assessing discourse including civility. The results will be compared with the results of analysis of participants' civility in American online deliberation in order to determine the set of potential factors influencing the communication culture of participants in the online environment, especially those related to the political development of the state as well as criteria for assessing the quality of deliberation. Moreover, in addition to social networks, we will take forums for analysis since there are discussions initiated not by the media as the discussions taken for this study but by the citizens themselves. Consequently, the culture of communication and its levels can differ significantly, as, for example, there are no moderators and other restrictive factors as in the case of Facebook media pages.

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# A Study of Personal Finance Practices. The Case of Online Discussions on Reddit

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## Abstract

Financial literacy is an important part of personal finance practices that can provide human well-being. Recent studies covered topics on financial decision-making, yet few papers showed the problems people discuss in online communities related to finances. The goal of our pilot study is to find out which problems people face in financial management and what is the context of those problems. We did this using computational text analysis techniques in an attempt to reveal the essential problems people ask for personal finance advice on social media. The work contributes to a discussion of studies of personal finance practices by exploring the problems and assessing their prevalence and sentiment in user communication.

## Keywords

Financial literacy, personal finance, online communities, netnography, Reddit

## 1. Introduction

Online discussions create huge amounts of information on a variety of topics. This data can be used by researchers for various purposes - for example, to identify topics that users discuss most and further analyze them. One of the topics that are widely discussed on social media platforms is personal finance. Often, the level of financial literacy of people is not enough to make any serious financial decisions, and therefore they ask for help in social networks or forums. Thus, huge sets of texts on finance and related topics are formed, the analysis of which can help to identify the immediate problems of concern to people and stimulate the development of products aimed at solving them.

In this study, we explored the topics of finance discussed in the Personal Finance subreddit, which is completely dedicated to this area. Also, within each topic discussed, we have identified the sub-topics related to it, as well as the immediate issues that people in this community share and discuss. Subsequently, such an approach can contribute to the development of products aimed at improving people's financial literacy and helping in such situations.

## 2. Background

Reddit is an online platform that consists of channels, or subreddits, where users discuss various topics online, from sports to health issues. Personal Finance is a subreddit where users discuss saving, investing, retirement planning, and other practices connected to money management. It is the largest online community on Reddit which consists of more than 14,5 million members and has existed since February 2009. Each post is assigned to a category like “credit”, “taxes” and other related terms. This subreddit was chosen to extract not only general topics mostly discussed in terms of personal finance practices but also specific subtopics inside each broad category and reveal problems that people face in money management.

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### 3. Related Work

#### 3.1. Personal Finance Practices

This research is focused on studying personal finance practices: how people manage finances, and how their knowledge corresponds with their behavior. Financial practices are part of a larger concept — financial capability, which refers to the ability to apply appropriate financial knowledge and perform desirable financial behaviors to achieve financial well-being [1]. Robb and Woodyard [2] suggested that financial behavior is influenced by subjective and objective financial knowledge, income, education, age, race, ethnicity, and financial satisfaction. However, this list can be continued. Analyzing money management problems which people express in different ways, for example, online as in our case, can reveal other connections. The ability to study the contents of the texts by subreddits allows identifying what difficulties people have regarding particular spheres of their money use.

According to the literature, self-assessment of financial literacy and observed financial behavior do not always correlate [3], [4]. Our method can be useful in giving an outer view on money decisions because the problems discussed online can be observed in relation to each other. As readers, we may also be less subjective when evaluating these decisions because we are not aquated with some previous posts of the author.

Once again, financial practices are tightly connected with financial literacy. Higher levels of both are associated with people sharing similar characteristics, like patience, superior numerical abilities, motivation to deal with personal finances [4], [5]. These characteristics are not easy to grasp. This issue can be considered in the opposite direction. As the purpose of this study is to reveal problems in money management practices, we are interested in the characteristics which unite people who experience these problems. And that leads us to the concept of online communities.

#### 3.2 Financial Literacy in Online Communities

Despite the extended research on personal finance practices, there are few papers on the interaction between financial management and online advice. Poston et al. [6] confirm that people who are less confident in their ability to make good investment decisions based on online technology are more eager to accept online financial advice. Also, they argue that people give the same value to the advice given by humans and computers, and people trust credible experts with expertise more while making the final financial decision. The latter may be applicable to our research in a way that people trust the advice in comments more if the users who left them write of themselves as experts in a field. On the other hand, Cwynar et al. showed that Facebook users who were more confident in their financial literacy about debt were more inclined to seek advice [7].

Social media was proven to serve as a good tool to improve personal finance practices which led to positive financial results [8] and increased financial knowledge [9]. Zhu et al. [10] showed that members of the online community produced more risky financial behaviors than nonparticipants, whereas submissions by traders on the social trading platform were confirmed to be replicated by followers [11].

Social media are used to discuss financial issues despite not being specialized platforms for this like Twitter which was utilized as a financial forum for online discussions in times of important financial events [12]. Way et al. [13] confirmed that on the Internet, people mainly discuss financial topics aimed at improving the ability to produce good financial behaviors, and some competing points of view were found on social media. One of them is the contradiction to the claim by the Financial Literacy and Education Commission to start saving early and living on their earnings. In comments, people argued it was not always possible due to reasons they could not influence like a crisis. Also, users of online forums mentioned that financial planning was not always possible due to the expectations of others and that financial knowledge was usually inapplicable to financial decision-making in practice. The paper by Way [13] covered some aspects people discussed in online forums dedicated to financial practices. In our work, we want to dive deeper into the topic of financial issues people worry about and discover, what problems people describe related to personal finance practices in online discussions on Reddit?

## 4. Methodology, Data, and Method

### 4.1 Methodology

Netnography as a research methodology was chosen to study practices of money management. This approach combines both qualitative and quantitative methods of studying online communities by the use of ethnography with participant observation and systematic analysis of large amounts of quantitative data [14]. Such a hybrid type of research is helpful in studying numerous digital traces left by members of online communities. As it is hard to go through all user-generated data by hand, the qualitative part is used. The digital data is gathered and analyzed by computational text analysis and similar techniques to find the major patterns of the community. After they are identified, the researcher applies qualitative methods to illustrate these patterns by the most distinctive examples like posts by particular users and following discussion in comments.

In our research, we identified problems that users face in everyday life connected to money management practice reported by the members of the Personal Finance community on Reddit. It was done by the computational text analysis and other data analysis techniques along with a manual examination of quantitatively chosen data. The existing problems and topics discussed by users were illustrated by the examples of posts and comments to confirm their existence and peculiarity from each other. Also, by qualitative analysis, it was found that major posts include several rather than one topic as the tags of posts in the community stated.

All data were retrieved from the public platform meaning users who left their submissions on the page agree to share their opinions which are freely viewed by other people.

### 4.2 Data

The dataset consists of 237 unique posts from 21.09.2018 to 09.02.2021 with a total of 3,939 comments from the Personal Finance subreddit. To obtain the text corpus, the RedditExtractoR package and R programming language were used.

### 4.3 Method

The text analysis was conducted on all text data where a post and a comment were separate units. After primary data preprocessing by the use of computational methods of text analysis, the RAKE was used for keywords extraction. This is a Rapid Automatic Keyword Extraction (RAKE) [15] algorithm that omits delimiters and stopwords and takes into account the word co-occurrences and their frequency in the text. By this, we extracted top-200 keyword phrases by the number of times they appeared in unique texts, posts, or comments, consisting of simple noun phrases.

Then we manually filtered phrases and transformed similar phrases to the same form, manually divided them into broad 12 topics and for each defined subtopics. Overall, we had 44 subtopics which are more specific problems users discussed in online discussions. For each topic and subtopic, the sentiment was gained via the vader package which works well with slang and texts of online communication. For each topic and subtopic, median and mean compound scores were calculated which is a normalized unidimensional measure for sentiment to evaluate the emotional attachment of a particular topic. Then, we extracted examples of financial problems that people describe in messages from discussions by searching for keywords of each topic in these texts.

## 5. Analysis and Results

The most frequent topics of discussion are 'credit, loans and dealing with banks' (1266 texts related to this topic), 'money management' (1174), and 'real estate issues (car, house)' (880). The first consists of 7 subtopics including 'credit history', 'bank account', 'credit', etc. 'Money management' is the broadest topic with 12 subtopics such as 'saving', 'personal finance system', and 'minimization of costs'. The last includes 4 subtopics of 'type of insurance' and 'borrowing money'. The full list of topics and corresponding subtopics is provided in Table 1.

**Table 1**

Example of the problems for each topic

Topic	Number of Texts	Median Compound Score	Examples of Problems
Credit, Loans, and other Banking Operations	1266	0.67	Bad credit history, high fee account, late payments
Money Management	1174	0.74	Lack of knowledge to make a financial plan and increase income
Real Estate and other Types of Property (car, house)	880	0.73	Choice of mortgage type, paying off a car loan
Advice in Financial Management	563	0.84	Advice on investing, teaching financial literacy at school
Taxes	317	0.69	Maximizing an Individual Retirement Account (Roth IRA) contributions, bad understanding of the tax system
Life Insurance	292	0.80	Securing money, lack of knowledge about social security benefits
Retirement Issues	255	0.81	Maximization of retirement savings, retirement planning
Investment	245	0.73	Choice of a financial service, lack of knowledge to start investing, maximizing income from investments
Student and School Payments	182	0.78	Need for advice on student loans, taxes for international students
Employment Issues	132	0.78	Choice between highly-paid and satisfactory job, too low salary to cover regular expenses
Criminal Activities and Investigation	66	-0.14	Protection from fraudulent charges, parents spoiling kids' credit history
Business	49	0.86	Precondition to start a business, managing business experience

Among the problems we highlighted in discussions on 'credit, loans and dealing with banks', people talk about how to open a bank account, how to improve credit score, whether student credit cards as a payment tool is a good way to start gaining financial literacy, etc. Within the 'money management' topic, such problems as managing finances and getting out from living paycheck to paycheck, lack of

knowledge on investment, efficient contribution to retirement funds, and so on. Finally, among the ‘real estate issues (car, house)’ discussions, there are problems of choosing an efficient mortgage type and obstacles to applying for credit.

Most topics have a positive mean or median sentiment with a value above 0.65 on (-1;1) scale. The only negative topic is related to criminal activities and investigation with a mean compound score of -0.08 and a median of -0.14. The most positive topics are related to business (mean: 0.68; median: 0.86), advices in financial management, teaching and learning (0.61, 0.84) and retirement issues (0.63, 0.81). The most neutral topics are ‘credit, loans and dealing with banks’ (0.46, 0.67) and taxes (0.47, 0.68).

Out of the subtopics, ‘passive income’ turned out to be the most positive subtopic discussed with an average compound score of 0.9 and a median of 0.97. Among the subsequent positive subtopics, ‘business services’ and ‘financial education’ also stand out. The only subtopic with negative central tendency measures was ‘crime and money’ (-0.08, -0.14) as the only one included in the ‘criminal activities and investigation’ topic. Others were revealed to be mostly positive with scores above 0.05.

## 6. Discussion and Conclusion

In this study, we broadened the field of online discussions research and showed how they could contribute to the understanding of people's real-life problems. First of all, since we work with a part of the social network where people discuss pressing issues and questions that interest them, the topics and subtopics themselves can be extracted for a preliminary analysis of what bothers people and what is most important. Sentiment analysis can serve as an auxiliary tool for understanding not only what topics people discuss, but also which ones cause them more or fewer emotions - positive or negative, which also gives an understanding of how acute the topic is.

Highlighting the problems within each topic and analyzing them can give a focus on certain aspects of people's financial life, which can later be used to develop products aimed at helping people in these areas. In the case of the study, the conducted analysis of phrases and their frequencies will be used further to define user pains and jobs-to-be-done, and sentiment analysis will help us to explore situations that people are very emotional about and understand user pains better.

Thus, services with online discussions like forums or social networks can serve as a strong basis for making strategic decisions to develop in-demand products that can help people make the right decisions and improve their financial literacy. This approach can also go beyond the topic of discussion of finance, expanding opportunities for the study and development of products designed to help with identified problems in many other areas of life.

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# Fans Capital in Contemporary Business: From the Perspective of Relational Capital to Understand Fandom

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## Abstract

This article aims to understand the status and features of fans relationship in the relational capital of enterprises, and then put forward some potential actions about how to take advantage of this kind of capital. The first part is about fans participation and the status of fan capital in the commercial context. From the technical perspective, it is based on an internet-based consumption model, making digital ubiquity will become the new normal. From the cultural perspective, convergence culture and participatory culture further evolve and develop. Therefore, it can be considered that fan relations provide enterprises with additional channels and new interaction possibilities. The second part is about fans psychological features and some problems concerned. In most cases, fan labour is driven by emotion without compensation. Loyalty, identity and Passion are the main psychological characteristics. This kind of emotional group will also bring about instability and moral problems, usually being regarded as the "Dark side". Some potential actions to expand their profit model and channel are what the last part wants to discuss. This article suggests three actions: i) Establish brand page and brand communities; ii) Value and operate the relationship of fans and iii) Combine products and propaganda with the aesthetic economy.

## Keywords

Fans capital, e-business, relational capital

## 1. Introduction

Developments of new technologies have greatly affected people's lifestyles. The widespread use of new media has influenced the communication relationships between business owners and their customers [1]. It also brings more possibilities and changes for the relationship between fans and relationships from them. The first question this study wants to discuss is what the status of fans' relationships is in the relational capital of enterprises. Most of the modern consumer market is often the generations described as "digital native", they are used to the internet-based consumption model, which is the foundation of this study. Combined with the technical foundation and participatory culture, fandom in social media provide additional channel and new interaction possibilities for modern business.

Based on online communities, especially today, with the popular development of UGC (User Generated Content) continues, fans will use social media and other platforms to conduct related activities based on their favourite content. Talking about whether fans capital can be regarded as an important and useful intellectual capital in this era of entertainment, it is not only necessary to discuss its influence and importance, but also to consider whether this capital can be used. Therefore, the psychology and motivation of fans need to be mentioned. Identity, loyalty, and passion are the three important psychological features behind fans participation. This part will also discuss the dark side and instability of fan's labour to remind such a point: before managing fans capital to expand enterprises' profit model and channel, the disadvantages and interests of the fan community are also worthy of attention.

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Traditionally, advertisers used to invite stars as spokesmen to promote sales, but they often used a relatively single way of communication, such as advertising in newspapers. Now, with the development of social media, enterprises should learn how to use these new tools to expand the market scale and maintain user stickiness [2]. Therefore, in this last part, from some new economic features, three actions related to social media are proposed.

## 2. Participation and Status of Fans in Business

People tend to be involved in social media and do fandom behaviours frequently in contemporary society. Jason [3] did research on American Internet users, revealing that the spend on social networking and microblogging are respectively 1.72 h and 0.81 h a day on average. Additionally, on social media, half of their users are obsessed with following brands [4]. The relationship between enterprises and consumers has changed a lot due to new communication ways.

Digital natives are often referred to as Generation Y and Z who grows in the environment full of digital and technological devices. While traditional sources of information and consumption models also have a big influence on these people, digital sources tend to play a more important role. A study about the young generation showed teens and tweens spend more than 6.5 h and 4.5 h respectively on screening media [5]. The study also indicated that the online behaviour of tweens and teens, finding social media has been integrated into our lives, regardless of adults and children, which caused a change with functions of social media to stick users has been well recognized by marketers who tend to use social media as their publicity tool and make advertisement on it in consumer behaviour. Meanwhile, there are more and more types of online shopping platforms and online goods, helping the young generation form an internet-based fan consumption model.

In the production link of the fandom economy, it requires the participation of a large number of people to form a heat and form a virtuous circle. In addition, due to the promotion of the cultural economy by the web 2.0 and UGC model, the behaviour of fans has evolved from "participation" to the "output". Enterprises must find some new changes and methods to deal with this consumption model, social media is the platform they often rely on. However, the typical method of focusing on the number of original fans cannot describe the potential and realized range of social media brand impressions, they need to take actions to interact actively with the digital natives, creating an effective strategy for reaching key audience segments [6].

Fans' online participation is completed by fans' expressions, sharing and communication. Within online communities, fans take the initiative to produce cultural products related to idols and interact with other fans, these all happen naturally around common interests when people participate in online communities [7]. The audience is no longer satisfied with passive acceptance but participates in cultural production. Fan groups use new media earlier than other types of audiences and are more active participants [8]. In the traditional concepts of convergence culture and participatory culture, the focus of fan practice is to "participate in production" rather than "what to produce". In the fan community, fans participate in the growth of their favourite content and gain experience for themselves through this participatory behaviour itself. On the internet-based consumption model, participatory culture is not only restricted by the market economy, fans' self-experience and self-identification in cultural consumption can be echoed more widely. Jenkins used "cultural dupes, social misfits, and mindless consumers" to describe fans as the active consumer to challenge the existing stereotypes of fans.

In addition, as a group, the behaviour of fans will also reflect collective characteristics. Hills [8] used the concept of "transmedia and collective intelligence" to describe the large-scale information collection and processing activities that occur in the online community. No one knows everything on the Internet, but everyone knows something. People gather for a common goal, forming a new type of community marked by voluntary, temporary, and strategic affiliation, cooperating in the production and exchange of knowledge.

Because of the unique communication characteristics of social media, communication between consumers and businesses has changed from one-way to two-way. Traditionally, advertisers used to invite stars as spokesmen to promote sales, but they often used a relatively single way of communication, such as advertising in newspapers and magazines. Now, with the development of new media technology, the commercial value of stars can be further explored. For example, some idols or

stars will recommend products when they live, resulting in great sales, forming some new types of digital labour and marketing methods, providing additional channels and new interaction possibilities.

The new platform supported by technology makes timely interaction possible and can even make this a habit. Social media users have the habit of reposting, commenting, following and liking others on social media. As a result, fans instead of customers, brand advocates instead of followers are the quest for a larger market share in business [10], the social media platforms can contribute to this process. The content and triggers on social media platforms can attract attention and cause them to act, action will also maintain their loyalty to the brand in return. In short, social media and fandom conduct an additional channel for enterprises to promote, and some new interaction possibilities come into existence according to platforms' mechanisms and rules.

### **3. Fans' Psychological Features and Some Problems about it**

Kim and Ko [11] argued that social media has effects in attracting and ultimately maintaining customers' loyalty, so companies must try to understand how to use it. To study the deep influencing factors behind this, fans' psychological features and some problems caused are explained in this part.

#### **3.1. Identity, Passion and Loyalty**

The fan community is often an internal communication space based on the identity of fans, which distinguishes fan behaviours from general online cultural practices. In the online community, fans will communicate through avatars and acquire different identities, through which they can also gain a sense of achievement, satisfaction, and social participation [12]. Different types of fans also show different loyalty characteristics. Managers of fan communities,

or those with more fans, often have more power to speak and make decisions. They can be regarded as key opinion leaders, possessing propaganda value similar to celebrities. As usual, virtual community members with a strong sense of social identity are more likely to be more willing to participate in online communities. Similarly, supporting evidence regarding the direct influence of social identity motivation on the intention to participate in online communities [11] & [13].

Fans' labour is always free, so the motivation behind their labour is not compensation. Passion is the most common motivation. In the sports industry, passion can be seen as the fuel of its future development [14]. Kirk Wakefield [15] uses his multiple-item passion scale and compare it with established social identification fan classification scales to provide evidence of discriminant and predictive validity to prove the concept of fan passion is important on sports and entertainment properties. For fans, their labour is often not for monetary and material gains, but emotional rewards. Sometimes the avoidance or escape from other activities is the primary motivation for fan's online participation [11], they need to find other ways to release their emotional needs, and this need is often through a passion for a certain culture or cultural content.

Loyalty is another important factor that should be taken into account, which could influence brand supporters in the long run. The relationship between relationship benefits and customer loyalty is related to relationship marketing [1], which is obvious in the gaming industry. Online games have become a popular computer application, and the loyalty of gamers is crucial to game providers because online gamers often switch between games [16]. The establishment and maintenance of brand loyalty is an important topic of long-term concern in the market [6]. It is a symbol of brand loyalty and can be conceptualized as the ultimate goal.

#### **3.2. Instability and Violation of Fan Interests**

Some arguments about the meaninglessness of managing fan capital are because they hold a view that fans are often emotional, they are often changeable and unreliable. But when it is discussed from the perspective of a group, this kind of concept is relatively stable. There are many factors involved: loyalty, identity, social participation, and satisfaction, etc. While some people leave the community, others will join the community, which can form a relative dynamic balance. Also, participating in team

activities encourages online gamers to abide by team norms and meet their social needs, while also increasing their loyalty.

In addition, some mechanisms of social media also establish technical feasibility for fan stability. Facebook provides opportunities not only to deliver brand impressions on a large scale but also to deliver impressions with a social background. This means that it has the potential to produce improvements through the whole marketing cycle from brand awareness to lifetime value [6]. Perhaps an individual's interests are changeable, but social media tags will always have a corresponding group of people, which also maintains a relatively stable target for marketing.

Fan participation is freely chosen in all aspects and understood as a kind of fun, and neither of these is usually related to money. Companies treat fans as a kind of free labour, the lack of relevant laws is also an important factor, making enterprises ignore the interests of fans. Concerns about free labour for fans not only exist in online fan communities, but also in some

traditional labour modes in real life. In the broader American working environment, it is called as "late capitalist sports culture industry" to describe the dark side of fans free labour as interns [17]. Because it expects interns to accept substandard working conditions but is full of enthusiasm and love for their work.

In short, the instability of fan groups is greatly reduced due to the protection of online communities and social media mechanisms. It is more valuable to manage this type of capital from the perspective of the group. However, before using the perspective of capital to understand fan capital, we must consider the protection of the interests of the fan community.

#### **4. Fans' Psychological Features and Some Problems about it**

In the era of new media, consumers' ability to identify and establish connections with brands of interest enables brands and consumers to share and interact in new ways. Brands and their consumers can now establish a two-way relationship and share content, news, and feedback, forming a good participatory communication and market paradigm. However, the typical method of focusing on the number of original fans (or the total number of participations in a given content) cannot describe the potential and realized the scope of social media brand impressions [6], and companies need to adopt some new methods to reach the fan base.

##### **4.1. Establish Brand Page and Brand Communities**

The Internet provides a brand new market channel for the brand where the display is the first and relatively important level. Pin Luarn et al. [18] studies 1,030 brand-page posts on Facebook, finding that "the media and content type of posts exert a significant effect on user online engagement".

The attention economy is an economic model that achieves profitability by attracting audience attention [19], which heavily influence modern marketing to attract the attention of users or consumers at low cost, cultivate potential consumer groups, and obtain the greatest future intangible assets. Under the mode of the attention economy, the concept of "symbolic value" of commodities has been further deepened. The gap between the quality of commodities is constantly narrowing, so the symbolic meaning of commodities has also changed when people choose commodities. From a sociological perspective, consumption is not only an act but also a symbol system [20]. Both consumption and consumer goods are symbolic systems and symbol systems used to convey meaning, which can be shown on the brand page. In addition to this, brand communities will maintain the loyalty of fans and provide them with a good place to produce symbols that are closer to consumers, because the audience of branded content on social platforms can better understand the true impact of these impressions. Using Facebook or other social media to meet the needs of Generation Y and respond will make marketers gain the most because consumers' loyalty is ensured through buying an assigned brand [18].

## 4.2. Establish Brand Page and Brand Communities

The paradigm of interpersonal communication has declined in recent years due to the development of mass communication technology, but the extensive use of social media has brought new development and possibilities to this paradigm. Zainal et al. [21] studies how electronic word-of-mouth can affect consumers on their intention of purchasing, finding social media engagement could improve their intention because of the recommendation in the fandom communities or from their friends. Attracting fans through marketing messages is of interest to brands, but current research has found that fans' friends represent a huge potential audience, usually far beyond the size of fans.

The mechanism of social media could convey the information actively and directly by algorithm, or by the participation of fans post, repost and likes. These unpaid impressions are created when friends actively interact with the brand and are visible on friends' walls or news sources. These behaviours may appear between fans, fan friends and other social media users. Take Facebook, for example, social media determines factors of digital native's relationship commitment towards brands [11] & [1]. Besides, social media users are more likely to share brand information with their friends in innovative ways on the platform, regardless of in positive ways like expressing their love and recommendation or negative ways like criticism. In this way, social media platforms such as Facebook accelerates the coverage and vitality of the sharing. For each fan, 34 fans can be contacted [22], so each user is endowed with great communication efficiency. Under this behaviour model, a very huge consumer market has emerged in front of the brand through the exploration of fan relationships. Therefore, by operating the relationship between fans and other social media users, the brand can form a wide and effective communication effect at the level of interpersonal communication.

## 4.3. Combine Products with Aesthetic Economy

The objects have "aesthetic value" besides the use value and exchange value considered by Marx. Aesthetic value is a new type of value that transcends human physiological desires [23]. It is the result of transforming production goals from satisfying the needs of human life to opening human desires in the pursuit of more benefits in the development of business and capital.

Under the influence of aesthetic economy and aesthetic culture, with the advancement of technology and the improvement of social tolerance, enterprises should take strategic vision to develop strategies on how to attract audiences through aesthetics. AR is considered to be a technology's ease of use, which will greatly affect consumers' attitudes towards technology [17]. The emergence of AR brings a new watching experience for fans, which is superior to traditional watching types with a fixed angle of view and low-speed movement, thus may be regarded as the most important new trend for consumers to interact with activation in some way [24]. AR is just an example of how enterprises could use new technology to make their consumers have a better aesthetic experience. Products with good design and a beautiful appearance will have better marketing results in social and cultural markets.

## 5. Conclusion

Fandom does play an important role in contemporary business models, which is largely linked with the Internet-based consumption model formed by digital natives. Additionally, people participate more actively and output more products in their social media or online communities. Fandom is taking shape of some new additional channels and interaction possibilities for enterprises, to expand their profit channel and marketing targets. It is no doubt that fandom drives by some emotional features and is not restricted by contract or money. But simply thinking it is unreliable is not correct, the good choice to tackle with fan capital is to understand and then take advantage of these psychological features to manage them in the long run. Besides, the problems about violation of fan interests are also worthy of attention because they will also influence enterprises in return.

As a result, enterprises have no choice but to adapt to this trend by making strategies regarding social media to manage this kind of relational capital. They need to manage fans capital through social media to form a good brand image and achieve better communication results with the help of social media. By

establishing brand homepages and communities, they can attract and maintain the attention of fans; by valuing and operating the relationship of fans, good communication can be formed, and its effect does not less than mass communication's; by giving consumers more aesthetic experience, their products will also have more unique aesthetic competitiveness, especially for fans.

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# Online Communities of Support for School Teachers in VK

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## Abstract

This paper explores main topics discussed in online communities of Russian-speaking school teachers in the Social Network Site Vkontakte. The method applied for the identification and further interpretation of topics is Structural Topic Modelling (STM) in R. Text posts from seven large open groups for teachers were analyzed during this study. The paper shows 24 distinguished topics that appear in teachers' groups in VK and their connection with types of social support observed in teachers' online communities; most frequent terms, the proportion of topic presence, and examples of posts are also provided. Besides, the research explores correlation between found topics and their co-occurrence in one post. Finally, the paper presents discussion of received results and compares it with studies conducted on other online platforms in different countries.

## Keywords

Online communities, school teachers, SNS, Structural Topic Modelling, Vkontakte

## 1. Introduction

Social Network Sites such as Vkontakte provide school teachers an opportunity to form online communities, where they can communicate with their colleagues independently from time and location.

Many studies of online communities in Social Network Sites explored the patterns of communication between members, including information exchange and forms of provided support. Studies of communities in Facebook and Twitter for people with such diseases as diabetes and cancer showed that mainly members discuss their experience related to practices, share scientific information, and ask for moral support [1, 2].

The field of studies of teachers' online communities also contains works about ways of knowledge-sharing [3], reasons of teachers' online interactions [4], their motivation to participate in online communities for professionals, and forms of support which they can receive in these communities [5, 6]. Recent studies are also draw its attention to situations, when large teachers' groups in SNSs become commercialized, while unpaid most active members do not receive any payments from it [7].

Despite the fact that there are studies of forms of online support in teachers' communities, specific topics which teachers discuss in their online communities are not the main focus of researchers' attention.

The main aim of this research is to distinguish the main topics of posts in large online communities for school teachers in Vkontakte and explore which topics receive a higher response from participants of communities.

Therefore, the research question is the following: what are the principal topics discussed in posts in online communities of support for school teachers in VK?

## 2. Literature review

Content and participants' interactions in online communities for teachers are studied by researchers from several aspects. One of the ways of studies concentrates on the fact that online communities are

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one of the methods of informal learning for teachers. The other direction of studies uses the framework of social support and suggests that besides exchanging of information teachers support each other emotionally and by providing feedback.

Besides online communities for teachers also can be perceived as a way to avoid professional isolation [8]. Teachers from remoted areas often have lack face-to-face interactions with professionals in their sphere [4, 9]. That is why online communities due to its access in any time and place can solve this problem [10].

## **2.1. Teachers' professional development in online communities**

Professional development of teachers can happen not only during formal events such as professional courses but also online with the help of professional online communities [4]. One of the earlier studies of school teachers' professional development suggested that the interactions in the online community for professionals makes learning more effective [11]. Authors identified that teachers cooperated with each other by sharing links to educational sources and study materials, teachers discussed their experience of including of new computer technologies into their teaching practices, and collectively came up with alternative methods for teaching. The idea of the importance of public exchange of teaching experience was supported by Lieberman and Mace [9], who suggested that teachers' knowledge exchanging in online communities helps not only in adaptation of new ideas into their work but also in structuring already known information. Furthermore, in later studies was elaborated that the ideas, which teachers learn from their online communities and later adapt into their classroom practices, also allow improving the performance of their students [12]. Besides, the study provided that teachers were actively involved in discussion mostly under the topics which were more relevant to them at the time when they were addressed to the community.

In later studies, researchers started to elaborate on the idea that interactions in online communities for teachers are one of the key elements for teachers' learning. The case study of the teachers' collaborative space eTwinning revealed that the collaboration of participants influences their feeling of mutual trust, which increases the effectivity of providing reflections about gained knowledge and the overall dynamic of discussion [13]. The importance of interaction was also highlighted in the study of PROEDI, the social network created specifically for teachers [14]. It was pointed out that the constant communication among participants allows other members faster find information about newly-appeared teaching practices and technologies.

Several studies of teachers' professional development argued that teachers need not only easy access to necessary information but also emotional support from peers [15, 16]. From the perspective of peer coaching, the main factors affecting teachers' learning are reflections and emotional encouragement [16].

## **2.2. Social support in online communities for teachers**

The study of the teachers' community in the Social Network Site Twitter stated that teachers use the space both for gain knowledge and encouraging from other community members [17]. The study of teachers' usage of Facebook for professional purposes also supported this idea and suggests that teachers seek in online communities emotional support and opportunity to communicate with colleagues [18]. The research of Kelly and Antonio [5] conducted in open groups for teachers in Facebook showed that in communities teachers provide support online in several forms. The main form of support observed by researchers in those groups for school teachers was connected with discussion of practices. Next, the recent study of Facebook groups for teachers in Taiwan showed that teachers, who participate in online groups for schools' professionals, are more confident in results of their teaching performance due to the exchange of support with peers [19].



### 3. Material and Methods

The data for the analysis consisted of posts collected from 7 groups of mutual support for teachers in Vkontakte. All groups were open and met the following criteria: activity since 2017 or earlier, more than 1000 followers, no specification to school subject, opportunity for all members to offer posts and comment them.

As a result, groups "Подслушано у учителей", "Злой Учитель", "Подслушано| Учительский портал", "Я - классный руководитель", "Фоксфорд.Учителю", "Geek Teachers|Учителя гики", "Профсоюз 'Учитель'" were included in the sample. The data was parsed from Vkontakte with the help of API and R-package ("vkR"). Overall, 68 150 posts within the period from 2017 to 2019 were collected, posts marked as ads were removed.

Data analysis was conducted using the method of Structural Topic Modelling and R-package "stm". The number of topics was identified with the function searchK. Before processing the model, the text corpus was tokenized and prepared for future analysis with the package "quanteda". All letters were converted to lower case, punctuation, special symbols, numbers, typical Russian stop words and 132 custom stop words were removed.

Interpretation of topics was made using two indicators: High Probability and FREX ("Frequency and Exclusivity"). The parameter High Probability shows the most frequent words, which are more likely to appear in posts with this topic, while FREX indicates frequent unique words for the topic. The full list of topics' keywords with examples of posts is provided in Table 1. Besides, after topics' identification the network of correlations among topics was built.

**Table 1**  
List of identified topics with their interpretation

Topic	High Probability	FREX	Interpretation	% Proportion	Example of post
23	классов, учитель, начальных, работать, английского, образование	умк, переподготовк у, заканчиваю, дипломе, бакалавриат	Young professionals	11,54	"Анонимно. Я мс. Скажите, много ли времени уходит на написание рабочих программ и планов ??Выхожу на работу с 10.08, и боюсь что не успею все сдать ( минимум 6 классов) Какими источниками пользуетесь. Английский язык ( Spotlight и Enjoy English)может ли кто то поделиться ?заранее спасибо" Podslushano - uchitelskiy portal, 07-08-2018
19	год, отпуск, директор, работать, руководство, заявление, дней	декрета, отпускные, бухгалтерии, больничный	Vacations including maternal and seek leaves	10,88	"Доброе утро! У меня такой вопрос. Я сообщила директору о выходе с сентября на работу, но недавно узнала, что я снова беременна. Теперь боюсь сообщить об этом, боюсь осуждения. Как мне лучше это сделать?" Podslushano u uchiteley, 29-06-2019
8	поделитесь, заранее, дорогие, класс,	идеями, паблики, сценарием, методичка,	Asks for sharing ideas, materials,	10,2	"Здравствуйте! Поделитесь, пожалуйста, может у кого-нибудь есть примерные задания олимпиадные по математике за 1

Topic	High Probability	FREX	Interpretation	% Proportion	Example of post
	опытом, помогите, провести	подкиньте, посвящение, поделитесь	experience		класс ? Заранее спасибо” Podslushano - uchitelskiy portal, 08-04-2019
4	скажите, право, директор, администрация, должен, имеет	обстоят, отказаться, прописано, организатором, заставляют, субботу, ссылаться	Conflicts with school administration, teachers' rights and duties	7,58	“Могут ли заставить учителя делать ремонт, если он увольняется? Как правильно по закону.(анонимно)” Ya - klassniy rukovoditel, 11-06-2018
18	класс, дети, делать, родители, год, первый, урок	пмпк, столкнулась, дисциплину, дз, уроках, проблема	Students' discipline issues	7,5	“Анонимно. Дети подрались в пятом классе. Прибежала, завела в кабинет - писать объяснительные. Родители возмущаются, что не имела права брать объяснительные с детей, да еще и без присутствия родителей. Скажите, как у вас в школе с подобными моментами?” Zloy uchitel, 22-03-2018
6	егэ, огэ, языку, оценки, задания, русскому, математике	впр, критерии, балла, фипи, оцениваете, огэ, четвертные	State exams	5,75	“Здравствуйте, коллеги. Вопрос об ОГЭ по русскому языку. Есть ли пособия, в которых тесты бы были разбиты по темам? Например, фонетика, орфография... или что-то подобное хотя бы.” Podslushano u uchiteley, 29-09-2017
22	мама, девочка, мальчик, ребенок, ситуации, говорит, родителей	диктофон, обижают, родительница, обзывает, звонит, мамочка, девочка	Problems with students and their parents	5,32	“Здравствуйте. Хотела спросить коллег. Какие записи вы делаете в дневнике младшего школьника? Я такие: " опаздал на урок", "не пришел в школу", "не выучил стих и т.д.", "не готов к уроку". Мама ученика грозит подать в прокуратуру, за то что я "разрисовываю" дневник его ребенка. Это она написала мне в дневнике такое послание.” Ya - klassniy rukovoditel, 02-10-2019
11	курс, сайте, участие, обучения, школьником,	регистрация, вебинаре, вебинара, fest, технологиям	Online courses	4,68	“Как проектировать интересные уроки? Как составить программу урока, чтобы можно было спланировать образовательные результаты и при этом соответствовать ФГОС? Ответим

Topic	High Probability	FREX	Interpretation	% Proportion	Example of post
	сертификация, образование				на эти вопросы на бесплатном открытом занятии «Основы педагогического дизайна: изучаем современные инструменты создания интересных и эффективных уроков». Foxvord - uchitelu, 26-06-2019
2	сентября, праздник, подарки, класс, выпускной, марта	поздравление, #я_классный_руководитель_день_учителя, медали-открытки, подарками, поздравляете, открытки-медали	Celebrations	4,44	"Уважаемые коллеги!!! Подскажите, весёлую песню для первоклассников, на последний звонок!!!" Podslushano - uchitelskiy portal, 10-05-2019
3	работать, люблю, сил, дома, год, нравится	радуясь, люблю, успеваю, чувствую, репетиторство, устала, нервов	Feelings towards work	3,65	"Просто хочу поделиться...Я учитель. ПОМОГИТЕ! Сил уже нет на работу! Постоянное раздражение, срыв. Такое ощущение, что уже ни на что нет сил. Может кто сталкивался с этим на работе? Может я выгорела?" Ya - klassniy rukovoditel, 03-10-2019
7	кабинет, тетради, фото, ремонт, купить, школа	A4, распечатывать, покупаете, оформляете, шкафы, раздать, стенгазета-раскраска	Renovation and decoration of school classrooms	3,56	"Классные руководители, висят ли в ваших классных комнатах общие фотографии с классом? Возникла идея распечатать несколько лучших фото, вставить в рамки и повесить. Вот только думаю, какого формата... Скорее всего, не менее А4." Ya - klassniy rukovoditel, 28-07-2019
24	времени, хотелось, интересно, почему, стоит, мнение	мнение, группе, хотелось, считаете, относитесь, услышать, коллег	Asks for colleagues' opinions	2,86	"Здравствуй! Коллеги, как вы считаете из-за чего может быть непонимание задач в нескольких действиях?" Podslushano - uchitelskiy portal, 22-10-2018
21	образование, учитель, педагог, школ,	луховицкий, сопредседатели, профсоюзов, лжем,	Teachers' professional union	2,74	"Пикет профсоюза "Учитель" около здания Минпросвещения в Москве против "черной метки", введенной Департаментом

Topic	High Probability	FREX	Interpretation	% Proportion	Example of post
10	профсоюза, области, россии должен, учащихся, правила, поведения, собрание, родительско	департамента, профсоюза организовывае т, анкета, собрания, родительское, поведения	Parent-teacher meeting	2,65	образования Москвы.” Profsouz uchitel, 14-12-2018 “Коллеги, подскажите, пожалуйста, наиболее актуальную на сегодняшний день тему родительского собрания. Спасибо!” Ya - klassniy rukovoditel, 16- 04-2018
17	учитель, работать, почему, родители, статья	выгляжу, обещаю, профессия, грязью, шишки, придирки, наставник	Reflections about the teaching profession	2,64	“Когда я шла работать в школу я ожидала: - интересные уроки - составление планов уроков - работа со слабо-успевающими и одаренными детьми - заполнение журнала. В итоге я хожу на концерты/мероприятия, на которые сгоняет нас администрация, хожу по дворам и переписываю детей, доказываю родителям, что их дети не на столько одаренные, как они убеждены, а скорее сядут в тюрьму в ближайшие годы за разбой, уговариваю родителей прийти на выборы, заполняю кучу никому ненужной макулатуры. Да, и в перерывах между этим всем уроки провожу. Ага.” Podslushano u uchiteley, 10- 03-2018
20	слова, читать, дети, буквы, слово, писать	слоги, печатными, почерка, почерк, буквы	Teaching children to read and write	2,3	“Здравствуйте, коллеги. Когда в 1 классе начинать писать диктанты? Пишем под диктовку буквы и слоги. Про диктанты - тексты в программе ни слова в 1 классе.” Podslushano u uchiteley, 18- 12-2019
16	мая, потерять, шаблоны, автор, безопасности, уголок	шаблоны, ростовская, поздравлялок, парад, полк	Preparations to May 9	1,92	“9 мая — праздник, который навсегда останется в нашей памяти. Мы помним подвиг наших солдат и благодарим за мирное небо над головой. Коллеги, как вы рассказываете ученикам о Дне Победы?” Foxvord – uchitelu, 09-05- 2018
15	деньги, участие,	комплектов, собираете,	Participation in	1,84	“Анонимно, пожалуйста. Уволилась учитель, которая

Topic	High Probability	FREX	Interpretation	% Proportion	Example of post
	участвовать, конкурсах, дети, родители, принимать	участвовать, конкурсах, стендов, олимпиадах	competitions		должна была участвовать в " Учителе года", и теперь участвую я. За 2 недели до конкурса я об этом узнала((( Ничего в голову не идёт, нужен мастер-класс. Я знаю вы все можете, подскажите идею. Буду очень благодарна" Ya - klassniy rukovoditel, 02- 11-2019
13	новости, учитель, дети, области, района, против, родители	протеста, издательско-полиграфического, следователи, следственного, техникума, пенсионного	News and accidents	1,83	"КАЗАНЬ, 13 мая — РИА Новости. В Казани задержали десятиклассника, который пришел в школу с пневматическим пистолетом и ножом, сообщили в республиканском МВД." Podslushano u uchiteley, 13- 05-2019
9	дети, столовой, обычно, дома, жена, еду	захожу, по-советски, питаются, жена, завтрак, врач, шк	Nutrition	1,73	"Всем добрый день! У вас вкусно кормят в школьной столовой? Если нет, то вы можете на это как-то повлиять? И что продают в буфете? Иногда ребята вместо обедов покупают шоколадки(((." Podslushano - uchitelskiy portal, 20-11-2018
12	рф, труда, образования, образования, заработной, платой, российской, платы	исследовательских, лестница, научно-практических, инновация, пртникдм, научно-образовательной, заработной	Discussion of teachers' wages and laws related to it		"Существует ли где-либо нормативная база по оплате труда педагогов с обучающимися ОВЗ? К моей коллеге в класс пришел ученик, который будет обучаться по адаптированной программе 7.1. Когда она пошла спросить о том, положены ли ей какие-либр доплаты, то получила отказ. Оказывается, что документа, где прописаны обязательные доплаты педагогическим работникам при работе с детьми ОВЗ на Федеральном уровне нет. Только рекомендации. Вопрос: существуют ли такие документы в природе? Анон." Podslushano - uchitelskiy portal, 25-12-2019

Topic	High Probability	FREX	Interpretation	% Proportion	Example of post
5	расписани е, смену, вторую, урок, личной, инициатив е, расписани и	мэш, гласные, power, расписание, смену, личной	Teachers' work schedule	1,2	“Работаю во вторую смену. Хочу взять репетиторство на утро, но боюсь, что могут быть проблемы, если попросят заменить урок в первую смену. Что делать? Можно ли отказаться от замены по этой причине?” Podslushano u uchiteley, 27-03-2019
1	жить, год, дети, души, началось, глаза, слезы	айфон, фен, баловство, миксер, подчинятся, заборы	Expressio n of emotions	1,02	“Как же надоели эти проверки! Да просто достали! То убери, сё убери. Как будто никто из этих проверяющих чай в кабинете не пьёт. Да ещё и важные такие ходят, детей прерывают при пересказе. Прямо брррррр. Крик души, извиняюсь. Анонимно.” Podslushano u uchiteley, 01- 03- 2017
14	читать, ребенок, мест, количеств о, родители, домашнег о	онлайн- интенсив, полюбили, сертифицирова нный, поднимите, скорочтению	Home reading	0,5	“Пару недель назад мы писали, как повысить у ученика скорость чтения. Этот пост можно найти тут: <a href="https://foxford.ru/l/b7M">https://foxford.ru/l/b7M</a> По просьбам подписчиков подготовили сегодня пост, как повысить понимание текста.” Foxvord – uchitelu, 05-02- 2019

#### 4. Results

The received model contains 24 distinguished topics among posts in groups from the sample. According to provided keywords (see Table 1), the most frequent topic includes a discussion of young specialists, their professional training, and specifically a discussion of “training and methodology complex” which are official recommendations for teaching practices. The second frequent topic is connected to the discussion of vacations, including maternity and sick leaves. The next frequent topic includes requests to share ideas and scenarios for school events, manuals, and personal experience.

Besides, among the top-10 frequent topics also are discussions of conflict situations with students and their parents, problems with school administration, state exams, and school events such as September 1st and high school graduations. The topic related to problems with school administration covers a wide range of issues such as writing explanatory notes, conflicts about the distribution of extracurricular workload on teachers, teachers' rights, and obligations.

Less frequently in online groups for teachers appears such topic as children's home reading. Among the least frequent topics, there are also discussions of emotions, teachers' working schedule, news and accidents.

The correlation between topics means that these topics are more likely to be discussed in one published post.

According to the topics' correlation network (see Fig.1) topics that cover discussion about conflicts with students, their discipline issues, problematic situations with parents, asks for colleagues' opinions and teachers' feelings towards their work are closely interconnected.

Besides, there are additionally two groups consisting of three connected topics. The first “triangle” consists of topics 21, 13, and 12, which include posts about the activity of teachers’ professional union, wages, and news related to the educational field. The second “triangle” is formed by topics 2, 8, and 16 connected with discussions of state exams, school events and teachers’ ask for ideas and materials.

Several topics do not have a connection with other topics. These topics discuss specific themes, such as home reading, participation in teachers’ competitions, online courses for teachers, parent-teacher meetings, renovation and decoration of school classrooms, teachers’ work schedules.

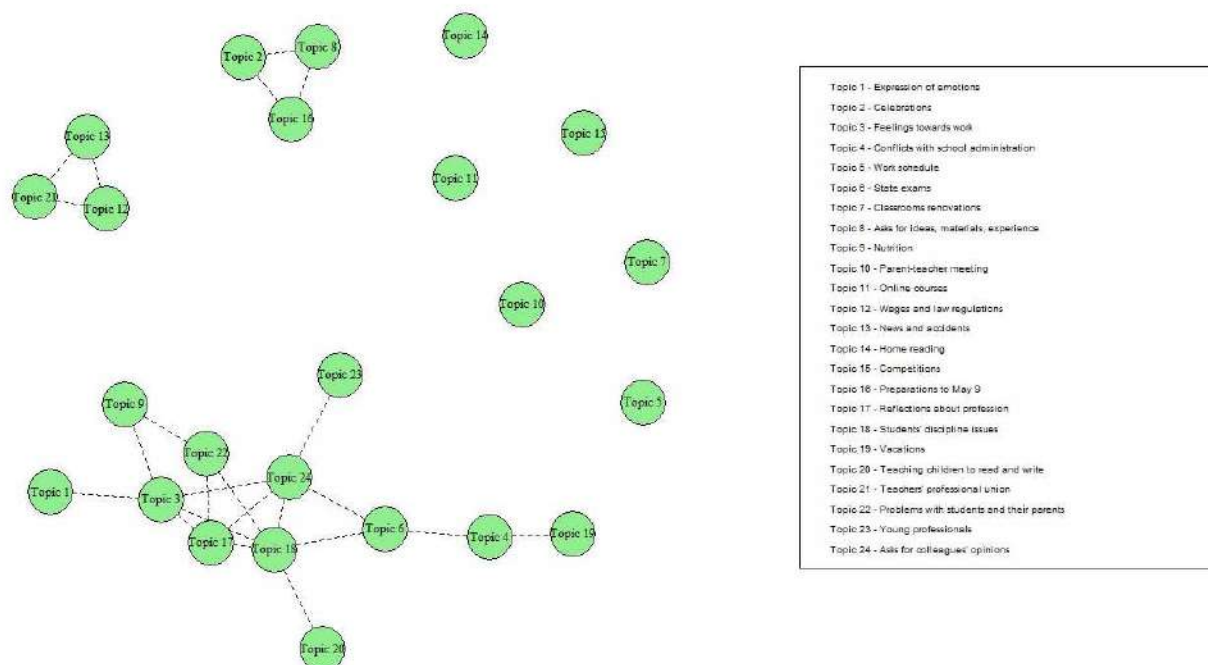


Figure 1: Correlation of identified topics in groups for school teachers in VK

## 5. Discussion and Conclusions

From the list of identified topics can be suggested that Russian-speaking teachers are seeking social support in professional online communities. They are not only sharing and exchange information but also express their feeling, ask for the opinions of colleagues. Also, several distinguished topics are related to teachers’ relationships with their surroundings, including students and their parents, colleagues, and family. Several distinguished topics are connected with conflicts and their solutions. According to the correlation network topics of feelings’ expression are interconnected with topics that discuss situations outside the methods of teaching. Teachers exchange their experiences about being involved in problematic situations at schools. These situations can be related to the behavior of their students, miscommunications with their parents, relations with school administration. In such posts, teachers ask for help and reflections of their colleagues, and also seek emotional support from professionals with similar experiences. It supports the idea that teachers’ interactions in communities in Social Network Sites involve not only the exchange of professional knowledge but also include emotional aspects of peer support [18].

Besides, one of the most frequent is related to young specialists. Teachers, who only begin their school careers undoubtedly need assistance from more experienced colleagues to overcome challenges [20]. In received results, the topic related to beginning professionals is connected with questions about colleges’ opinions. It can be assumed that by communicating in online communities young teachers gain the necessary support for their professional development.

To conclude, online communities in V Kontakte allow teachers to interact with peers, share their ideas and professional experience, learn practices related not only to teaching but also to conflict solving. Teachers are able to get emotional support and anonymously express their feeling towards situations at their workplace, which they lack in face-to-face communications with colleagues.

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# Social Aspects of Machine Learning Model Evaluation: Model Interpretation and Justification from ML-practitioners' Perspective

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## Abstract

Machine Learning (ML) is now widely applied in various life spheres. Experts from different domains become involved in the decision-making on the basis of complex machine learning models that causes in-creased interest in the research in model explainability. However, little is known about the ways that ML-practitioners use to describe and justify their models to others. This work aims to fill the research gap in understanding how data specialists evaluate machine learning models and how they communicate results to third parties. To explore that, the qualitative research design is suggested and semi-structured interviews with ML-practitioners are conducted. The decision-making process will be explored from a sociological perspective according to which data specialists are considered as actors who tend to construct knowledge rather than passively take it. The potential result of this work is to reveal the role of data specialists in model explanation and justification and describe methods they could use to explain complex models to domain experts with non-technical backgrounds.

## Keywords

Machine Learning, Algorithm Evaluation, Knowledge Sharing

## 1. Introduction

Digitalization promotes innovations and facilitates a process of globalization. With that, ongoing digital transformation causes the emergence of new tasks together with new methods for their solutions which are rarely clear for a wide audience but accepted since they provide solutions for urgent issues [1]. This tendency is noticeable in the applied domains when medium-size companies, large corporations, and small start-ups appeal to non-traditional digital solutions to present unique values of their works to strengthen competitiveness and take an outstanding position among the other market players. Data-driven approaches have achieved their recognition in customer-oriented settings that are thought to have an impact on society and its characteristics causing far-reaching effects [2]. For example, the banking sphere has changed with the help of the implementation of chat-bots based on machine learning algorithms, that give answers to clients quicker or send personalized notifications that are also already used in such industries as retail [3], healthcare [4], and insurance [5].

As one of the consequences, being motivated by the up-growing demand for analytical expertise at the labour market some people adhere to follow trends and take roles of problem-solvers to deal with latter-day challenges [6]. Expanding knowledge to boost expertise and diving into the data science sphere, such roles become diverse and barely clearly defined due to uncertainty. Moreover, specialists have to collaborate with each other to reach the commonly established goals such as releasing new digital products or upgrading existing infrastructure with advanced algorithms. Simplifying the concepts, model builders, model breakers, and consumers can be distinguished [7]. Considering a ground stage of the technological development and knowledge formation about that, the first two mentioned roles are taken by actors who are interested in facilitating innovations initially and make

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decisions based on data introducing state-of-the-art project results to the mass. Specifically, data specialists have not only to develop and evaluate statistical models such as machine learning ones but also come to an agreement with stakeholders who are far from direct work with mathematical algorithms, but they are who can ensure the promotion and assistance of the further project realization.

Motivation for conducting this research is based on the recent increase in scientific papers that emphasize the importance of machine learning practitioners' expertise dealing with algorithms promoting transparency analysis as an integral part of the work with algorithms and, by this, paying precise attention to a need for clarification of the data- and machine-learning-based solutions to providing understanding for all involved parties [7, 8, 9, 10]. As for a potential work contribution, this work attempts to present theoretical justification of model evaluation process with consideration of practices of model interpretation and sharing the knowledge to the other involved actors supported with qualitative data provided by machine learning practitioners seeing a case from their perspective.

## 2. Related Research and Problem Statement

Presently, there is plenty of research papers proving scientific interests towards data-driven innovations from the managerial, economical, and social perspectives. One of the research themes is related to studying a working process performed by data practitioners. In particular, these research are more focused on data-oriented skill-set [11], data science role division [12, 13, 14], team collaborations [15, 16], tools and practices within the workflow with the notion of practical settings [17, 18, 19]. In addition, other studies focus on the role of explanation in decision-making revealing that data specialists tend to trust algorithms too much and make decisions in a biased manner [20, 21]. However, little is known how data specialists, who implement complex models (i.e., machine learning ones), evaluate models in non-academic settings, and how they translate the obtained information to the others involved directly or indirectly in their work. Actually, several studies related to that issue have been aimed at a direction of practitioner's work investigation, but they are much more empirical rather than theoretically justified [7], and experts' needs and opinions about interpretability is rarely provided.

Thus, this research is aimed at studying practices (i.e., practical actions based on the real-life working experience) of data science specialists with the focus on the model evaluation stage and communicating their knowledge about model quality and other characteristics with the third parties. The following research questions are proposed: How do specialists perform model evaluation and what they pay attention at? How do data practitioners explain complex statistical models to other people without a deep understanding of data science principles and ideas? The relevance of studying this issue stems from the idea that data-experts are the first who interact with algorithms, who have specific knowledge to understand them, and their decisions are initial for promoting the use of algorithms in production, which might have a significant impact on society over time [22, 23].

## 3. Research Design

In the framework of this research, the description of the practical work of specialists is planning to be supported with empirical data collected via semi-structured interviews with practitioners working in different business spheres with data-intense applications. An interview-based approach is used to understand experience, positions, attitudes, and to know opinions of industry practitioners who are direct guides to the world of technology [24]. Variability sample or, in other words, interviewing practitioners from various domains is thought to be applicable for reviewing common (domain-independent) patterns and discrepancies to provide explanations of the performed actions and formed viewpoints with the help of shared real-life. As for sampling technique, convenient and snowball samplings were performed, and, as a result, 16 interviews with 11 men and 5 women have been conducted. The main criteria for recruiting participants were that they had to have at least one year of practical experience in the industry, as well as they had to practice machine learning algorithms for problem-solving at their work.

The obtained results will be analyzed with the help of thematic qualitative analysis in order to explore the general case from the perspective of the applied theoretical framework. In detail, this work is planning to be based on theory in order to justify its results by grounded interpretation of empirics.

As for the theory, a concept of “worlds” introduced by Boltanski and Thévenot in 2006 [25] is chosen for the elaboration of data practitioners’ work. According to that, there are a few “worlds” or ways of thinking related to how people and objects dwell together being guided by their own interests, intentions, and perception of particular issues. These “worlds”, that are prone to experience conflicts, reach compromises, and collaborate on justification, are the following: inspired, fame, domestic, civic, market, and industrial. Taking into account a fact that data scientists generally work in a business sphere, an idea that these practitioners have to work together not only with each other but also with managers and stakeholders that are more likely to be related to the other “worlds”, especially market one, seems to be straightforward.

#### 4. Plans and Preliminary Results

Further plans of this research are mainly focused on data analysis to obtain justified answers to the research questions. In beforehand, findings emphasize the difficulty of contacting a few “worlds”. Precisely, data practitioners actually evaluate models with the help of mathematical metrics that are understandable for them, and further, they have to consider interests of the others such as managers who are more likely to concern about financial payoffs and stakeholders who decide whether they should invest to an ML-based project or not. The situation becomes more complicated when there is a necessity to review the models in a social context (e.g., whether obscene content that was unblocked by mistake is causing moral injury to users). In addition, data practitioners support the idea that one of the managerial purposes is to sell projects reeling in superiors. Moreover, sometimes managers can attempt to take part in market tenders offering technical solutions that hardly can be realized by data specialists. In general, these insights strengthen the idea that there is a high need in building effective communication between the “worlds” to inform about the capabilities of each of the parties, in particular converting mathematical metrics to business ones to demonstrate the efficiency and potential benefits justifiably.

As for interpretable machine learning methods (which appear to be one of the highly debatable topics in data science communities), several practitioners mentioned the usefulness of such tools for revealing model transparency with a certain degree of confidence since there were cases when they helped to define which model would be better in terms of its algorithm or even elaborate on a project case considering it step-by-step making representation of the work easier for experts from the other “worlds”. The others pointed that they did not use interpretable machine learning methods in their project workflow since they are not worth it: strict explanations are required by stakeholders but computationally and timely expensive.

#### 5. Acknowledgements

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# The Method of Monitoring Incidents Based on Data from Social Networks: the Case of St. Petersburg

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## Abstract

The paper presents an approach to extracting the address and type of incident from a text data array formed based on posts in social networks. Data was uploaded from the Vkontakte community dedicated to incidents in St. Petersburg. A total of 48,943 records were collected and processed. A service has been developed for automatic recognition of the post topic and address extraction (if available) using natural language processing and machine learning methods using the free natasha library for Russian-language texts. Using the Geocoding API service from Google, the existing addresses were geocoded, and an array in GeoJSON format was obtained, which allows working with the dataset in various map services in real time.

## Keywords

natural language processing, address extraction, parser, natasha, yargy, geocoding, GeoJSON.

## 1. Introduction

Currently, the interconnection of heterogeneous urban elements is supported primarily by information technologies that provide communication links between residents, the management sector and infrastructure. On the one hand, the modern information space allows residents to constantly observe the life of the city, to meet their needs and interests in a mobile way, and on the other hand, it creates high expectations in relation to the urban environment and increases the level of responsibility of city authorities.

Due to the lack of capacity to limit the impact of hazards, many cities still face a high level of threats. As threats to cities increase, improving the resilience of cities becomes a major challenge. To increase the sustainability of cities, there is a growing need for information that is relevant to all stages of urban development. Thus, a better understanding of the spatio-temporal patterns of public response is a key step towards reducing damage and improving the resilience of cities.

So, a team of researchers from New York University analyzed incident data from two different sources: from a traditional data provider that collects incident reports from multiple agencies, and user messages from Twitter during Hurricane Sandy, which flooded many areas of New York in 2012 [1]. The result showed that Twitter can provide detailed information about the location of a particular incident, as well as its intensity, duration, etc.

In recent years, interest in Twitter has been growing due to the fact that data in it is stored in real time. Microblogs are increasingly attracting attention as an important source of information in emergency management. Twitter is used as a way to predict accidents, natural disasters, and traffic. [2] For example, in China, local floods are studied using geo data from Twitter [3]. There are methods for monitoring the traffic situation in real time based on data in social networks using modern machine learning algorithms [4]. Metro passenger traffic forecasting is strategically important in the management of the metro transit system. Predicting the occurrence of events turns into a very difficult task, so today, forecasting in passenger transport is developing based on data from their social

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networks [5]. In most cases, Twitter data is used [6-9], the use of the social network Vkontakte has not yet become widespread.

The purpose of this work is to study and analyze the use of methods for extracting addresses from Russian-language text messages about incidents in social networks Vkontakte to generate geospatial data in the GeoJSON format, which can be used later in GIS systems or in the hardware-software complex “Safe City”.

The result of this approach is the distribution of incidents in the city on the map since the text will consist of 2 entities: the address and the type of incident. At the first stage of the study, 5 main topics were selected: Car theft, Accident, Fire, Robbery and Assault. Using this approach, we can identify the most dangerous or problematic area in the city or find the area where the most theft occurs and so on [10]. By the way, this information is available in official sources, it is not always available to urbanists and researchers and does not always reflect the current state of the city. This approach can expand the data set for researchers and citizens.

In addition, the data obtained can be used in the hardware-software complex “Safe City”, since often the incident message does not arrive in the system immediately, and this approach allows you to generate information online. For example, information about an accident can be included in the statistics in a week or even a month, if the accident was registered according to the Euro protocol. But active citizens quickly highlight road accidents and publish them into this community, which allows to search for problem areas in the city online.

## **2. Development of an address extraction and incident recognition service**

### **2.1. Data preparation**

In the case of St. Petersburg, we considered the possibility of extracting data about incidents that citizens write about in the social network called Vkontakte. The community about road accidents and emergencies in St. Petersburg ([https://vk.com/spb\\_today](https://vk.com/spb_today)) was chosen as a site for the study.

The collection of information for the study was carried out using a set of tools that included the Vkontakte API, a content parser, and a public service. The method API Vkontakte “Wall.get” returns a list of posts from the user's wall or community, using this method you can collect all the comments in the community. When conducting research on social networks, there is a complex problem of personal data security during parsing. Personal data, according to art. 3 of the federal law "On Personal Data", is called "any information related directly or indirectly to a certain or identifiable individual (subject of personal data)". No personal information was collected or stored in this report. A total of 48,943 records were collected.

For the collected sample, preliminary automatic processing of posts was carried out, which consisted in deleting entries starting with the words “News of our metropolis:”. In this case, we did not consider the daily news reports when forming the final sample for analysis, because its only summed up the results of the day. The size of the final sample after deleting such posts was 48,408 entries.

### **2.2. Using natasha library and yargy parser for extracting address and incident topic from posts**

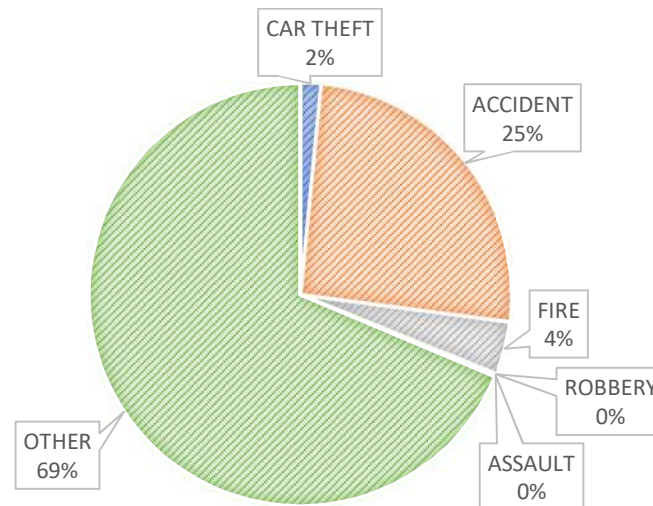
One of the tasks of the research was also the development of tools for automatic processing and analysis of the data array of posts from social networks. The main functionality of the tool was the automatic detection of the topic of the post and recognition of the address or its component part: street, block, house number, district, etc. To get the primary results of the tool, it was decided to recognize five topics of posts: Car theft, Accident, Fire, Robbery and Assault.

To develop the toolkit, we used the open neural network library natasha (v.1.4.0), which was updated in 2020, for recognizing addresses in Russian-language text [11]. To recognize the one of 5 incident topics a yargy parser was configured. To extract user entities in yargy, special rules are created using context-free grammars and specialized dictionaries. As part of the research work, simple rules were added with ready-made parser predicates that recognize words for highlighting the topic:



“theft, stolen, stealing, car theft” – Car theft, or “accident, road accident, lapped, collided, crash” – Accident.

To recognize the topics of posts, we used self-written rules for the yargy parser. As a result of setting up the parser, a sample of these posts was obtained, which contained only five topics. The Figure 1 shows the ratio of posts with five selected topics to the total number of posts.



**Figure 1:** Distribution of posts by topic

Based on this sample in semi-automatic mode (SQL query + manual markup), the average accuracy of the yargy parser recognition of the five selected topics was calculated, the results are presented below in Table 1.

**Table 1.** Results of post topics recognition using yargy parser

Topic	Recognized	Not recognized	Total number	Accuracy
Car theft	694	61	755	91.92%
Accident	11 568	774	12 342	93.73%
Fire	1801	153	1954	92.17%
Robbery	25	6	31	80.65%
Assault	77	8	85	90.59%

The result of the average accuracy of determining the topics in the text using the configured yargy parser is good (more than 90% except for Robbery). Among the disadvantages of this approach, the long duration of the parser's operation time was highlighted, since which we can assume about the slowness of the algorithm itself, especially when increasing the data sample. Thus, the next stage will require optimization of the parsing rules and more efficient data processing.

To recognize addresses in the text, the built-in “AddrExtractor” function from the natasha library was used. Address recognition was performed on a sample of data, including posts with recognized topics. A total of 15,167 records were selected in the sample. To calculate the average recognition accuracy, the condition was set that if at least one part of the address is recognized in the text of the post (for example, street, name, house number, etc.), then the address is considered recognized. The results of address recognition are shown in Table 2.

**Table 2.** Results of address recognition using the natasha library

Entity	Recognized	Not recognized	Total number	Accuracy
Address	11 389	3 778	15 167	75,09%

The table shows that the result of the average accuracy of address recognition in the Russian text is satisfactory for solving the problem (more than 75%), but in the future, the algorithm and rules for address recognition also require improvements to improve the accuracy and quality of determining the recognized addresses. When recognizing the address, it was also noted that the highest percentage of accuracy is achieved when determining the name “Moscow” for the type “street”, for example, in the format “Moscow Street”. However, if you remove the marker word “street”, the recognition accuracy will significantly decrease, even if there are other markers nearby, such as “house number”, “building”, and other parts of the address.

As a result of the analysis, we can conclude that it is sufficiently possible to use open and free ready-made solutions that provide the functionality of flexible rule settings for performing tasks of this kind of analysis.

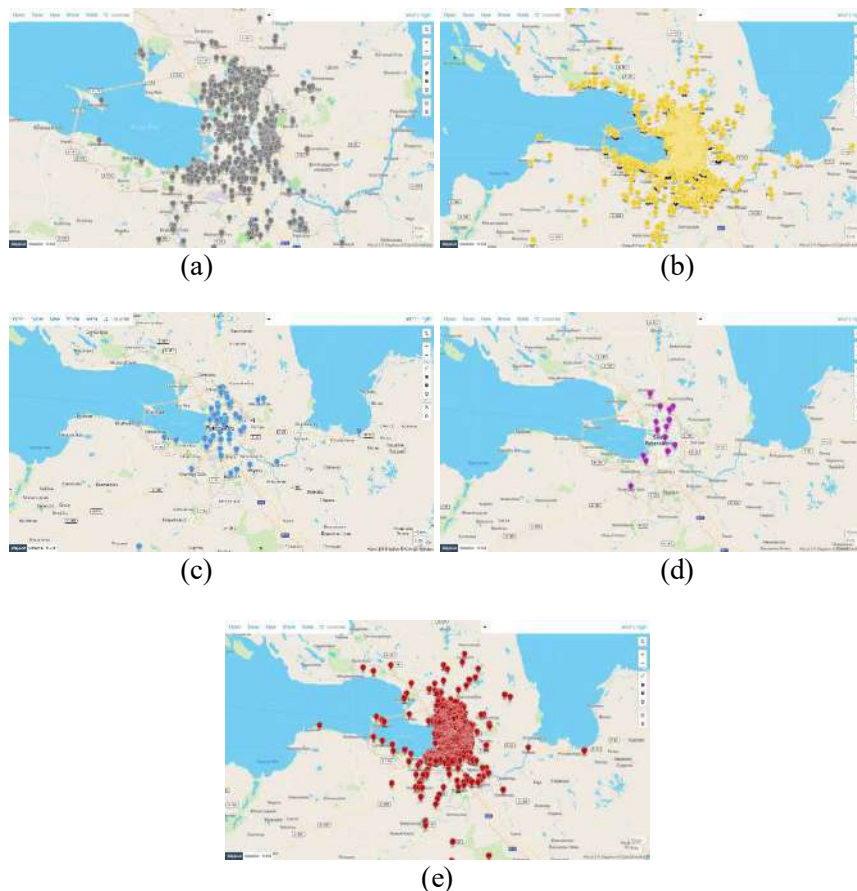
### 2.3. Representing incidents from the posts on a map

Geocoding recognized addresses and formatting dataset to GeoJSON was the next step of work. For this purpose, we used Geocoding API service from Google [12], that can convert address parts and return its coordinates. One of disadvantage of Geocoding API is that it returns standard JSON, so we also needed to convert it to GeoJSON format afterwards.

As we need to store and show topic on a map, we used the Feature and FeatureCollection objects according to GeoJSON specification. Here is the example of format we used:

```
{
  "features": [
    {
      "geometry": {
        "coordinates": [30.36091, 59.931058],
        "type": "Point"
      },
      "properties": {
        "topic": "nan",
        "type": "Feature"
      }
    },
    {
      "geometry": {
        "coordinates": [30.516726, 59.73777],
        "type": "Point"
      },
      "properties": {
        "topic": "Угон",
        "type": "Feature"
      }
    }
  ],
  "type": "FeatureCollection"
}
```

The dataset of 15,1567 records with all recognized addresses was geocoded and converted to GeoJSON. Below in Figure 2 you can see the visualizations of points according to five incident topics.



**Figure 2:** Car theft (a); Accident (b); Assault (c); Robbery (d); Fire (e)

Meanwhile we discovered that not all the address parts were recognized properly, for instance there can be only house number without street location or only street, which can be long. Thus, for future steps of research work we need to increase recognition accuracy and quality of address parts extraction.

### 3. Conclusions and Discussion

The selected source of information in the social network Vkontakte showed that users generate a large amount of information about incidents. In Russia, Vkontakte is more popular than Twitter [13], which is why it is important for researchers to have tools to work with this social network. The method has shown its promise, and the data obtained can be used by both researchers and representatives of government departments.

During the research work, a toolkit was developed for automatic recognition of the post topic and addresses. The considered experiment confirmed the good effectiveness of the selected open library natasha (v.1.4.0) with a yargy parser, which managed to extract the topic and address from the text of the posts. With the help of the Geocoding API from Google, we managed to get the coordinates of addresses, translate the result of geocoding into the standard GeoJSON format, which allows us to use this data in different map services, GIS, as well as in the hardware-software complex “Safe City”. In the future, it is planned to increase and improve the data sample by using methods of automatic collection and extraction of entities, improving the accuracy of extraction and recognition of the posts topics and address parts.

### 4. Acknowledgement

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# Computational Linguistics



# Machine Learning Methods for Indicating Cultural Biases in Spoken Russian Language: Dominants and Trends of Modern Society

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## Abstract

The formation of a socio-cultural layer is based on a person's understanding of himself and the world around him and the translation of this understanding into abstraction. This inevitably leads to the emergence of cultural biases in society as an extreme form of separation of one social group from another. In fact bias is nonrandom errors in thinking. The growing cultural biases in society is preserved in the consciousness of individuals and further affects the possible interpretation and perception of the neighboring social group, and, therefore, the public mood, in other words, the level of aggressiveness of the society. Thus the problem of identifying cultural shifts is relevant for the scientific community. There are many methods based on surveys and their subsequent analysis. In this paper, we propose to use machine learning and analysis of the large collection of text data from social networks (public Telegram chat). This approach can complement the standard methodology, including helping to reveal hidden patterns by being able to cover large amounts of data.

## Keywords

machine learning, natural language processing, text clustering, cultural biases, text analysis, cultural code, cultural process

## 1. Introduction

The view of the world formed by immersion of an individual in media space, which includes all possible communication channels (communication «one to one», «one to many», «many to many»). In the current moment, social networks accumulate the potential of the key influence on the consciousness of individuals due to their dynamic structure. A complex of stable associations, opinions and stereotypes around complex social phenomena is formed on their basis. Even where social networks are not the primary sources of information, there is a need to get an opinion of people to the news by this channel of mass communication and to compare own opinion with the opinion of others. The non-representativeness of information increases within horizontal communicative structures. Thus, social media texts not only build the information agenda, but radically affect to social mood and public opinion by spontaneously distorting the picture of objective reality.

Therefore, social media texts form a subjective and biased point of view on events, creating a certain image of reality in the mind of the information consumer and influencing the course of events in the end. The peculiarity of communication in a social media lies in the specific flow of interpersonal perception processes. People find uncertainty in interpersonal relationships unpleasant, thus they are motivated to reduce it. Stereotyping and identification by affiliation with particular social groups have a strong influence on individual mind in this way and contribute to judge a person. This provides the

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situation in which social network participants are united by homogenized opinions by receiving an average consciousness.

Participants of communication are keen to get approval of the social group, thus the feedback effect (verbal response, likes, emoticons) provides an important incentive. Social networks are not a platform for spontaneously emerged communities and they are not isolated from other channels of interactions with information flows. Therefore, sociocultural tendencies penetrate there from media sphere in its multifaceted understanding (including through traditional media, opinion leaders, propaganda, etc.). The cycle of comments (and replies to them) is repeated depending on the severity of the topic and the activity of the initiators of the conversation thread. Acquiring the features of recursion, this cycle of communication forms public mood and stereo-types.

The effectiveness of communication remains in question, because the existence of a rational conversation vector (constructive dialogue) is quite difficult to trace. Since the incentive to continue communication in this case is the approval of the majority, it is fair to assume that this kind of dialogue strengthens the existing cultural and social biases, and also creates the basis for the formation of an aggressive field around them.

Subjective and systemic biases of social actors influence to the information choice and content features of texts which are presented in this communicative space. Subjective biases operate at the level of individual information processing in the context of current events. Such subjective biases could arise from shared values, information overloads, and cultural preferences. Some of the subjective prejudices are transformed into systemic ones over time, which shape the consciousness of individuals at the mesoscopic level (mass consciousness). This creates patterns in the mindsets of societies. These regularities cannot be observed at the level of a specific statement of individual. However these patterns can be observed by analyzing big data. In this paper we present mathematical methods for detection these collective spontaneous information filters, which form cultural and social biases that exist in modern Russian society.

## 2. Method

The language model is the basis for mathematical methods of text analysis. It provides to calculate the probability that a word will follow a given word sequences as a continuation of the text. Thus a statistical language model helps to calculate the probability distribution function on a set of vocabulary sequences.

One of the first methods of constructing language models was n-gram model [1, 2]. The probability of a word sequence is considered as the product of word probabilities, given the known previous ones. Therefore only a few previous words (n words) are matter for this kind of statistical analyze. Further various architectures based on machine learning algorithms and artificial neural networks were widespread as the basis of language models [3, 4, 5]. Neural network language models are divided into two groups: word-aware NLM and character-aware NLM.

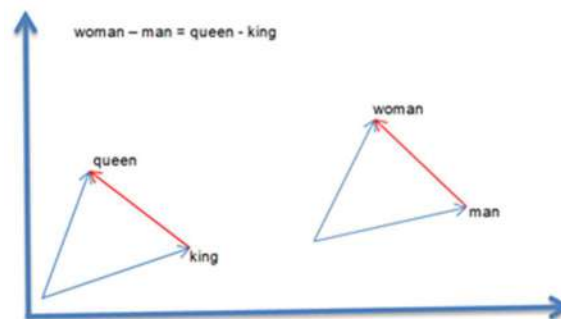
A good language model must capture two important properties of a natural language. The first one is correct syntax. Thus, a few previous words are sufficient for a relevant prediction of the next word, however the word order in a sentence becomes important item. The second property is coherence. Including large number of words is often required in order to understand the global meaning of a sentence or document (but the word order has less importance). Traditional N-gram models and neural probabilistic language models have difficulties in extracting global semantic information from text (because of a fixed-size context window), that is, polysemy and context-dependent nature of words are not taken into account. Consequently, contextualized language models are gradually gaining popularity, trying to take into account the context of the use of the word [6, 7, 8, 9]. This approach allows combining two necessary properties of a natural language (correct syntax and coherence).

The process of train a language model begins with creating a collection of texts by natural language (dataset). A language model predicts the next word in a text, thus it should have seen a lot of examples to learn the language. Essentially the model calculates the probability the appearance of a word next to the known word sequence. This prediction is based on examples from the dataset. For the representation of words into a language model it is necessary to map words or phrases from the vocabulary to vectors



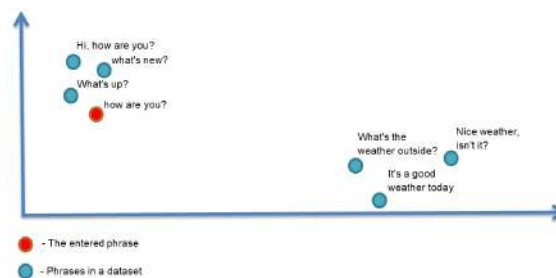
of real numbers (word embeddings). Consequently the semantic similarity of words or the frequency of their joint occurrence can be detected by comparing the distances between these vectors (cosine similarity).

A classic example of this method shows the interdependency between pairs of words («king-man» and «queen-woman»). Figure 1 demonstrates that algebraic operations in this space correspond to operations on the meaning of words.



**Figure 1:** Semantic relationships of words in a language model

Similar calculations can be performed for sentences (Fig. 2). This allows calculating the similarity of the entered phrase (its semantic coherence or antonymic nature) to sentences from dataset that are already understandable to the language model.



**Figure 2:** Matching sentences based on how the language model works

Accordingly semantic relationships between words (or sentences) are gaining mathematical meaning in a vector space. This suggests that the most productive language models reproduce text sequences that contain typical biases for social micro and macro groups. These biases initially arise as an emotional reaction to different phenomena and antagonistic groups. The detection of these biases by language model is possible because its training occurs by calculating the joint occurrence of words. In other words, a language model would know better that «freedom» is used with the word «speech», the more often such idiom («freedom of speech») would be found in the training dataset. In summing up, the biases, that was found in datasets and fallen into language models, in general, can be characterized as actual social landmarks of society.

### 3. Typology of cultural bias

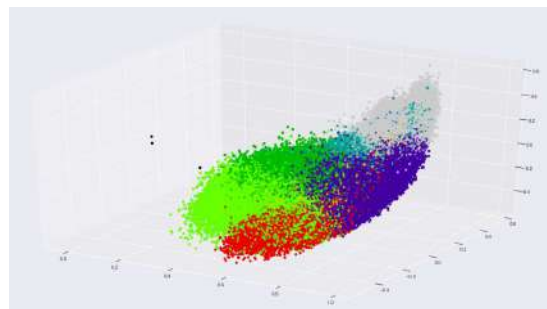
The following types of cultural biases can be identified: national or religious ideals, social connotations, gender stereotypes and aggressive statements of a general nature.

Cultural biases in natural language can be present in a latent form or in a direct manifestation of an attitude to the object of a statement. The collected text data (on the basis of which the language model works) attracts to socio-demographic and mental stereotypes, traditions and patterns of behavior accepted in society. Therefore, it seems interesting to analyze the social connotations and contexts of cultural biases. In this paper, we provide the analysis of biases in two contexts: the ones that at the descriptive level reflect social mood [10, 11, 12] on a specific topic, and those that outline the characteristics of a social group. A group is people with the same markers (gender, nationality, etc.).

## 4. Experiments and Results

The public Telegram chat has been chosen as the data source (chat of the news channel Mash – «MACH», 1608 participants, not moderated). Thus, the overall text collection consists of 556 354 records, the first of which was dated 2018-07-05, and the last - 2020-12-03).

Clustering of messages provided first characteristics of the chat conversations, including the information about topics' content and their close interaction with each other. The cluster analysis of the dataset was performed with the k-means algorithm. The vector matrix was created using Word2Vec model trained on our dataset in order to obtain more unambiguous result of partitioning into cluster groups. Figure 3 shows that the clusters are very close to each other, and even sometimes intersect in space.



**Figure 3:** Cluster ratio

The next step was to identify the associative chains of terms. Pairs and triples of words were taken to take this goal. The model found the most semantically close terms from the dataset to chosen items (the theoretical algorithm of the model is shown in Fig. 1). The model finds sets of words that are close in meaning (quasi-synonyms), the meanings of which can differ in several characteristics (for example, in relation to the speaker) and change depending on the context. The closeness of the word to the term can be interpreted either as equality («she» = «her» = «girl» = «wife» = ...) or as a word very well associated with the term («she» = «girl» = «wife» => husband). Thus, only those words that are closely interrelated in the cultural code can catch into associations. An example of the resulting associations is shown in Table 1.

**Table 1**

Semantic associations to the words «freedom», «democracy», «Internet»

Liberty	Democracy	Internet
('recognize', 0.9017236232757568),	('opposition', 0.9191081523895264),	('anonymity', 0.6254202723503113),
('corruption', 0.8983240723609924),	('communism', 0.9145876169204712),	('vpn', 0.6117355227470398),
('punishment', 0.8904907703399658),	('equality', 0.9139655828475952),	('doesn't work', 0.6087996959686279),
('citizen', 0.880867063999176),	('develop', 0.9133450984954834),	('free access', 0.5988985300064087),
('crime', 0.8789682388305664),	('putinsky', 0.9130712747573853),	('telegram', 0.5986903309822083),
('revision_year', 0.871111273765564),	('capitalism', 0.8889749646186829),	('rkn', 0.5934107899665833),
('ratio', 0.8698971271514893),	('monarchy', 0.8852110505104065),	('outage', 0.5892473459243774),
('death_punishment', 0.7523390054702759),	('socialism', 0.8837734460830688),	('space', 0.5862609148025513),
('monarchy', 0.7488603591918945),		

Liberty	Democracy	Internet
('liberalism', 0.7421742081642151), ( <i>'acting_power'</i> , 0.7411474585533142), ( <i>'civil_society'</i> , 0.7408543229103088)	('vertical', 0.8762210607528687), ( <i>'scrap'</i> , 0.8600466251373291), ( <i>'dictatorship'</i> , 0.8596632480621338), ( <i>'mentality'</i> , 0.8592602610588074)	('default', 0.5862008929252625)

People most often associate the term «democracy» with opposition. The next logical link from this word leads to «communism». Thus the evidence base for discussions around democracy is the previous political system of our country. Obviously the understanding of the term is reduced to cultural and social contexts colored by national history. The words «equality» and «develop» frequently appear in conversations on this topic. This fact can probably be classified as hopes for a brighter future. It is noteworthy that the adjective «putinskii» (the time of something in association to the period of Putin's presidential term) appears in the seven most closely related terms. It strongly links the discussion of democracy with the current agenda, because this word clearly indicates a non-abstract line of reasoning).

We also investigated the reflection of the agenda through collocations. A collocation is a phrase that has signs of a syntactically and semantically integral unit (stable phrases). Highlighting of them can help delineate the social and political tendencies of the social macro groups. For example, throughout the entire data collection (more than 500 thousand messages), «Russia» most often occurs with the word «president»; such phrases as «Russians forward» and «Putin is the president» have shown themselves as stable collocations. Below is an example of identified collocations (Table 2).

**Table 2**

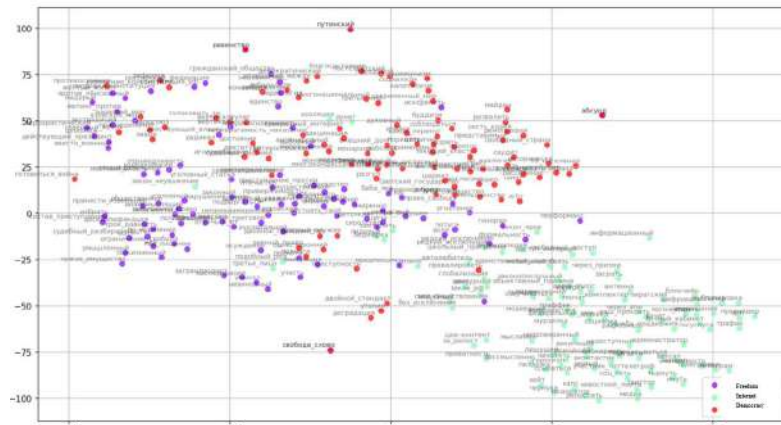
Collocation examples

Liberty	the Internet
'freedom of speech', 'deprivation of freedom', 'restriction freedom', 'release from prison.', 'right to freedom', 'internet freedom'	'bad_internet', 'sovereign_internet', 'internet_freedom', 'free_internet', 'internet_access', 'internet_passport'

The same terms as in previous example were taken for clearly interpretation of the results. Identification of stable collocations complements the ability to assess the social and cultural landscapes by the language models. If in the above example the term «liberty» was associated exclusively with criminal liability and offenses, then when searching for collocations, topics appeared that interest people most likely in connection with the term «democracy». However, there are no stable phrases with the term "democracy" in this case of text analysis, while at the previous step of the study, tendencies were identified. At the same time, the detection bounds of the term "Internet" in this way gives good results and it could be used to deep understanding the public mood.

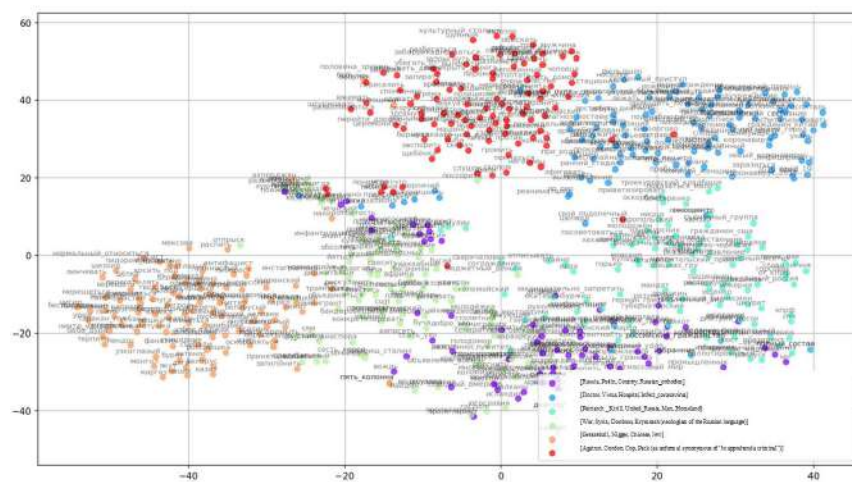
Multidimensional space visualizations of word vectors can help in interpreting relationships between word embeddings. Figure 4 presents the visualization of the results described above for associative bounds to the words «liberty», «democracy», «Internet». The method of nonlinear dimensionality reduction (T-SNE) [13] was used for this purpose. The basic principle of t-SNE is to reduce the pairwise distance between points while maintaining their relative position. Thus the algorithm constructs a probability distribution over pairs of high-dimensional objects in such a way that similar objects are assigned a higher probability while dissimilar points are assigned a lower probability. It becomes

possible to map high-dimensional data to a low-dimensional space, while the location structure of the neighboring points is saved.



**Figure 3:** Semantic associations to the words «liberty», «democracy», «Internet»

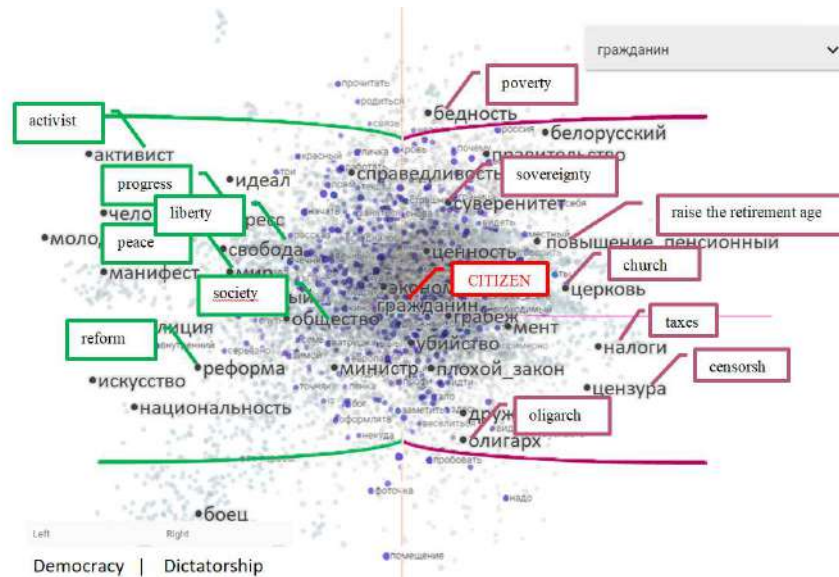
Information about semantic correlations of the texts has been received by visualizing grouped data. The figure demonstrates that vector representations of words fix the semantic relations between such categories as the political system of the country, gender stereotypes, and even there are clearly seen the associations of swear words with discussions of dissatisfaction with that or another phenomenon, and etc. This kind of analysis provides direct information about cultural biases based on mathematical apparatus, that is, with a certain accuracy and impartiality. In developing this strategy of text analysis in its deeper condition, the most frequent words (the first 4 in frequency) were taken from each cluster, which were detected on the first step of the research (Fig. 5).



**Figure 4:** Sociocultural analysis of the identified clusters

The presence of sufficiently clearly grouped semantic clouds shows the tendencies of public opinion. In particular, the totality of the formed clusters and their content reveal the tendencies present in society related to the separation of male and female roles, as well as attitudes towards national minorities; at the same time, it is clearly seen the topics around COVID-19 (such as emergency medical services, general news about the virus, discussion of hospitals).

In terms of mathematical and computational linguistics the biases implies a shift from the selected item to the left or to the right along the space coordinate axes. By way of illustration, the example of the bias between the words «dictatorship» and «democracy» is shown in Figure 6. The X-axis (horizontal) is set from «democracy» to «dictatorship»: words close in meaning to democracy (within the studied texts) are on the left, and words similar to the word «dictatorship» are on the right. It was decided to use «citizen» as the anchor word.



**Figure 5:** An example of the social and cultural biases which are detected in data collection from chat dialogs (the 0X axis is stretched between the words «democracy» and «dictatorship», point (0,0) is «civil»)

It turned out that «citizen» is a very good choice of the anchor word, because its position (in the middle of the projection, zero mark on the X-axis) indicates the neutrality of the term within the context of our research. The words that are attracted to the pole of the word «democracy» (the left of the zero mark on the X-axis) are outlined in green for convenience; words that are semantically connected with «dictatorship» (right) are purple. Accordingly, the closer a word is to the left edge of the x-axis, the more clearly it illustrates public attitudes toward «democracy». Y-axis displays the spread of words in their ideological differences and helps to detect two semantic groups that characterize this phenomenon in the public consciousness. On the one hand, an opinion clearly emerges in the mass consciousness that democracy is established with the active participation of society in this process (all words that fall into a significant sample, such as «person», «manifesto», «activist», are easily summarized in the category «civil society»). On the other hand, the words «art», «scientist», «peace» and «freedom» can also be highlighted as markers of the general idea of what democracy provides. Words that are «drawn» to the right side (to «dictatorship») are «censorship», «church», «raise the retirement age», «taxes». Obviously the clearly expressed attitude to the term is seen. Cultural biases of meanings between synonymous words become convenient to trace due to this item arrangement in space. For example, «police» - «cop» and «reform» - «law». If «police» is an attribute of a democratic society, then «cop» refers to a dictatorship in Russian language; «reform» is associated in the public perceptions with democracy, and the phrases with words «law» and «bad law» appear for the dictatorship.

## 5. Conclusion

Examples of aggressive cultural biases (although they have been identified) are deliberately not shown in the results. The purpose of this paper is to describe the potential of the method without deep analysis of specific stereotypes and public opinion. Thus, our experiments demonstrate that the method is applicable to interpret cultural biases, which are formed in public consciousness by active using of social media. It is important to consider a number of factors before using statistical language models, such as the definition of the subject and functional boundaries of the object under study, the nature of the object under study and possible linguocultural consequences of its use, the detection the role of the object in language (natural language as a repository of cultural code), that determines its place in the system of linguacultural universals. An important application of this method can be the identification of aggression in social groups through text data.

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# Question Answering Systems and Inclusion: Pros and Cons

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## Abstract

In the inclusion, automated QA might become an effective tool allowing, for example, to ask questions about the interaction between neurotypical and atypical people anonymously and get reliable information immediately. However, the controllability of such systems is challenging. Before the integration of QA in the inclusion, a research is required to prevent the generation of misleading and false answers, and verify that a system is safe and does not misrepresent or alter the information. Although the problem of data misrepresentation is not new, the approach presented in the paper is novel, because it highlights a particular NLP application in the field of social policy and healthcare. The study focuses on extractive and generative QA models based on BERT and GPT-2 pre-trained Transformers, fine-tuned on a Russian dataset for the inclusion of people with autism spectrum disorder.

## Keywords

Natural Language Processing, Question Answering, Information Extraction, BERT, GPT-2

## 1. Introduction

AI-powered question answering systems might find their practical application in the medical and social domain. Question answering (QA) systems take questions in natural language as input and provide (for example, by text generation or data extraction) corresponding answers as outputs. In the healthcare field, automated QA might benefit both patients and medical practitioners by providing immediate access to required extracts from medical knowledge bases. Closed-domain QA can be used as an additional source of information for volunteers or members of a social institution by providing immediate access to the internal information of a certain organization. Based on a rich and reliable database, QA systems can be used as an additional educational source in the processes of gamification and digitalization at schools or higher education institutions.

The idea of the paper came after the first trial of building an informational question answering system. The system aims to give information about inclusive education in the Russian language. The project supports the inclusion of people with autism spectrum disorder (ASD). In the inclusion, automated QA might become an efficient tool. Limited knowledge of the inclusive education process and lack of awareness about the people with special needs raise anxiety among both neurologically typical members of the inclusion and members with developmental characteristics. The information awareness would help to dispel misconceptions and prevent conflicts in classes.

AI-powered QA is a way to provide information fast and playfully. Children and young adults are not likely to read and analyze extensive texts to find the needed information. The ability to ask any question in a free form would not require a high concentration and save a lot of time, making the inclusion more comfortable. Moreover, members of the inclusion would have an opportunity to ask frequent and uncomfortable questions anonymously. For example, if a student needs a tip for communication with a classmate with ASD and is too shy to ask a friend or teacher, or there is no teacher or tutor around, the student will have a chance to ask a QA bot and get reliable information immediately.

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However, the integration of QA systems into inclusive organizations requires confidence that the built applications are safe. Safe applications involve language models that do not generate false information or mislead. Such models should be bias-resistant. They should interact with a user in a friendly way generating coherent and understandable texts, although they should not entertain a user.

One of the challenges of neural approaches towards natural language processing is their controllability. High scores of perplexity imply coherent text generation but do not exclude the generation of misleading or false responses. Thus, the outputs of uncontrollable models might be generic or factually incorrect, whereas, for neural conversation models, semantic control ensuring is essential [1]. The semantic control provides dialogue specification, ensures model flexibility, and develops the model knowledge grounding [2].

The paper aims to highlight the linguistic features of question answering systems' responses and analyze their strengths and weaknesses from the users' perspective. The study will lead to a broader understanding of the capabilities of the practical efficiency of AI-powered QA. The research focuses on the underlying causes of dialogue system errors and will contribute to the further development of conversational AI.

As a research method, it was chosen to build two question answering systems using two different approaches. The first approach is extractive. This approach is widespread in the reading comprehension task, one of the problems of natural language understanding (NLU) [3]. In the extraction based QA, the answer to a user's question is a specific piece of information from a given database. The answer can be presented in the form of a single word, sentence, or paragraph [4]. The second approach is generative. Generative models learn to exploit correlations in the data by memorizing the information [5]. This can also be a result of zero-shot learning within the ability of a model to learn some generalizations during the training across tasks [6]. Zero-shot learning is a learning method allowing one to solve a task without training on examples of that task. The method allows a model process previously non observed classes by associating knowledge gained during the pre-training on data representing other classes.

For the implementation of two approaches, self-attention Transformer network architecture models were applied. The generative approach was implemented with the Transformer decoder based model GPT-2 [7]. The extractive one was implemented with the Transformer encoder based model BERT [8]. Both models were fine-tuned on a custom question answering dataset. GPT-2 was trained as a traditional language model, which uses zero-shot learning to memorize the structure of a QA dataset and generate answers. BERT was fine-tuned for the downstream question answering task. In recent years, the models based on Transformer architecture showed high efficiency on many NLP tasks, including question answering, due to the self-attention mechanism, which allows attending the focus to specific words and establishing sequence contexts. This allows analyzing texts while training more accurately, memorizing longer sequences, and transferring the gained knowledge to new tasks.

One of the issues of modern NLP is that most of the models are evaluated on the English data. However, the English language is rather weakly inflected. That is not typical for most of the Indo-European languages. Thus, high model evaluation scores might be reached without taking into consideration the facts about linguistic features of other languages. The Russian language, for example, is fusional. That means that the morphological features are crucial for the understanding of the meaning of a sentence. Spans, which represent the answers in extractive QA, are direct citations of the text. Thus, if the wording of the question is not equal to the wording of the context, the rules of conjugation and declension might be broken.

Although the problem of data misrepresentation is not new, the approach presented in the paper is novel, because it highlights a particular NLP application in the field of social policy and healthcare. The development of two QA models and their analysis presented in the paper should shed light on the problems of building social-oriented conversational AI systems. That might help to predict possible issues and solve them before they happen.

## 2. Related Work

The study focuses on building a conversational AI (ConvAI) system. According to Gao et al. [9], conversational systems usually solve three fundamental tasks: question answering, task-oriented



dialogues, and chatbots. Conversational systems aim to imitate human behavior. One of the ways to reach this is to use language patterns that would ensure dialogue credibility. The credibility might be established when human-AI dialogue lines would be considered close enough to real-life human interaction according to some objective criteria. Among such objective criteria, the linguistic features of the text can be considered. For example, dialogue systems should learn to generate coherent, grammatically correct utterances without redundant lexical repetitions. Those elements ensure intuitive dialogue capabilities, such as reasoning, logic inference, and associative properties [10].

The tasks of ConvAI vary, although there are common fundamental tasks that form the basis of the research field. One of the foundational problems of conversational AI is task completion. While solving this type of problem, the dialogue agent should be capable of recognizing the user's needs. After the task recognition, the agent should be able to accomplish it and give an appropriate response in the natural language if necessary. The range of tasks varies from the restaurant and hotel reservations to the meeting scheduling and business planning [9].

Another foundational task is social chat. Social chatbots are designed for human-AI communication, which imitates everyday human interaction. The development of such systems may have the goal of modeling human conversations to pass the Turing test [9]. Apart from that, social chatbots might give recommendations and provide psychological support. Although such systems cannot and should not replace professional therapists, they might become helpful in situations when assistance is needed instantly, and other sources of support are not available [11].

The current study focuses on question answering systems. Question answering is another foundational ConvAI task [9]. QA agents aim to provide a user brief answers to his or her request on a certain topic. The answers of such dialogue systems can be based on knowledge bases, such as text collections, web sources, sets of structured or unstructured data on narrow subjects, for example, on a certain field of medicine.

The spectrum of QA-world represents such systems as Knowledge-Based QA agents, or KB-QA, text-QA, and Machine Reading Comprehension (MRC) models. Question answering systems that use natural language as a part of their interface are more convenient to use than similar systems not based on NLP algorithms. For example, KB-QA agents are often compared to SQL-like systems. KB-QA are considered to be more user-friendly than their predecessors due to their interactivity [9]. The flexibility of QA systems is reflected, for example, in text-QA agents integrated with mobile virtual assistants. Such systems usually have web access. That allows them to provide answers to simple questions faster and more convenient than traditional search engines [9].

Neural MRC is another important QA related model. The task of MRC is to generate an answer to a user's question posed on a given text. The task aims to evaluate the machine capability of natural language understanding. Theoretically, the ability of a machine to make some conclusions after the reading, for example, to answer text-related questions might lead to a breakthrough in human-AI interaction. MRC might have a broader practical application. For example, MRC algorithms can be integrated into search engines allowing them to give short answers to a user's query instead of providing an unstructured list of possible web-pages with relevant information [12]. In the current study, an MRC algorithm would be used as a basis for the informational extractive QA model.

One of the examples of reading comprehension datasets is Stanford Question Answering Dataset (SQuAD) [13]. SQuAD has the following features. Firstly, the authors and creators of SQuAD paid attention to answer types. They have allocated several categories including, for example, dates, persons, locations, and others. Secondly, the developmental SQuAD set was provided with reasoning labels. For example, they have highlighted such types of reasoning as a lexical and syntactic variation. Besides, some actions were made to ensure that the dataset is diverse. For example, the answers were categorized into numerical and non-numerical ones by means of constituency parsing and POS-tagging. The non-numerical answers were also split into narrower categories, such as persons and locations by using Named Entity Recognition (NER).

SQuAD v2.0 [14] has several differences from its predecessor SQuAD v1.1. The renewed dataset can evaluate the model's capability to ignore the questions that do not have an explicit answer in a given reading passage. The authors of SQuAD v2.0 offer to include some unanswerable questions in their dataset, although these unanswerable questions should be relevant to the corresponding reading passage and have a plausible answer in the text. That complicates the reading comprehension task by

inviting the model to learn how to distinguish answerable questions from unanswerable ones and thus achieve higher accuracy in its analysis.

### 3. Data

The models built for the experiments were trained on a custom question answering dataset. The dataset was collected by the author of the paper. It is available online (see Online Resources). The dataset is called Autism Spectrum Disorder Question Answering (ASD QA). ASD QA is based on the data from the informational websites about autism spectrum disorder and Asperger syndrome in children and adults, inclusion and support of people with Asperger syndrome and ASD, their health, and communication with neurologically typical people. ASD QA is a long-term project. For the year 2021, it has the status of active, which means that the dataset is in the process of collection and development.

The data for the ASD QA was collected from the informational website about ASD and Asperger syndrome <http://aspergers.ru/> with the agreement of the website administration. The data from the website represent a collection of articles and texts of related genres (blog entries, messages to readers, etc.). The texts were created by neurologically typical people and people with Asperger's syndrome or ASD, created in Russian or translated into Russian from foreign languages. The authors are native or fluent speakers of the Russian language.

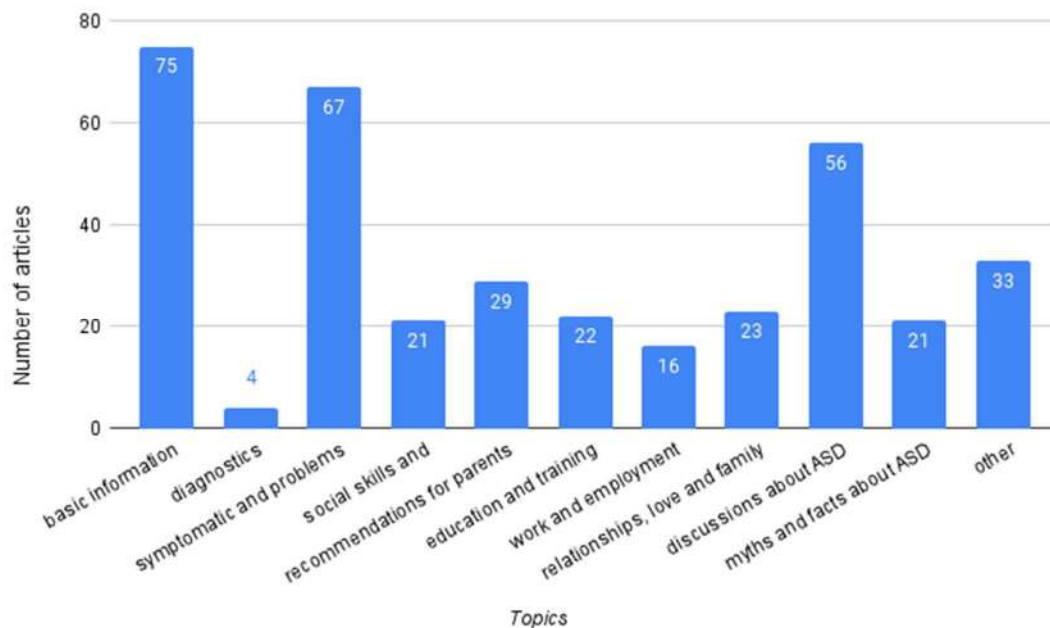
According to the website categories, the publications from the informational source cover the following topics: basic information about Asperger's syndrome and ASD, diagnostics of Asperger's syndrome and ASD, symptomatic of Asperger's syndrome and ASD, problems of people with Asperger's syndrome and ASD, social skills and communication issues of people Asperger's syndrome and ASD, recommendations for parents of children with Asperger's syndrome and ASD, education, and training, work and employment, relationships, love and family, discussions about ASD, myths and facts about ASD, etc.

Figure 1 presents a topical data distribution in the ASD QA dataset as at May 2021. The topics were extracted from the website <http://aspergers.ru/> which served as a source for the ASD QA dataset. Each article on the website has one or several tags indicating its topics. After we had extracted those tags we built a bar chart showing the number of articles covering each topic. One article could cover several topics.

The data was collected with an HTML parser built with Beautiful Soup 4 [15] on Python. Beautiful Soup is a library that is often used for web data extraction. For the data extraction from the chosen for the dataset collection website, the following steps were made. Firstly, HTML content from pages of the website was obtained with the "get" method from the "Requests" Python library. Secondly, the text data was analyzed and parsed with "findAll" and "find" basic Beautiful Soup methods. Finally, the extracted texts were saved as text data for further processing and dataset development.

After the data was collected, it was important to structure it. Insofar as the dataset was being designed for the question answering models training and evaluation, it was decided to develop it like a reading comprehension one. In contrast with traditional question answering datasets, which contain only sets of QA-pairs, the format of reading comprehension datasets also implies the presence of reading passages. Reading passages are sets of sentences or paragraphs, which an MRC model should learn to "understand" or answer the questions about the information contained in each passage.

Another important aspect is the question acquisition. The reading passages were split into sentences separated by periods, ellipses, question or exclamation marks. We strove to ask one or several questions to each sentence, but some of the text pieces (for example, some introductory remarks or personal reflections) did not contain significant information, so we had to ignore them. We have asked 2-3 questions on average to each sentence containing significant information, using different types of questions. We have chosen the type of a question based on the structure of its possible answer (excerpt from a reading passage). For example, we have asked closed questions to sentences containing affirmative or negative constructions, and we have asked open questions to sentences containing factual information. This was done manually because the ASD QA dataset is being designed for "safety-first" systems which require the best available training data.



**Figure 1:** ASD QA topical data distribution. May 2021

Figure 2 presents an ASD QA dataset sample. The dataset structure was inspired by SQuAD v2.0 [14]. During the development of the ASD QA dataset, it was decided to provide it with several unanswerable questions too. However, after the first training trials on a new dataset, it was noticed that the aim of unanswerable questions in ASD QA should differ from the aim of those in SQuAD v2.0.

During the ASD QA development, the dataset was provided with 5% of unanswerable questions on the principle of SQuAD v2.0. Unanswerable questions in the ASD QA dataset are deliberately irrelevant, which means that there are no answers to these questions in the reading passages, and also there are no answers in the dataset at all. Among such questions, there are ones that aim to set an entertaining tone in a human-AI dialogue. For example, some questions ask a system to tell a joke or a fairy tale, some are about artificial intelligence misconceptions, some contain complaints about boredom, etc. Presumably, users can ask such questions for entertainment purposes. However, the systems, for training and evaluation of which the ASD QA dataset is developed, should avoid such questions. These systems aim to consult and give accurate information. They do not have an aim to entertain a user.

For the unanswerable questions, the system includes a label “is unanswerable”. The JSON object containing the ASD QA data includes the label with a Boolean for each QA-pair. Thus, if a question has a piece of information in a corresponding reading passage, the label “is unanswerable” is False. Otherwise, the label is True. For example, in Figure 3 two QA-pairs are presented. The question of the first pair is translated from Russian into English as “Is autism a deviation?”. This question has an answer in a corresponding reading passage, which is marked as a “context” in the dataset. The label “is unanswerable” is False. Labels “answer start” and “answer end” mark the answer span, serial numbers of the first and last characters position of answers in the passage.

The question of the second pair is translated from Russian into English as “Tell me the news?”. This question has no answer in the dataset reading passages, it is added in the dataset to complicate the task. The label “is unanswerable” for this question is True. The values of “answer start” and “answer end” are both 0. Despite the fact that the question is unanswerable and irrelevant, the dataset is provided with a plausible answer, which is translated from Russian into English as “I cannot answer this question”. This makes the dataset also suitable for the training of generative QA models. Such models instead of answering irrelevant questions can learn to generate this phrase.

```

"question": "Аутизм - это отклонение?",
"answers": [
  {
    "text": "Я родился со своими уникальными способностям и трудностями",
    "answer_start": 152,
    "answer_end": 238
  }
],
"is_impossible": false
},
{
"question": "Расскажи мне новости?",
"answers": [
  {
    "text": "Я не могу ответить на этот вопрос.",
    "answer_start": 0,
    "answer_end": 0
  }
],
"is_impossible": true
},
]
"context": "Пожалуйста, не осуждайте меня или других аутистов за наши отлич

```

**Figure 2:** An ASD QA dataset sample

Table 1 presents the ASD QA data statistics in the context of the paper research. For the implementation of the experiments, the dataset was split with the “train\_test\_split” method from the Scikit-learn library [16] for machine learning in Python. The set of 756 QA-pairs (including the corresponding context and the metadata: spans, and labels of answerableness) was randomly shuffled and split into a train set including 69% of the data (523 QA-pairs), a validation set including 17% of the data (126 QA-pairs), and a test set including 14% of the data (107 QA-pairs). The size of the vocabulary created and used for the question answering models’ training was 30 522 tokens on a word level. According to the frequency vocabulary built during the pre-processing, 4.47% Out-of-Vocabulary (OOV) tokens were replaced by an (meaning “unknown”) token. During the data processing, each OOV-token was split into sub-words greedily using byte pair encoding (consecutive bytes are steadily replaced with a new byte). This allows allocating frequently used pieces of words, such as prefixes and suffixes, as well as roots, and conducting a lossless analysis.

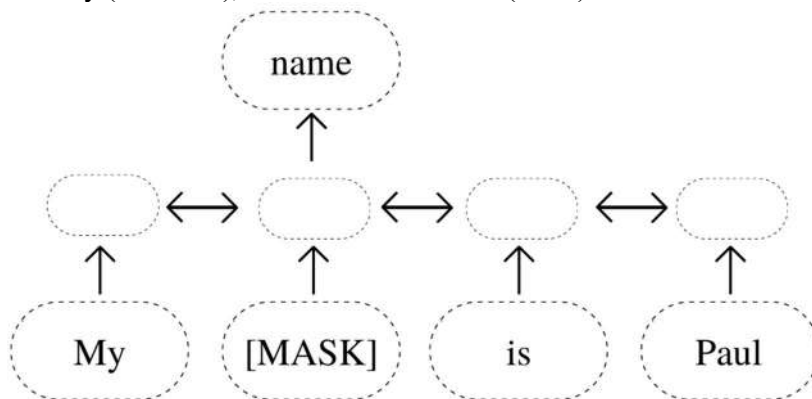
**Table 1**  
Statistics of the ASD QA data used for the paper research

Parameter	Train	Valid	Test	Sum
QA pairs	523	126	107	756
Tokens (word level)	12 264	3 694	2 936	18 894
Unanswerable questions	5.8%	3.95%	4.35%	
Vocabulary size (sub-words)		30 522		
Out of Vocab rate		4.47%		

## 4. Approaches

### 4.1. Extractive Approach

The extractive approach, which is closely related to machine reading comprehension (MRC), was implemented using pre-trained Transformer Bidirectional Encoder Representations from Transformers (BERT) [8]. BERT is a model that was pre-trained for the masked language modeling (MLM) task. MLM is a task of predicting a masked token (for example, a word) according to its context surrounding. BERT was the first model that used MLM as a training task. The BERT performance shows that knowledge acquired through MLM solving can be successfully transferred to information retrieval and information extraction tasks. That makes BERT based models suitable for MRC and extractive QA [17]. BERT showed significant improvements in MRC performance obtained with SQuAD v1.1 [13] and SQuAD v2.0 [14] in comparison to architectures which previously showed State-of-the-Art results, such as models based on Bidirectional Long Short-Term Memory (BiLSTM), Gated Recurrent Unit (GRU) or Convolutional Neural Network (CNN).



**Figure 3:** A concept of the MLM task

Figure 3 represents a concept of the MLM task. Bidirectional arrows in Figure 4 show bidirectional BERT processing. [MASK] illustrates a masked token that a model should predict. The sequence “My [MASK] is Paul” is input data. The word “name” is a model output, which is a result of model processing.

For the model training, a Russian dataset containing the QA-pairs on ASD and Asperger’s syndrome was used (see Online Resources). The structure of the dataset represents a traditional MRC dataset structure (see Figure 3) containing three key MRC elements. Those elements are a reading passage, a set of questions posed on the passage, and a corresponding answer or a set of answers. Apart from that, the dataset includes a label, which indicates whether the question has an answer in the reading passage. Thus, if a user’s question is irrelevant, a system should ignore it.

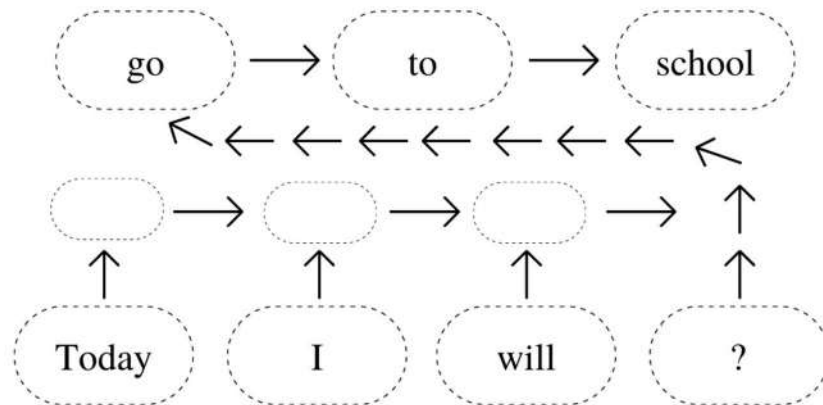
One can find different pre-trained BERT models. In this paper, the Multilingual BERT (MBERT) was used, BERT-Base, Multilingual Cased model [18]. M-BERT is a language model for 104 languages. The model was trained on Wikipedia data. The capabilities of the model allow using Transfer Learning techniques. Transfer Learning allows transferring knowledge from a general task to a specific one, or downstream one, by fine-tuning a pre-trained model or adding some layers to the original model architecture [19].

### 4.2. Generative Approach

In the current research, the generative approach was implemented with a Generative Pre-trained Transformer (GPT-2) [7]. We have used the original GPT-2 Large with 774 million parameters also known as 774M GPT-2. GPT-2 is a model for traditional language modeling. The model is unidirectional. GPT-2 analyzes only left-to-right context to predict the next token in a given sequence. Apart from showing high perplexity scores on the language modeling task, GPT-2 model shows high

zero-shot performance on a wide range of other tasks. Zero-shot learning allows achieving high performance on domain-specific tasks without fine-tuning. Zero-shot learning capabilities can be revealed after evaluating a model on tasks, which it did not learn to solve during the training.

Among GPT-2 zero-shot learning achievements are solving question answering tasks and MRC, summarization, and translation without fine-tuning, and others. All this is achieved only by pre-training the model for traditional language modeling. Figure 4 represents the concept of traditional language modeling. Unidirectional arrows in Figure 4 show unidirectional GPT-2 processing. The question mark illustrates the model task to complete a given sequence. The sequence “Today I will” is input data, or prefix, which a model should continue. The sequence “go to school” is a model output.



**Figure 4:** A concept of traditional language modeling

Both BERT based and GPT-2 based models were trained with a Russian dataset for the inclusion of people with autism spectrum disorder (ASD) (see Online Resources), although, for the generative model training, some changes were required. The dataset includes a special label indicating whether a question has an answer in a corresponding reading passage. If the value of this label is True, the answer presented in the dataset is special (see Figure 2). It is translated from Russian into English as “I cannot answer this question”. This dataset feature was provided for generative models training, so they could learn to answer irrelevant questions politely.

The original version of the dataset is designed for MRC, so it had to be changed for the generative GPT-2 based model training. Firstly, all the answers and questions were extracted from the original dataset. Pairs of questions and answers, or QA-pairs, were located sequentially, separated by an empty row. All the QA-pairs were randomly shuffled. Secondly, the spans metadata was removed. Thirdly, the reading passages were not removed for the model failsafe. That was intended for cases when a possible answer to a user’s question was contained in reading passages but absent in the training QA-pairs. Finally, the meta-information on answerable and unanswerable questions was removed, but the answer “I cannot answer this question” was saved for each unanswerable question.

## 5. Methodology

Transfer Learning techniques were used to fine-tune the models for the experiments. Transfer Learning allows using the knowledge gained while solving one general task to solve another similar one. The model is first trained on a large amount of data. Then, the pre-trained model is trained on the target dataset to solve a downstream problem. There are different Transfer Learning techniques. In this study, a fine-tuning strategy is used. The network trains end-to-end on a new custom dataset to adjust and adapt for the downstream task.

### 5.1. Metrics

For the question answering evaluation, F1-Score was used as proposed in [20]. F1 is the harmonic mean of the precision P and recall R. P is the fraction of relevant (true positive) model answers among

the retrieved (true positive and false positive) ones.  $R$  is the fraction of the total amount of relevant model (true positive) answers among all the samples (true positive and false negative):

$$F = \frac{2PR}{P + R} \quad (1)$$

$$P = \frac{tp}{tp + fp} \quad (2)$$

$$R = \frac{tp}{tp + fn} \quad (3)$$

In question answering, true positive answers are the tokens shared between the correct (gold) tokens and all the predicted tokens. False positives are the predicted tokens absent in the correct (gold) answers, and false negatives are the tokens from the correct (gold) answer absent in the predicted ones. With this correction, the formula is the following as presented in the SQuAD evaluation script [21]:

$$F = \frac{2PR}{P + R} \quad (4)$$

$$P = \frac{shared}{shared + (predicted - shared)} \quad (5)$$

$$R = \frac{shared}{shared + (gold - shared)} \quad (6)$$

## 5.2. Experiment Setup

The model training was performed in Google Colaboratory with the Tesla T4 GPU. The code was implemented in Python [22] with the PyTorch library [23]. The configuration of the BERT based model and the GPT-2 based model is presented in Table 2. For the BERT base model, the HuggingFace Transformers repository [24] was used. For the GPT-2 based model, the Gpt-2- simple package was used [25]. We have also used the HuggingFace Transformers repository for the data pre-processing. During the pre-processing, we have not removed the stop words, because this might influence the structure of the utterances in the training data. Transformations of the structure of questions and answers might cause difficulties in natural language understanding during the question answering. However, this hypothesis needs verification with additional experiments.

**Table 2**

BERT based and GPT-2 based models configurations. General settings

Parameter	BERT based model	GPT-2 based model
The base pre-trained model	BERT base multilingual	774 M GPT-2
The activation function	GELU	GELU
Tokens in an input sequence	512	1 024
Attention heads	12	20
The dropout ratio	0.1	0.1
The learning rate	5e-5	1e-4
The number of runs	10 epochs	3000 steps
Hidden layers	12	36
Vocabulary size	30 522 (word level)	50 257 (byte pair encoding level)
Other parameters	The size of encoder layers: 768	The number of embeddings: 1 280
	The size of feed-forward layer: 3 072	The temperature (the output randomness): 0.7 The top K (the output diversity): 40

**Table 3**

Results obtained on the test data

Base model	F-Score
Multilingual BERT	0.55
774M GPT-2	0.63

## 6. Results and Analysis

Table 3 shows the results of both models obtained on the test set. The GPT-2 based model showed higher results. However, the model outputs contain some inconsistent, irrelevant answers generated by the language model, whereas the BERT based model showed more coherent and full answers. Table 4 shows the results of the linguistic analysis of both models outputs. The analysis allowed to reveal strengths and weaknesses of both models and make conclusions about their possible integration in inclusive education. Figure 5 shows a sample output.

### BERT based model

**Q:** Есть ли какие-то техники, чтобы научить ребенка с РАС вести себя в социальном мире?

**A:** Поговорите со специалистами, работающими с ребёнком, о каких-либо программах, которые могут ему помочь.

### GPT-2 based model

**Q:** У детей-аутистов могут быть проблемы с одноклассниками?

**A:** У детей с расстройством аутистического спектра (РАС) высок риск подвергнуться травле, особенно в обычных школах.

**Figure 5:** An output sample**Table 4**

The results of the linguistic analysis

Language level	BERT based model		GPT-2 based model	
	Strength	Weakness	Strength	Weakness
Syntax	Complete answers if copes with a question	One-word or one-letter answers if do not cope	Often gives a complete answer	Frequent syntactic violations
Morphology	No or rare morphological violations	Truncates words if do not cope	Rare morphological violations	Might generate new words or word forms
Grammar	No or rare grammar mistakes	Unknown words might cause grammar mistakes	Can generate grammatically correct original utterances	Frequent grammar mistakes
Lexical diversity	Extracts single answer without lexical repetitions	Cannot generate unique utterances	Generate unique utterances without topical violation	Creates words that do not exist, repeats lexical constructions



## 7. Conclusion

After the linguistic analysis, the author of the paper defines four criteria of the models' outputs evaluation. The criteria were determined according to the language levels that the author of the paper found essential for the analysis. The analysis focused on the evaluation of the QA models' safety for their further integration into inclusive education. The criteria and language levels are the following: syntax level, morphology level, grammar correctness, lexical diversity.

On the syntax level, it was found that the extractive BERT based model can give full, syntactically correct sentences, but only if it copes with a user's question. If the model cannot correctly recognize a user's question, it would output a single word or a single letter, the first token from a corresponding context, with a high probability. For example, during the research, prepositions were very frequent in the model outputs. The generative GPT-2 based model, in turn, tends to give complete answers more often. However, its outputs contain frequent syntactic violations. That is inappropriate and is yet to be improved.

On the morphology level, the BERT based model did not show significant violations due to the extraction properties, although it truncated words in cases when it did not cope with a question. The GPT-2 based model could generate new words or word forms, which is worse because it might create unexisting lexical units. Grammar mistakes in the extractive model could only be caused by the presence of unknown words (due to the size of the training vocabulary) in the dataset. In the generative model, grammar mistakes were more frequent.

The extractive model did not make lexical repetitions extracting single answers. That makes the model clear and informative. However, this model cannot generate unique utterances. The generative model, in turn, could generate lexically diverse unique sentences. However, it also could create words that do not exist and repeat lexical constructions.

According to the conclusion of the study, extractive question answering is more reliable than generative question answering. The QA chatbot systems integration into inclusive education requires high alertness to its outputs. Thus, generative systems can be unsafe, as they might turn a tool for the information support or consultations into a toy, which is inappropriate.

Nevertheless, the capabilities of generative systems allow them to generate unique answers without grammar mistakes, lexical repetitions, and syntactic violations while maintaining factual accuracy. That makes them efficient. Although the score and errors point are yet far from optimal solution, the solutions presented in the paper provide future directions for improvement. For example, we can build models based on the extractive approach to extract accurate information containing the answer to the user's question and use generative algorithms as part of the natural language interface to arrange the answer.

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# Automatic Generation of Russian News Headlines

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## Abstract

Text summarization is one of the key Natural Language Processing tasks. Automated text summarization has the potential to save time when creating reviews, abstracts etc. of the texts across multiple domains. Automatic headline generation is a challenging kind of text summarization. Basically, the distinction between extractive and abstractive summarization methods is drawn. Application of the extractive summarization techniques results in the extraction of relevant words or sentences from the original text. Abstractive summarization models synthesize a summary in which some of its material is not present in the input document. This paper deals with the fine-tuning the pretrained model based on Transformer architecture for the task of generation of Russian news headlines. Experiments discussed were carried out for the new dataset of Russian news which was automatically compiled from the “Bumaga” website. The paper contains the quantitative evaluation results using BLEU and ROUGE metrics as well as the human evaluation results. Finally, the paper presents error analysis and discussion of particular contexts.

## Keywords

Headline generation, text summarization, abstractive summarization, Russian language, RuBERT

## 1. Introduction

In modern computational linguistics, text summarization holds a special place among the tasks of natural language processing (NLP). The aim of summarization is to produce a shorter version of the text that expresses the main idea of the source document. That is, given input text  $x$ , a model writes a summary  $y$  which is shorter than  $x$  and contains vital information from  $x$ . Text summarization makes it possible to access and process large amounts of textual data and extract the necessary information from a huge corpus of texts.

The automatic summarization problem can be addressed with two types of techniques, extractive and abstractive ones [1]. In extractive summarization, the most significant chunks of the source text are detected and extracted without any changes. That means that all words in the summary come from the input data. In contrast, abstractive summarization systems attempt to generate abstracts from new sentences, which may not even include words that occurred in the original. Although an abstractive model is much more complex than the extractive one, it produces detailed human-like summaries. It is this advantage that makes abstractive approaches increasingly popular today and, for this reason, we focus on them.

In this paper, we are concerned with the task of headline generation that tends to be considered as a special type of text summarization [2]. This is accounted for by the fact that the headline is a key component of the news text since it includes its main ideas. On the one hand, it should be quite informative, and on the other, encourage readers to spend their time on reading the full text. However, for digital media, it is especially essential to provide clear and informative headlines, since the user does not have time to guess what the hidden meaning was intended. In addition, the headline like any other text should have grammatical and lexical linking and meaningfulness.

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There are several sections in this paper. The review of current studies in the field of automatic summarization is presented in the Related work section. In the Methods section there is information about the corpus of news messages which was to be processed as well as the description of the used model. The Experiment section describes the present method of generation of Russian News Headlines. In the Results section there are examples of headlines predicted by our model, automatic and human evaluation results and error analysis. The Conclusion section provides the conclusions drawn up by the presented results.

## 2. Related work

Analysis of current research shows that the automatic summarization problem can be approached differently and a large number of papers covers it.

Many studies are devoted to extractive methods of text summarization [3][4]. [5] was one of the first to work on this issue in terms of detecting the most informative words relying on the word frequency. His idea was to count the frequency of words in order to find a list of the most meaningful words. However, the main disadvantage of using extractive methods to headline generation is that the abstracts they produce are hardly headlines. They cannot be shorter than the minimum text blocks used to compose them (a sentence or a paragraph). This is how neural models for abstractive summarization and text generation came into being.

Sequence-to-sequence (seq2seq) model is one of the most important recent concepts used in the current state-of-the-art applications in natural language processing. It is a type of encoder-decoder model using Recurrent neural network (RNN), that generates one sequence from the other after it has learned a great deal of sequence pairs. Developers from Google [6] demonstrated that translation models based on seq2seq outperform a standard statistical machine translation based (SMT-based) system. Not only machine translation benefits from seq2seq models; they do well on many other sequences learning problems, including text summarization and headline generation. In 2015, [7] proposed an approach called Attention-Based Summarization (ABS). It is a local attention-based model that generates the next word of the summary given the input sentence in terms of the combination of a neural language model and a contextual input encoder. Following them, [7] extended the ABS model using semantic and syntactic information about the source text in a standard neural attention-model.

Later, copying mechanism was presented [9] to improve RNN encoder-decoder model. It is designed to copy tokens from the source text. This model was taken as a basis in another study [10] and trained on the dataset of Russian news.

The Transformer architecture, originally developed for machine translation [11], is now applied to all the main tasks of natural language processing. There are many modified versions of Transformer. Thus, [2] adapted the Universal Transformer architecture [12], which is a modification of Transformer, to the task of headline generation.

Previous advances in abstractive text summarization have been made using pretrained language models based on Transformer architecture. In 2019, a new Bidirectional Encoder Representations from Transformers (BERT) [13] architecture was developed specifically for text summarization (BertSumExt and BertSumAbs for extractive and abstractive summarization, respectively) [14]. The BertSumAbs model is a standard encoder-decoder framework for abstractive summarization [15], where the encoder is the pretrained BertSum and the decoder is a 6-layered Transformer initialized randomly. In [16] RuBERT [17] was used as a pretrained BERT for fine-tuned on the Russian texts BertSumAbs model. Application of this approach to the task of Russian news headlines allowed to obtain state-of-the-art results on the RIA [2] and Lenta<sup>2</sup> datasets.

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<sup>2</sup> <https://github.com/yutkin/Lenta.Ru-News-Dataset>

### 3. Methods

#### 3.1. Data

We conduct our experiments on the new corpus of news messages in Russian. We have developed a programming algorithm for automatic corpus building from the website of the Russian online newspaper “Bumaga”<sup>3</sup>. It contains news messages from June, 2013 to April, 2021. In total, there are 38 499 news articles in the provided corpus which are supplied with additional meta information: title, date and link<sup>4</sup>. For the experiment, we split the Bumaga corpus into the train, validation, and test parts in a proportion of 90:5:5.

#### 3.2. Model description

We examine the BertSumAbs model, which utilizes RuBERT as a pretrained BERT [16]. The original BertSumAbs model is a standard encoder-decoder framework that was fine-tuned for abstractive summarization task. The encoder is 6 stacked layers of BERT, while the decoder is a 6-layered Transformer that is initialized randomly. Thus, the encoder is pretrained and the decoder must be trained from the ground up. The model has more than 317M parameters.

We fine-tune a 40K checkpoint saved by the authors of [16], since its validation loss score was the best. That is, trained on the RIA dataset checkpoint is fine-tuned on the Bumaga dataset.

### 4. Experiment

#### 4.1. Baseline model

**First Sentence** This model uses the first sentence of a news message as its hypothesis for a news message headline. It is the most naïve approach to headline generation. Its application is valid due to the fact that the structure of news articles is based on the principle of inverted pyramid. It means that the most valuable information can be found in the first sentence through the answers to key questions: Who? When? Where? Why? What? How?

#### 4.2. Training

It has been mentioned that the encoder is pretrained while the decoder is trained from scratch in the BertSumAbs model. This mismatch between two parts of the Transformer can make fine-tuning unstable, as noted [14]. In order to overcome the difficulty, a new fine-tuning schedule was designed by [14] and then borrowed by [16][16]. This novel approach is characterized by using of different optimizers for the encoder and the decoder. Following [16], we separate the optimizers of the encoder and the decoder when training model on our dataset. We use two Adam optimizers [18] with  $\beta_1 = 0.9$  and  $\beta_2 = 0.999$  and learning rates  $lr_e = 0.002$  и  $lr_d = 0.2$  for the encoder and decoder, respectively. When setting the parameters for training the model, we rely on the idea of [14] that the pretrained encoder must be fine-tuned with a smaller learning rate.

The model is fine-tuned with a batch size equals 128, gradient accumulation every 95 steps. The model was trained for 4,700 steps on a Tesla V100 GPU provided by Google's Colaboratory service<sup>5</sup>. The training of the model took about 24 hours.

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<sup>3</sup> <https://paperpaper.ru/>

<sup>4</sup> The dataset is available at <https://github.com/ekaterinatretvak/PreSumm>.

<sup>5</sup> <https://colab.research.google.com/>

## 5. Results

In Table 1<sup>6</sup> we present results of the headline generation based on the Bumaga corpus for Russian. Despite the fact that our fine-tuned model makes mistakes, which are discussed in Section 5.3., relevant headlines still prevail.

**Table 1**  
Samples of headlines generated after fine-tuning BertSumAbs

№	Lang.	Original text	Original headline	Generated headline
1	ru	В Эрмитаже появились коты с именами Трамп и Хиллари...	В Эрмитаже появились коты Трамп и Хиллари	В Эрмитаже появились коты с именами Трампа и Клинтон
	en	Cats with the names Trump and Hillary appeared in the Hermitage...	Cats Trump and Hillary appeared in the Hermitage	Cats with the names of Trump and Clinton appeared in the Hermitage
2	ru	Совет Федерации назначил дату проведения президентских выборов в 2018 году — 18 марта...	Совет Федерации объявил дату проведения выборов президента в 2018 году	Совет Федерации назвал дату проведения президентских выборов в 2018 году
	en	The Federation Council set the date for the presidential elections in 2018 — March 18...	The Federation Council announced the date of the presidential election in 2018	The Federation Council named the date of the presidential elections in 2018
3	ru	Пожар на Васильевском острове затруднил дорожную обстановку в центре Петербурга, поскольку сотрудники ДПС перекрывали участок дороги... в коммунальной квартире в доме 31/22 по Кадетской линии горела одна из комнат...	На Васильевском острове скопились пробки из-за пожара на Кадетской линии	На Васильевском острове горела коммуналка, движение перекрыто
	en	The fire on Vasilyevsky Island complicated the traffic situation in the center of St. Petersburg, since traffic officers blocked traffic on a section of road... in a communal apartment in the house 31/22 on the Kadetskaya line, one of the rooms was burning...	Traffic jams have accumulated on Vasilyevsky Island due to a fire on the Kadetskaya line	On Vasilyevsky Island, a communal apartment burned, traffic was blocked
4	ru	В Петербурге 25 июля произошли прорывы труб на севере и юго-западе Петербурга... Водой залило перекресток улицы Симонова и проспекта Просвещения...	Улицы на севере и юге Петербурга затопило из-за прорывов труб	В Петербурге прорвало трубу. Машины оказались наполовину в воде
	en	In St. Petersburg, on July 25, there were bursts of pipes in the north and south-west of St. Petersburg... Water flooded the crossroad of Simonov Street and Prosveshcheniya Avenue...	Streets in the north and south of St. Petersburg were flooded due to bursts of pipes	A pipe burst in St. Petersburg. The cars were half in the water

<sup>6</sup> The texts of news articles are given in an abbreviated form

The generated headlines seem to have quite a high grammatical and semantic coherence. It should be noted that predicted headlines may consist of words that are not present in the text of the article. Moreover, the model effectively uses techniques from the theory of paraphrasing, e.g., use of converses, synonyms etc.

Among generated news headlines single-sentence headlines predominate over headlines with two and more clauses. It was found that when the model produces two simple sentences, this decreases the text quality due to a repetition of the already generated word or phrase. These problems seem to be related to the fact that the checkpoint used was trained on the RIA corpus which includes more than 1 million news headlines, consisting mainly of a single sentence. Thus, the increase of training examples, in which the headline consists of two sentences, is expected to contribute to better results for generation of headlines of more complex structure.

Nevertheless, the model is able to generate relevant headlines that consist of two sentences:

- Сайт об архитектуре Петербурга Citywalls снова не работает. <q> Петербуржцы встревожены  
(en) *The website about the architecture of St. Petersburg 'Citywalls' is not working again. <q> Petersburgers are alarmed*
- Финляндия заняла первое место в рейтинге самых счастливых стран. <q>Россия заняла 59-е место  
(en) *Finland placed first in the list of the happiest countries. <q> Russia took the 59th place*

The model generates complex sentences with subordinate clauses:

- На Гороховой улице открылся ресторан «Мука и вода», где можно попробовать пасту  
(en) *The restaurant "Flour and Water" has opened on Gorokhovaya Street, where you can taste pasta*
- Здание клуба «Камчатку», где работал Цой, расселят  
(en) *The residents of the building of the club "Kamchatka", where Viktor Tsoi worked, are going to be rehoused*

An analysis of the headlines produced indicates that the model performs best when generating information-rich headlines consisting of a single sentence that inform the readers about the main facts of a news article. In addition, the model is able to produce headlines that contain quotes. However, among the generated headlines, it is quite difficult to find the headlines that would contain an irony, wordplay or hidden author's opinion. Some examples can be seen below:

- В РПЦ назвали позицию Эрмитажа по Исаакиевскому собору «провокацией»  
(en) *The Russian Orthodox Church called the Hermitage's position on St. Isaac's Cathedral a "provocation"*
- «Путин, спаси нас»: жильцы дома на Ремесленной  
(en) *"Putin, save us": residents of the house on Remeslennaya Street*
- На Гороховой улице восстановили под гостиницу дом Крутикова. <q> Посмотрите, как выглядит  
(en) *On Gorokhovaya Street, the Krutikov house was restored as a hotel. <q> See what it looks like*

## 5.1. Automatic Evaluation

For automatic quality evaluation we use BLEU score [19] and ROUGE score [20]. Since the Bumaga corpus has no previous art, in Table 2 we present results for the baseline and fine-tuned model. Moreover, we present evaluation results on the Bumaga dataset while model is trained on the RIA dataset in order to evaluate the success of the model in headlines generation given news articles with another structure.

The results obtained demonstrate that the BertSumAbs model fine-tuned on the Bumaga dataset **performs best** for all metrics. However, the Bumaga dataset evaluation results using model trained on the RIA dataset are the worst. This may indicate that the format and style of writing news texts and headlines differ from one news agency to another. Thus, one of the most noticeable differences is that

the headlines from the Bumaga corpus often consist of two sentences, while ones from the RIA corpus mostly consist of a single sentence.

**Table 2**  
Bumaga dataset evaluation

Model	BLEU	R1	R2	RL	R-mean
	<b>Bumaga</b>				
<b>First Sentence</b>	41.06	38.9	22.8	36.8	32.8
<b>BertSumAbs</b>	25.84	21.8	9.0	20.5	17.1
trained on the RIA dataset					
<b>BertSumAbs</b>	<b>48.51</b>	<b>44.1</b>	<b>28.4</b>	<b>42.4</b>	<b>38.3</b>
fine-tuned on the Bumaga dataset					

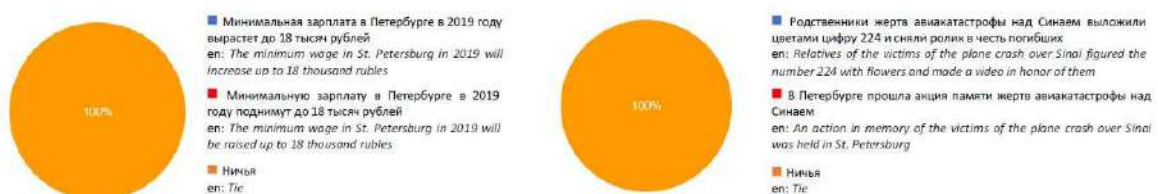
## 5.2. Human evaluation

We have found out that the headline of digital media especially should be informative. We have established also that the headline should have grammatical and lexical cohesion (see Section 1). Since automatic quality evaluation methods evaluate the formal match of tokens, rather than the semantic one, it is hardly possible to use them to understand how well the headlines meet these requirements. Commonly, it is the degree to which native speakers perceive a text that is the main criterion when analyzing the results of text generation experiments. For this purpose, we perform a qualitative analysis by randomly sampling 190 examples of the news text, original headline and our fine-tuned model generated headline for human evaluation. We asked 5 annotators who are native speakers of Russian to choose the most preferred headline for a news article between the original headline (Reference) and the generated one (Hypothesis). If there was no preference, the annotators chose the third option (Tie). The annotators had no idea about the details of the experiment, including which of the headlines was the reference. The results can be seen in Table 3.

**Table 3**  
Human evaluation of generated headlines

Reference	Tie	Hypothesis
36%	48.6%	15.4%

From the results obtained it might be inferred that in almost every second case (48.6%) our model reaches human parity. This means that the headlines generated by the fine-tuned BertSumAbs model are interpreted to the same extent as the ones written by the journalists. Based on the criteria for choosing the preferred headline, it might be concluded that such headlines are informative and relevant, they are perceived as a single grammatical text. In Figure 1 we present examples of headlines for which the annotators have chosen the Tie option.



**Figure 1:** Examples of the headlines for which Tie option was selected

Analysing the aggregate statistics, we found that in 15.4% of cases, the annotators had a preference for generated headlines. This means that for some examples, such a headline was perceived more easily



and naturally than the reference one. Nevertheless, human generated headlines were chosen in 36%. Although we cannot yet claim that our model is completely equivalent to how a human produces headlines for news messages, this result is already pretty promising.

### 5.3. Error Analysis

The neural network makes several types of errors. In Table 4, we provide some examples of generated headlines. The most common mistakes are incomplete phrases, as in examples *a*, *b*, *c*. In example *d*, there is a factual error, which brings to the erroneous understanding. there is a factual error. One more type of errors is grammar mistakes. Thus, in example *e*, the model produces a sentence with incorrect verbal government. Example *f* shows the use of an erroneous noun case-form.

**Table 4**

Examples with errors

a	Увольняемые сотрудники Ford в Ленобласти провели пикет против <b>«суверенного»</b> (en) <i>Dismissed Ford employees in Leningrad Oblast held a picket against the “sovereign</i>
b	Активиста «Весны» арестовали на 10 суток за акцию с манекенами на <b>Марс</b> (en) <i>The activist of “Spring” was arrested for 10 days for the action with mannequins on the Mars</i>
c	Россия с 1 апреля возобновляет регулярное авиасообщение с Германией, Шри-Ланкой и еще четырьмя (en) <i>Russia resumes regular flights with Germany, Sri Lanka and four other from April 1</i>
d	<b>Новостное сообщение:</b> На улице Тамбасова, 5 в <b>Красносельском районе</b> Петербурга в ночь с 31 января на 1 февраля произошел сильный пожар в павильоне киностудии «Ленфильм» ... (en) <b>News text:</b> <i>On Tamasova Street, 5 in the Krasnoselsky district of St. Petersburg, there was a strong fire in the pavilion of the “Lenfilm” film studio on the night of January 31 to February 1...</i>  <b>Сгенерированный заголовок:</b> В <b>Приморском районе</b> Петербурга произошел сильный пожар в павильоне «Ленфильма» (en) <b>Generated:</b> <i>In the Primorsky district of St. Petersburg there was a strong fire in the pavilion of “Lenfilm”</i>
e	Минобороны официально подтвердило <b>об</b> уничтожении военного штаба в Сирии
f	На мосту Александра Невского с грузовика упал мешка с песком и цементом

## 6. Conclusion

In this paper, we explored the effectiveness of application of the fine-tuned pretrained Transformer-based model, that as a pretrained BERT uses RuBERT, to the task of neural generation of Russian news headlines. We showed that predicted headlines are highly grammatically and semantically coherent and resemble original news headlines. We also present a newly gathered Bumaga corpus and provide results achieved by the BertSumAbs model applied to generation of headlines for news articles from this dataset.

## 7. Acknowledgements

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# Defining Kinds of Violence in Russian Short Stories of 1900–1930: A Case of Topic Modelling with LDA and PCA

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## Abstract

This paper discusses the problem of defining subthemes in literary texts about violence of different kinds from the Corpus of Russian short stories of the first third of the 20<sup>th</sup> century. It considers the results of topic modelling via Latent Dirichlet Allocation (LDA), which is used to reveal various kinds of violence, and principal component analysis (PCA), which is used to compare stories by the level of ‘violent lexis saturation’. The experiment based on short stories that depict violence and death demonstrates that topic modelling did not allow the detection of internal topics but did group together stories with similar plots. The LDA algorithm seems to unveil some of the semantically related episodes of texts, though it is not always sufficient for providing complete interpretation of the resulting topics. The PCA method, on the other hand, successfully distinguishes between the following themes: *death*, *execution*, and *murder*. The research has proven that literary works are, indeed, rather difficult objects for automatic theme detection. In the case of fiction, the explicitness of themes appears to be a crucial factor in success of both LDA and PCA methods. The authors suggest that for more comprehensive analysis of fictional texts, several methods should be applied at the same time.

## Keywords

Computational linguistics, machine learning, text mining, violence, Russian fiction, topic modelling, principal component analysis, latent Dirichlet allocation, literary corpus, literature studies

## 1. Introduction

Violence is considered to be an intrinsic part of human interactions that regard periods of time when various confrontations, be they social, political or historical, take place. Indeed, it is a foundation of a majority of social conflicts. As literature is, according to some interpretations [4; 5], a reflection of human experiences, it often chooses violence as its theme. Being an intercultural phenomenon, the issue of violence is reflected in a variety of texts, however, the definition of a ‘violent’ text is a quite challenging task. According to Reimer, texts determined by this theme “are often assumed by critics of media and literature to be those texts that depict acts of injurious physical force” [15, p. 102]. Though the description of violent acts through the lexis is a crucial part of the narrative about violence, there are some complications: a violent act is not necessarily placed in the text in an obvious way, and it is more likely to stay hidden in the rhetorical structures of the story [17, p. 2].

As one of the literary themes, violence reoccurs in the texts of the Corpus of Russian short stories of the first third of the 20<sup>th</sup> century [10], due to the specific period of time they were written. The beginning of the 20<sup>th</sup> century in Russia was marked by a number of violent historical events, such as the Russo-Japanese War, World War I, October and February Revolutions, and the subsequent Civil War. At the same time, cruel stories include not only examples of socially-induced violent acts and

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their consequences (death, murder, execution, rape), but also cases of, for instance, cruelty to animals or psychological pressure towards other characters. The common feature of all these forms of violence is that they are not necessarily placed in episodes of the stories in an explicit way.

This paper aims to explore the theme of violence in Russian short story of the early 20<sup>th</sup> century. To investigate violence diversity and intensity, we provide the analysis with topic modelling, using Latent Dirichlet Allocation (LDA) which is one of the most popular and quite effective topic modelling algorithms. Then, in order to scale the explicitness of violence narrative in the stories under consideration, we test them with principal component analysis (PCA) based on the list of violent lexis that has been compiled manually. This research continues the ongoing study of automatic thematic annotation of literary texts on the basis of the Corpus of Russian short stories of 1900–1930 described in [18; 19; 22]. For that reason, it also presents a comparison of human assessment of literary texts which exploit violence as a theme and the results of theme extraction obtained via an application of computational methods.

## 2. Data description and preprocessing

The experiment is performed on the part of the annotated subcorpus of the Corpus of Russian short stories of the first third of the 20th century, which includes 310 texts written by 300 different authors with the total number of almost 1 000 000 words [10; 11; 12]. The thematic annotation of the subcorpus was done manually by an expert and described in [20]. As a result, the initial mark-up of 89 themes was normalized and the list of 30 tags was obtained (for details see [18]). For the present analysis a ‘violence’ subcorpus was compiled. It contains 115 texts from 115 Russian writers with the following distribution of texts into historical periods suggested for the Corpus:

- **I period:** early 20th century (1900–1913) – 41 stories;
- **II period:** World War I, October and February revolutions, and the Civil War (1917–1922) – 40 stories;
- **III period:** early Soviet period (1923–1930) – 34 stories.

The selection of these specific stories was not random – all of them are united by the tags *violence* and *death*. The topic *death* was also chosen because it, firstly, often occurs in the same stories and, secondly, death naturally presents a resolution of violent conflict. Besides, the vast majority of texts about death refer to the cases of unnatural death, mainly violent or self-violent. In addition, stories with non-violent types of death pose another interesting challenge – will LDA distinguish it as a separate group?

Given the tag’s nature, similarly to categories, it can cover multiple themes. Thus, tag *violence* includes the following thematic elements – *rape*, *cruelty*, and *blood* (3), while tag *death* unites *death from gunshot wounds (during the war or on the barricade)*; *death from natural causes* (including *epidemic* and *thoughts about death*), *execution (by shooting as well, and fear of death)*, *sudden and accidental death*, *suicide*, and *murder (not at war)* (6). The total number of themes suggested by the expert equals 9.

It also has to be mentioned that some of the stories not only lie in both groups presented by tags *violence* and *death*, but also are described by several themes. For instance, *The Seven Who Were Hanged (Rasskaz o semi poveshennykh)* by L. Andreev is one of these stories and, moreover, allegedly, the most violent text in subcorpus, as it is labelled by 4 themes in total: *execution*, *death from natural causes*, *cruelty*, and *murder (not at war)*. A story’s thematic density, thus, varies from one to another. Another peculiarity about the thematic mark-up of the literary texts in the given corpus is that the stories can at some point of the narrative develop non-violent or non-death related themes at all. So, one story, for example *Matter (Materiya)* by M. Krinitskij includes not only the tag *violence*, but also such tags as *relations*, *love*, *sins*, and *nature*. This tendency raises the problem if a number of themes that the story carries can cause a predicament for successful detection of the ones in question.

With regards to preprocessing, the texts were tokenized and lemmatized with automatic contextual disambiguation and POS-tagging by MyStem [16]. The total number of tokens is 426 778. Then the

stop words and, additionally, the specific for fiction words that indicate the direct speech, such as *skazat'* (to say), *govorit'* (to speak), *otvechat'* (to answer), *sprashivat'* (to ask), *dumat'* (to think), and so on, as well as the most frequent names of the characters were removed. The tidy data size equals 228 745 tokens.

### 3. Topic modelling with LDA

#### 3.1. Determination of the number of topics

Topic modelling is commonly used to detect clusters of semantically connected words within various corpora [13; 14]. As thus, a topic covers a cluster of texts which share similar content. Topic modelling is widely applied to large collections of texts, mainly non-fictional, where the quantity and quality of the topics are relatively easier to determine, due to the fact that there are no that many specific and implicit themes as we find in literary works [1; 3]. One of the most popular algorithms for topic modelling is Latent Dirichlet Allocation (LDA), which is an unsupervised generative probabilistic model [2]. Commonly speaking, it represents each document in data as a mixture of random topics.

For topic modelling the LDA implementation in R package ‘topicmodels’ was chosen [6]. After testing different numbers of topics, it was noted that the bigger the number gets the more detailed topics the model results. On closer consideration, for the model for 20 topics, it appeared to cover mainly individual texts rather than groups and, therefore, the topics were too detailed and difficult to interpret. This problem is similar to the one described in [21]. Since “the highest coherence value does not seem to necessarily correspond to the quality of topics”, it was decided to limit the number of topics [ibid., p. 65]. To better the quality of the topics and to fulfill the suggestion to experiment with a number of topics proposed in [18], it was agreed to set the number of topics that corresponds with the one deduced from the expert annotation for the chosen group of texts – 9.

#### 3.2. Evaluation of the model with expert annotation and stories per topic distribution

Dealing with short texts and, especially ones that often include other themes as well, even though they share the same thematic tags (namely *violence* and *death*), we are still facing some difficulties. As it can be seen from Table 1, for the words of the highest weight suggested for each topic, in some cases, for instance, topics 7 and 9, it is challenging to establish semantic connection between the terms, let alone assign the name, even if they are based on the list of expert themes. That is why in order to name the topics, we took corresponding thematic elements from the expert annotation and not only their distribution among the topic but also frequency measurements. Further evaluation of the topics’ quality was conducted in accordance with the expert themes, as first suggested in [18]. We also decided to look into the stories that got clustered together based on the document distribution lists. The most frequent occurrences of the themes and the stories of the highest rank for each topic are presented in the table below.

**Table 1**

Distribution of themes and stories per topic

Topic terms	Thematic elements	Freq. (%)	Stories of the highest rank
Topic 1 “VIOLENCE TOWARDS WOMEN”			
<i>den'</i> (day), <i>god</i> (year) <i>dusha</i> (soul), <b><i>noch'</i> (night), <i>vremya</i> (time), <i>pis'mo</i> (letter), <i>hotet'</i> (to want), <b><i>zhenshchina</i> (woman), <i>uhodit'</i> (leave)</b></b>	death from natural causes	28,6	<i>Too Late</i> (Pozdno) by A. Verbitskaya, <i>The Platform 10</i> (Platforma 10) by L. Charskaya, <i>The Rooms in Kirochnaya street</i> (Nomera na Kirochnoj) by F. Bogrov
	suicide	28,6	
	cruelty	14,3	
	rape	7,1	

Topic terms	Thematic elements	Freq. (%)	Stories of the highest rank
<b>Topic 2 "NON-WAR MURDER"</b>			
<b>dom</b> (house), <b>den'</b> (day), <b>starik</b> (old man), <b>ubivat'</b> (kill), <b>delo</b> (matter/case), <b>hotet'</b> (want), <b>hod</b> (move), <b>tolpa</b> (croud), <b>vdrug</b> (suddenly), <b>ulitsa</b> (street)	murder (not at war)	26,7	<i>The Chess</i> (Shakhmaty) by Ya. Braun, <i>The Burning Days</i> (Ognennye dni) by A. Gorelov, <i>Riot</i> (Bunt) by L. Lunts
	cruelty	20,0	
	suicide	13,3	
	death from gunshot wound	13,3	
<b>Topic 3 "DEATH AT WAR"</b>			
<b>zemlya</b> (ground), <b>den'</b> (day), <b>belyj</b> (white), <b>stoyat'</b> (stand), <b>chjornyj</b> (black), <b>soldat</b> (soldier), <b>muzhik</b> (man), <b>loshad'</b> (horse), <b>doroga</b> (road), <b>storona</b> (side)	cruelty	23,5	<i>The Sharashka Bureau</i> (Sharashkina kontora) by B. Guber, <i>The Earth Shakes</i> (Zemnoj tryas) by A. Kargopolov, <i>The Outhouse</i> (Fligel') by A. Karavaeva
	execution	17,6	
	death from gunshot wounds	17,6	
	murder (not at war)	17,6	
<b>Topic 4 "DOMESTIC VIOLENCE"</b>			
<b>buryj</b> (fulvous), <b>pojti</b> (to go), <b>syn</b> (son), <b>hotet'</b> (to want), <b>stojat'</b> (stand), <b>rebjonok</b> (child), <b>batjushka</b> (priest), <b>soldat</b> (soldier), <b>golos</b> (voice), <b>krichat'</b> (scream)	cruelty	35,7	<i>The Fulvous</i> (Buryj) by M. Chernokov, <i>A Nightmare</i> (Koshmar) by Gusev-Orenburgsky, <i>The Barricade</i> (Barricada) by G. Yablochkov
	suicide	21,4	
	death from gunshot wounds	21,4	
<b>Topic 5 "UNEXPECTED DEATH AND ILLUSIONS"</b>			
<b>starik</b> (old man), <b>vremja</b> (time), <b>stojat'</b> (stand), <b>zemlja</b> (ground), <b>dver'</b> (door), <b>videt'</b> (see), <b>golos</b> (golos), <b>kazatsya</b> (seem), <b>chjornyj</b> (black), <b>voda</b> (water)	cruelty	21,4	<i>Rioters</i> (Buntovshchiki) by P. Semynin, <i>The Trophy</i> (Nagrada) by N. Anov, <i>The Forgotten Colliery</i> (Zabytyj rudnik), <b>Two Bloods (Dva krovnika)</b> by L. Pasyнков
	sudden death	21,4	
	death from natural causes	14,3	
	suicide	14,3	
	murder (not at war)	14,3	
<b>Topic 6 "SUDDEN DEATH"</b>			
<b>vdrug</b> (suddenly), <b>den'</b> (day), <b>smert'</b> (death), <b>hotet'</b> (want), <b>slovo</b> (word), <b>volk</b> (wolf), <b>kazatsya</b> (seem), <b>nachinat'</b> (start), <b>chas</b> (hour), <b>noch'</b> (night)	death from gunshot wounds	25,0	<b>The Seven Who Were Hanged (Rasskaz o semi poveshennykh)</b> by L. Andreev, <i>The Silent Valley</i> (Gluchaja pad') by L. Ulin, <i>The Wolves</i> (Volky) by L. Zinovyeva-Annibal
	cruelty	18,8	
	murder (not at war)	18,8	
	death from natural causes	12,5	
	execution	12,5	
<b>Topic 7 "NATURAL DEATH"</b>			
<b>den'</b> (day), <b>drug</b> (friend), <b>kazatsya</b> (seem), <b>vdrug</b> (suddenly), <b>stojat'</b> (stand), <b>golos</b> (voice), <b>tolpa</b> (crowd), <b>vremja</b> (time), <b>komnata</b> (room), <b>tjomnyj</b> (dark)	death from natural causes	23,1	<i>In the Circus</i> (V cyrke) by A. Kuprin, <i>In the Crowd</i> (V tolpe) by F. Sologub, <i>From Another World</i> (Iz drugogo mira) by V. Orlovsky
	sudden death	23,1	
	execution	15,4	
	death from gun wounds	15,4	
<b>Topic 8 "LIFE IN PRISON"</b>			
<b>davat'</b> (to give), <b>pojti</b> (to go), <b>delo</b> (case), <b>hotet'</b> (to want), <b>lager'</b> (camp), <b>den'</b> (day), <b>prihodit'</b> (to come), <b>ruskij</b>	natural death	33,3	<i>Behind the Barbed Wire</i> (Za koluchej provolkoj) by K. Levin, <i>How Ivan spent time</i> (Kak Ivan provel vremja) by S. Podyachev,
	death from gun wounds	22,2	

Topic terms	Thematic elements	Freq. (%)	Stories of the highest rank
(russian), <i>zhit'</i> (to live), <i>sidet'</i> (to be seated)			<i>The Bad Hat</i> (Neputevyj) by E. Zamyatin
Topic 9 “CRUEL DEATH”			
<i>lipa</i> (Lipa), <i>pojti</i> (to go), <i>delo</i> (case), <i>ded</i> (grandfather), <i>hotet'</i> (to want), <i>bolshoj</i> (big), <i>vyhodit'</i> (to exit), <i>dver'</i> (door), <i>vdrug</i> (suddenly), <i>zemlja</i> (ground)	execution	23,1	<i>Savel Semenyuch</i> (Savel Semenyuch) by K. Fedin, <i>In the quiet corner</i> (V tikhom uglu) by E. Fedorov, <i>Communist</i> (Kommunistka) by A. Tyukhanov
	murder (not at war)	23,1	
	death from natural causes	15,4	
	cruelty	15,4	
	suicide	15,4	

The words that compose the clusters do not largely differ between the topics. Though, there are a few cases where the certain words strike the most. For example, these are the nouns that describe the places where the action takes place: *dom* (house), *komnata* (room), *ulitsa* (street), *lager'* (camp). Thus, topic 8, for example, seems to have gathered stories that describe prison and labour camps. Russian word *sidet'* (to be seated) has a second meaning of being in prison, and the word *lager'* (labour camp) adds to that theme. The word *ruskij* (Russian) indicates the topic of international relations in prisons and camps that can be found in stories from this group.

Topic 1, on the other hand, probably exploits the themes of rape or cruel behavior towards women at some point of the narrative's development. After considering the stories of the highest rank that contribute to this topic, it would be more accurate to say that all of them present a *woman* as a central figure. However, the stories below the 3rd rank are indeed dealing with another kind of violence, namely – *death from natural causes* and *suicide* (or suicide attempt). A pattern alike is found in topic 5 and 9. It is possible that these kinds of death are not largely presented in the lexis of the stories which makes it hard to detect them.

Moreover, we deliberately did not exclude verbs from the data, though this procedure is recommended for the improvement of the model [9]. It was suggested that violence is a theme that presupposes the usage of ‘active’ lexis. For that reason, it was expected that such verbs as, for instance, *to kill*, *to murder*, *to rape*, and etc., will result as terms of the highest probability within topics. However, the most helpful for interpretation words happened to be the nouns. More interestingly, the same tendency is discovered with regards to principal component analysis which is to be discussed in the next chapter.

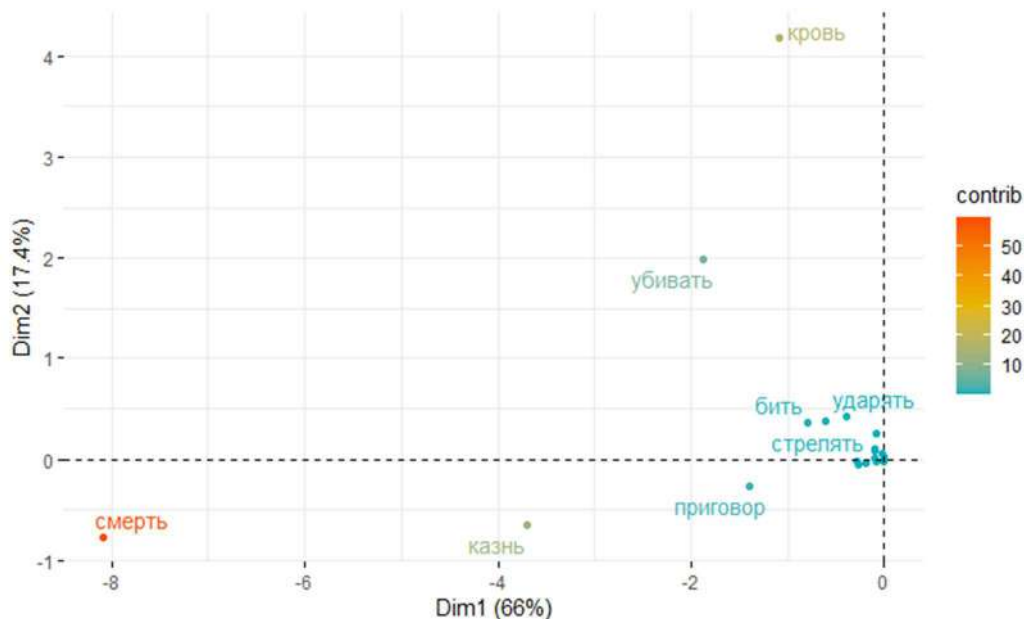
## 4. Scaling violence with PCA

### 4.1. Detection of violent lexis

Principal component analysis (PCA) is an unsupervised machine learning method that reduces the dimensionality without losing much of statistical information [7]. Often textual data contains variables that either strongly correlate with each other, or there is not much variation within a variable. Such variables are often quite useless for research. The PCA reduces the size of data by creating new variables that represent it, while saving only important information. It also visualizes the important correlation between variables, thus this method works well for finding dependencies in data. Compared to LDA, it does not detect deep semantic connections. That being said, the PCA can scale the explicitness of the violence narrative in the given subcorpus. The PCA algorithm that was used for this research is from the R package ‘factoextra’ [8].

A list of violent words was compiled manually with consideration of cases which are specific for the period in question: *ubit'* (to kill), *ubivat'* (to kill), *bit'* (to beat), *izbit'* (to beat up), *izbivat'* (to beat up), *pribit'* (to beat to death), *dushit'* (to choke), *pridushit'* (to choke to death), *udushit'* (to choke to death), *strelyat'* (to shoot), *zastrelit'* (to kill by shooting), *rasstrelyat'* (to kill by shooting), *pristrelit'* (to kill by shooting), *rasstrelivat'* (to kill by shooting), *zarezat'* (to slaughter), *topit'* (to drown), *utopit'* (to kill by drowning), *smert'* (death), *nasilije* (violence), *nasilovat'* (to rape), *iznasilovat'* (to rape),

*pytat'* (to torture), *pytka* (torture), *prikonchit'* (to kill), *rasstrel* (shooting), *kazn'* (execution), *krov'* (blood), *udarit'* (to hit), *udaryat'* (to hit), *nasilstvennyj* (violent), *terror* (terror), *terrorizirovat'* (to terrorize), *prigovor* (sentence), *viselitsa* (gallows).



**Figure 1:** Distribution of violent lexis

According to Figure 1, the lemmas, which usage differs from all the other words, are *smert'* (death), *krov'* (blood) and *kazn'* (execution). That means that these words appear more often in certain texts and that is what distinguishes one text from another. Other words like *bit'* (to beat), *udaryat'* (to hit) and *strelyat'* (to shoot) do not excel. *Ubivat'* (to kill) does not contribute much to distinguishing a certain story, however it does excel. It could mean that this word is simply used more often in general, rather than it being specific to a certain story. It is expected that the stories also fall in the same pattern.

What is more, though the words that were chosen for the list are presented mainly by verbs, as it can be seen from the graph above, the most striking results, again, were obtained, except for *ubivat'* (to kill), by virtue of nouns. It seems that despite the proactiveness of the characters that show violent behavior, nouns contribute to the quality of both, the LDA model and the PCA, the most.

## 4.2. Degree of violence within a story

One of the disadvantages of the PCA is that it does not perform well on high-dimensional data; therefore, the graphs demonstrate only a few stories to make it more readable. As it can be seen from Figure 2, the most 'violent' stories are *The Seven Who Were Hanged* (Rasskaz o semi poveshennykh) by L. Andreev and *Two bloods* (Dva krovnika) by L. Pasynkov, which means they both contain more violent words than any other story. However, they differ from each other in terms of what kind of violence they describe: *The Seven Who Were Hanged* (Rasskaz o semi poveshennykh) has a strong connection with the word *smert'* (death), while *Two Bloods* (Dva krovnika) with the word *krov'* (blood) on the other side of the graph.



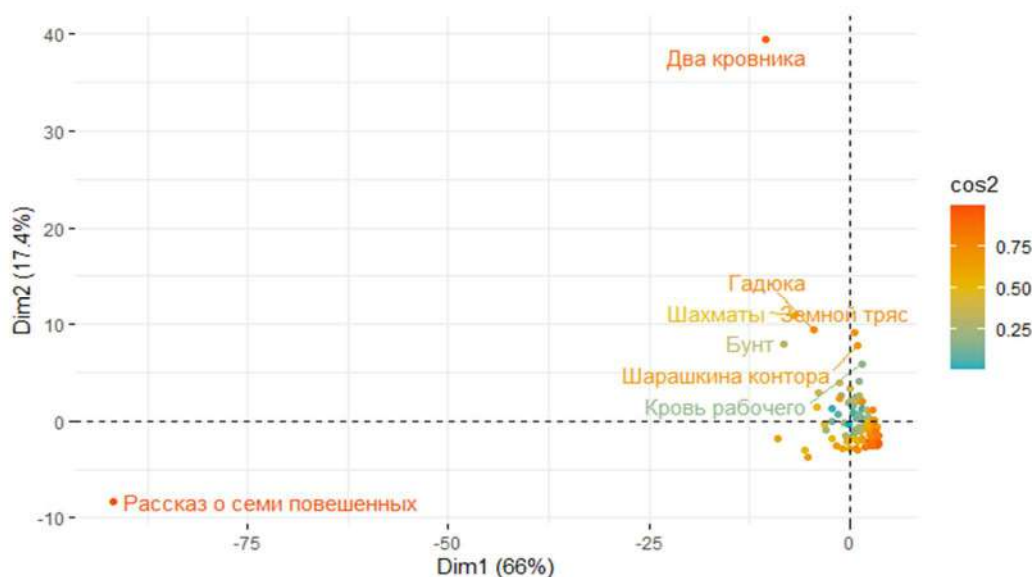


Figure 2: Degree of violent lexis in stories: a few examples

The stories *Viper (Gadyuka)* by A. Tolstoy and *The Sharashka Bureau (Sharashkina kontora)* by B. Guber also contain a lot of violent lexis, but they are not unique in the kind of lexis they contain. It is quite interesting that the story *Blood of a working man (Krov' rabochego)* by P. Arsky that already has a word from a dictionary in its title does not excel, which means that the word *krov'* (*blood*) does not contribute to distinguishing this story from others. Meanwhile *Two Bloods (Dva krovnika)* by L. Pasyukov is separated from the group, but *krov'* (*blood*) in this story also does not stand for the violent component only. As it follows from the story's plot, it is about two brothers related by blood and their blood enemy. Though the violent episodes or discussions between characters, including, for instance, spilling blood, indeed take place, the word *blood* here may have several meanings. The examples like this one demonstrate the problem of explicitness in stories' narratives.

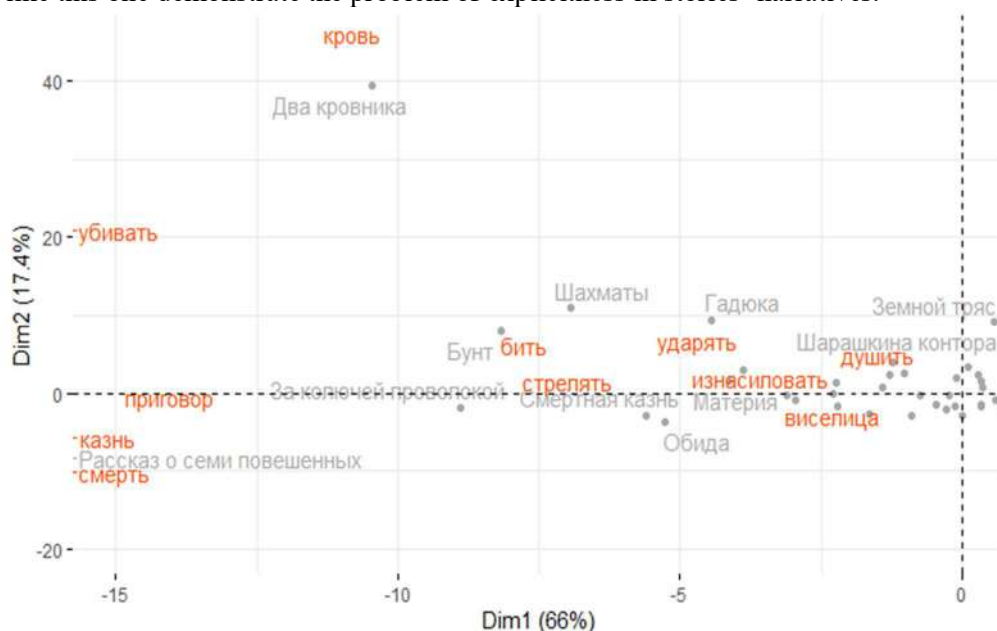


Figure 3: Correlation between lexis and stories

One thing that the PCA excelled in, as better seen in Figure 3, is in distinguishing the theme of execution (*prigovor* (*sentence*), *kazn'* (*execution*), *smert'* (*death*) and *viselitsa* (*gallows*)) from the other topics. One of them possibly being a distinctive topic of murder (*ubivat'* (*kill*), *krov'* (*blood*)),

however *ubivat'* (*kill*) does not correlate with a specific story. Possibly the narrative of execution tends not to describe blood and gore, while the narrative of murder does.

To sum up the results of the PCA, this method is an efficient tool to measure the explicitness of topics in the text, in this case – violence, since it not only shows the most explicit stories, but also distinguishes death from execution and murder, though it did not separate death from violence. It did not detect any other violent acts or causes of death that are hidden in the rhetorical structures and are not that explicit.

## 5. Conclusion

This research has proven that, albeit the homogeneous nature of the subcorpus, the LDA and PCA algorithms are able to detect different violent acts, however, with a few restrictions in terms of their diversity. Thus, topic modelling was able to capture some common plot-related features in the stories, while the PCA allowed to distinguish two stories that excessively describe two kinds of violence.

On the whole, the analysis of the LDA model showed that the most probable words for each topic did not represent any violent acts. One possible explanation regards the data itself, namely the fact that some stories fall into different categories at the same time which may complicate the detection of themes of our interest only. Another reason for unsatisfying results is that the stories, being short, do not comprehensively cover each of the subthemes enough, so they are not vastly expressed in the lexis of the texts. On the other hand, it occurs that the LDA was able to put into one cluster the stories with the similar plot details or characters (in terms of gender or social status). For instance, topic 1 unites those stories in which woman is the main character while the depiction of the act of rape or any sexual act at all is not necessarily present. Perhaps, regarding literature, topic modelling appears to identify common structures that occur in various texts, however, they do not always constitute their themes.

Since the PCA works with variables, it performed better – the difference between death by execution and murder was detected which can be juxtaposed with the stories. Thus, the most explicitly violent stories – *Two bloods (Dva krovnika)* by L. Pasyukov and *The Seven Who Were Hanged (Rasskaz o semi poveshennyh)* by L. Andreev – tell about murder and execution respectively. What is more, a comparison of the PCA results and per-document-per-topic probabilities of the LDA shed a light on some interesting tendencies. *Two bloods (Dva krovnika)* by L. Pasyukov and *The Seven Who Were Hanged (Rasskaz o semi poveshennyh)* by L. Andreev, which were distinguished by the PCA as the most violent, are also the stories of the highest rank in topics 5 and 6 respectively of the LDA model. For any other topic they do not contribute the same, lying at the bottom of the lists. It appears that these two stories indeed differ in terms of violence representation from others.

To conclude, we suggest that applying topic modelling to the literary texts unveils some difficulties prompted by the fact that the theme in the fictional text, as a rule, is not obviously expressed in the story's lexis. In our case, comparing the expert annotation and the automatic one, the automatic one did not detect as many themes as the expert did. For that reason, when tackling fictional texts that do not differ in genre, several methods need to be applied. As this study shows, the PCA can contribute to dealing with lexis-specific themes extraction. Additionally, the results of both LDA and PCA could be properly interpreted only with the knowledge of the contents of the stories and their thematic assessment by an expert.

For future research, experimenting with various topic modelling algorithms (NMF, for instance), on the one hand, and applying supervised machine learning methods for analysis of literary works, on the other, might help to obtain better results in terms of comprehensive interpretation. Mastering the automatic theme extraction may be a step towards human-alike textual analysis, allowing studying literature with the means of computation methods in more conclusive manner.

## 6. Acknowledgements

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# Disciplinary Variation in Syntactic Complexity: A Corpus Analysis of Professional Academic Writing

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## Abstract

This study deals with the analysis of syntactic complexity in professional academic writing and is based on a corpus of so-called ‘hard’ and ‘soft’ papers published in leading international journals. We aim at describing the main complexity features of academic discourse and testing the hypothesis that there is considerable disciplinary variation in linguistic complexity. We conclude that, first, clausal complexity strategies are more prevalent in the ‘hard’ sciences, while phrasal-complexity features dominate in the ‘soft’ ones. Second, the data reveal a continuum across subdisciplines within the broad categories of ‘soft’ and ‘hard’ genres with respect to the adoption of complexity strategies.

## Keywords

Corpus analysis, disciplinary variation, academic discourse, academic writing, syntactic complexity

## 1. Introduction

The phenomenon of complexity has been extensively approached in corpus linguistics over the recent years. Specifically, the complexity of writing has been studied in terms of the comparison of L2 and L1 writing [e.g. 1], correlations between text complexity, language proficiency and task types [e.g. 2], and the development of text complexity after intensive instruction [e.g. 3]. However, complexity in professional academic writing has been relatively under-researched to date despite the potential pedagogical implications of such studies. In this respect, we contend that following the linguistic conventions of a particular discipline plays a crucial role in identifying the writers as experts in their own discourse communities [4]. From this perspective, a research article can serve as a benchmark for optimal academic writing, providing learners with “a rich and authentic introduction to the complexities and nuances of the genre” [5: 3]. This study reports the empirical analysis of linguistic complexity features which aims, first, to describe the complexity features of research articles written by professional authors and, second, to test the hypothesis that linguistic complexity varies across disciplines.

## 2. Data and methodology

The analysis of linguistic complexity in professional academic writing has been conducted on a 775,000-word corpus of research papers in four ‘soft’ arts and social sciences (business studies, linguistics, history and political science), and four ‘hard’ life and physical sciences (mathematics, engineering, chemistry and physics) which were published in leading peer-review journals indexed in Scopus Quartile 1, in 2016 and 2017. Once collected, the texts were manually cleared from tables, formulas, graphs, charts, metadata and reference lists for further analysis. The size and details of the corpus are given in Table 1.

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**Table 1**  
Corpus

Discipline	No. texts	Word totals	Journals
HARD SCIENCES			
Chemistry	16	97,947	<i>Cell Chemical Biology (CCB)</i> <i>Chem</i>
Physics	18	95,852	<i>Physics Letters B (PL)</i> <i>Reviews in Physics (RP)</i>
Mathematics	13	98,430	<i>Compositio Mathematica (CM)</i> <i>The Journal of Differential Geometry (JDG)</i>
Engineering	17	99,003	<i>Automatica (Auto)</i> <i>Materials Characterisation (MC)</i>
Totals	64	391,232	
SOFT SCIENCES			
Business	10	95,350	<i>The Journal of Management (JM)</i> <i>The Journal of Management Studies (JMS)</i>
Linguistics	10	95,603	<i>Applied Linguistics (AL)</i> <i>Lingua (Ling)</i>
History	10	99,303	<i>Contemporary European History (CEH)</i> <i>The Journal of Modern History (JMH)</i>
Political science	11	93,366	<i>Political Analysis (PA)</i> <i>World Politics (WP)</i>
Totals	41	383,622	

In this study we undertake both the quantitative analysis of measures automatically generated by the complexity analyser and the qualitative scrutiny of a number of syntactic patterns associated with syntactic complexity. Firstly, to accomplish the quantitative analysis, the corpus texts were processed using Lu's L2 Syntactic Complexity Analyser (hereafter L2SCA). L2SCA provided the 14 indices given in Table 2 along with their descriptions, as in Lu [6: 43]. Such indices were categorised into: (i) metrics of structural complexity: indices reporting the length of units (sentences, T-units, clauses<sup>2</sup>), measured by counting the number of words; (ii) metrics of syntactic complexity: indices reflecting syntactic depth and dependency, that is, those based on coordination and subordination ratios as well as on clausal/T-unit embedding within other superordinate units; and (iii) metrics of categorial complexity: indices expressing the pervasiveness of nominal and verbal categories in the text.

At the second stage of the analysis, we carried out the qualitative analysis of the clausal and the phrasal complexity features, based on the taxonomy in Staples et al. [9]. The features are: sentence-final adverbial clauses of different types, *wh* complement clauses, verb + *that*-clauses, nouns, attributive adjectives, premodifying nouns and *of*-genitives. The analysis of such features required extensive manual disambiguation of the data examples.

<sup>2</sup> The notion of a T-unit is extensively used in complexity studies and is defined as "the shortest terminable units into which a connected discourse can be segmented without leaving any residue" [7: 34]. Bardovi-Harllg [8] notes that a T-unit normally comprises an independent along with its dependent clauses. For example, the expression *This would certainly continue to be the case with the CNT, but the UGT fared differently thanks to the support of the PSOE, its European partners and even the Spanish government, who had a strong interest in weakening the Communists* (CEH-2016-4) consists of one sentence, two T-units (*This would certainly continue to be the case with the CNT* and *the UGT fared differently thanks to the support of the PSOE, its European partners and even the Spanish government, who had a strong interest in weakening the Communists*) and three clauses (*This would certainly continue...*, *...but the UGT fared differently...* and *...who had a strong interest...*).

**Table 2**  
L2SCA syntactic complexity indices

Structural complexity		MLS	mean length of sentence (no. of words)
		MLT	mean length of T-unit (no. of words)
		MLC	mean length of clause (no. of words)
Syntactic complexity	Coordination	CPC	coordinate-phrase/clause ratio
		CPT	coordinate-phrase/T-unit ratio
	Subordination	CS	clause/sentence ratio
		CT	clause/T-unit
		TS	T-unit/sentence ratio
		DCC	dependent-clause/clause ratio
Categorical complexity	Predicates	CTT	dependent-clause/T-unit ratio
		VPT	verb-phrase/T-unit ratio
Categorical complexity	Nominals	CNT	complex-nominal/T-unit ratio
		CNC	complex-nominal/clause ratio

### 3. Results

The automated complexity indices are given in Table 3.

**Table 3**  
L2SCA syntactic complexity indices in hard/soft sciences

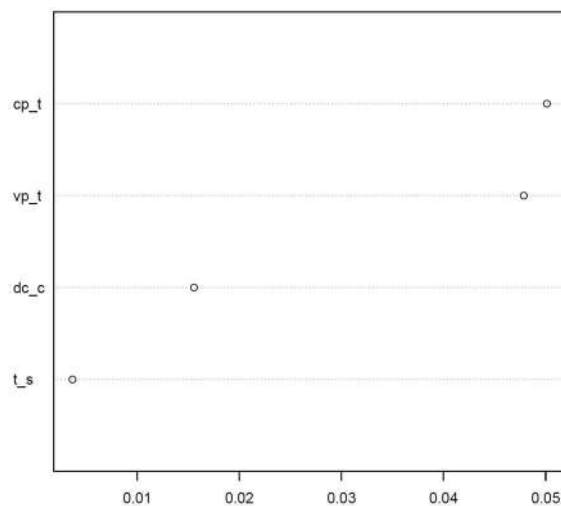
Index	Hard sciences					Soft sciences				
	chemistry	physics	mathematics	engineering	mean	business	linguistics	history	political-sc	mean
MLS	32.3	26.26	27.99	27.34	28.47	32.68	31.47	63.9	35.84	40.97
MLT	29.75	25.35	25.87	25.33	26.58	30.87	29.04	56.74	31.88	37.13
MLC	20.03	16.33	15.12	15.49	16.74	17.65	16.52	29.42	16.02	19.9
CPC	0.49	0.31	0.17	0.34	0.33	0.66	0.41	0.37	0.28	0.43
CPT	0.74	0.47	0.29	0.52	0.5	0.88	0.7	0.71	0.56	0.71
CS	1.63	1.59	1.88	1.75	1.71	2.06	2.06	2.21	2.25	2.14
CT	1.5	1.19	1.74	1.62	1.51	1.79	1.84	1.93	2	1.89
TS	1.12	1.08	1.08	1.07	1.09	1.06	1.08	1.14	1.13	1.1
DCC	0.31	0.34	0.4	0.35	0.35	0.43	0.43	0.43	0.47	0.44
DCT	0.49	0.54	0.7	0.57	0.58	0.75	0.8	0.83	0.96	0.84
CTT	0.36	0.38	0.48	0.39	0.4	0.52	0.52	0.53	0.57	0.53
VPT	2.08	2.13	2.09	2.13	2.11	2.81	2.42	2.67	2.82	2.68
CNT	3.66	3.39	2.9	3.01	3.06	4.07	3.05	4.4	3.78	3.83
CNC	2.45	2.2	1.68	1.88	2.05	2.24	2.07	2.31	1.91	2.13

In an attempt to determine the relative weights of the complexity indices, a binomial linear regression analysis was applied to the data, implemented via the function 'glm' ('stats' package, R Core Team 2020). We operationalised a (backward-steps) reduction of the number of indices that led to the model in (1), with only the indices VPT (Verb phrases per T-unit), DCS (Dependent clause ratio), TS (T-unit/sentence ratio) and CPT (Coordinate phrases per T-unit). Both the C(oncurrence) 0.918 and Nagelkerke  $R^2$  0.653 discrimination indices indicate that the model is very good at explaining the variation.

(1) Definitive glm model (‘\*\*\*’: 0,001, ‘\*’: 0,05)

	Estimate	Std. Error	z value	Pr(> z )	
(Intercept)	-25,9115	4,0116	-6,459	1,05e-10	***
vpt	3,4756	1,0531	3,300	0,000966	***
dcs	10,6276	5,0567	2,102	0,035580	*
ts	10,1416	2,6373	3,845	0,000120	***
cpt	3,8392	0,7312	5,250	1,52e-07	***

Figure 1 presents the Random Forests (function ‘cforest’, ‘party’ package) corresponding to the model’s fixed predictors, with an excellent C-index of 0.918. Figure 1 reflects the significant impact of the indices CPT, VPT and DCC on the variation hard/soft science, and the more minor contribution of TS to the model.



**Figure 1:** Dot chart of conditional variable importance

The interpretation of the findings revealed by the statistical analysis of the complexity indices per broad discipline, that is, hard and soft sciences, is as follows. The reduction of the indices led to a model with only 4 indices evincing different dimensions of linguistic complexity:

(i) syntactic complexity mirrored by pervasive coordination, as reflected by the index CPT, which calculates the ratio of coordinated phrases per T-unit

(ii) syntactic complexity determined by subordination within clausal units, as evinced by the index DCC, which expresses the amount of subordinate dependent clauses in matrix clauses, and in sentences, which has been corroborated by the statistical significance of the index TS, a telling indicator of the ratio of T-units per sentence

(iii) categorial complexity associated with the frequency of, specifically, verbal constituents in T-units, here captured by the index VPT.

Random Forests have demonstrated, on the one hand, that, out of the indices that proved to be very strong in the model, those measures evincing complexity triggered by coordination (CPT) and by the profusion of verbal categories (VPT), contribute to the variation of hard *versus* soft science to a greater extent than DCC and TS. On the other hand, the probability of higher values in the four complexity indices increases in academic writings categorised as soft science. In other words, greater ratios of coordination, subordination and the ‘verby’ status of texts can be taken as proxies for the categorisation of a research paper within the domain of social sciences and humanities. These results are in line with Biber et al, [10: 29] when they claim that “complexity is not a single unified construct, and it is therefore not reasonable to suppose that any single measure will adequately represent this construct”. However, some remarks are in order here as regards the interpretation of our findings in light of the conclusions drawn by Biber and colleagues. In their multidimensional analysis of academic writing *versus* other more informal genres, Biber et al, [11] found that high(er) phrasal complexity and low(er) clausal complexity are characteristic features of academic English (as well as of newspaper and magazine writings). By contrast, the type of complexity evinced in personal,



professional (even academic) spoken genres, as well as in popular written (novels, personal essays) discourse, is fundamentally clausal. Specifically, they contend that T-unit- and subordination-based (i.e. clausal) measures are not typical of academic writing but of conversational discourse, whereas nominal/prepositional (i.e. phrasal) measures are good indicators of academic writing. The statistical modeling of the complexity indices reported in this section has shown that subordination, coordination and the ‘verby’ status of sentences (or, better, T-units) are defining features of soft academic writing. As we see it, this conclusion does not invalidate a dominantly phrasal characterisation of academic writing when compared to more informal speech-based/related discourse, but gives support to the multifaceted nature of academic writing.

Subsequently, a more qualitative analysis of the frequencies of the features associated with clausal and phrasal complexity was carried out. The results of the such an analysis are shown in Figure 2, which provides the normalised frequencies (per 100,000 words) of the features.

All the differences in the use of the complexity features in hard and in soft sciences were found to be statistically significant at the level of 1%, except that of verb+*that*-clauses, which was significant at the 5% level. As can be seen in Figure 2, adverbial clauses were found to be more common in the corpus of the hard-science papers. A closer look at the types of adverbial clauses extensively employed in life and physical sciences revealed that the most frequently used one is the conditional clause, which accounts for almost a third of all adverbial clauses. This type of adverbial clauses is typically used in the comments for various calculations, formulas and theorems (see example 1). As regards the two features evincing complementation strategies, *wh*-clauses prevail in the soft research papers, whereas *that*-clauses are more frequent in the hard disciplines. Finally, the data demonstrates that, overall, phrasal complexity features, particularly, adjectival and prepositional phrases prevail in the soft-science texts, while nominal categories are more frequent in the hard sciences, particularly in chemistry, where they are used in long names of chemical entities and processes (see example 2).

- (1) The next lemma expresses the important fact that if  $qC > 0$  and if the excess measured relative to  $C$  is much smaller than the excess measured relative to pairs of planes with higher-dimensional axes... (JDG-2017-3).
- (2) In addition, methyliminodiacetic acid (MIDA)-protected boronate esters were well tolerated (Chem-2016-4)

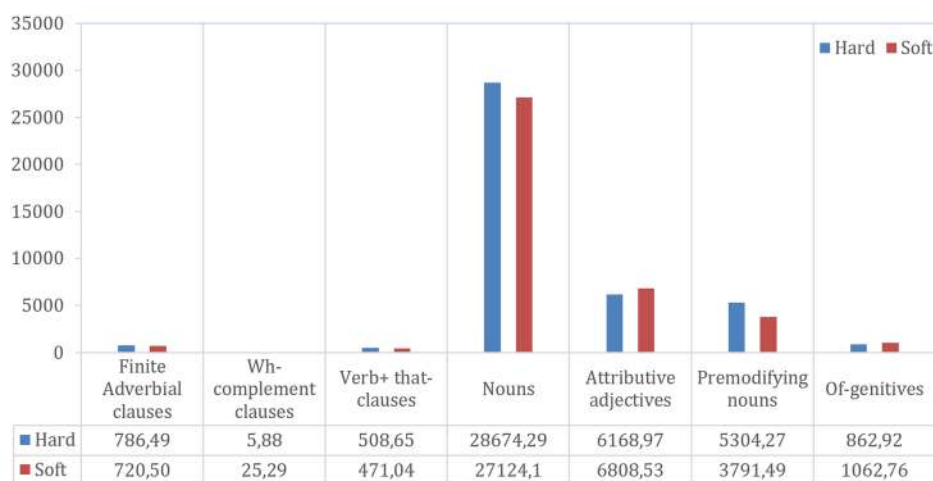


Figure 2: Clausal/phrasal complexity features in hard/soft sciences

#### 4. Conclusions

This study has tackled the analysis of linguistic complexity in professional academic writing in English. The analysis of automated indices of complexity in a corpus of research articles published in leading journals in hard (mathematics, chemistry, physics, engineering) and soft (linguistics, history, business, political science) science papers led to the following conclusions. Soft sciences demonstrate a significantly larger number of features associated with syntactic complexity, subordination and coordination ratios than the hard-science genre. The data have also revealed that the clausal-

complexity indices, in particular, the occurrence of sentence-final adverbial clauses, are significantly more frequent in the corpus of the hard-science papers. Phrasal complexity, measured here by the amount of adjectival and prepositional phrases, proved to prevail in the soft-science category, whereas the hard-science texts exhibited greater ratios of nominal categories.

An in-depth description of linguistic complexity in professional academic texts, along the lines of analyses of objectively depicted indices, can benefit the teaching of EAP/ESP writing in terms of guiding the production of discipline-specific language-learning materials that will address the needs of learners of different sciences in a more effective way. From the perspective of Data Driven Learning (DDL) approaches [12], EAP/ESP practitioners could employ teaching materials with examples from research papers in a particular discipline or group of disciplines (hard vs soft) with the purpose of helping students learn how to meet the necessary language and stylistic conventions established in a specific discipline. In this vein, concordance lines with the most common finite adverbial clauses could for example be employed to demonstrate the way in which clausal complexity is achieved and realised in hard sciences, while occurrences of adjectival and prepositional phrases from papers in soft disciplines would serve as an illustration of the type of phrasal complexity in this domain.

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# The Comparison of Self-reported and Real Effects of Using Corpus-based Exercises in ESP Course to Improve Students' Language Skills

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## Abstract

This paper presents the outcomes of the controlled experiment in which we studied the impact of corpus-based classroom activities and the inquiry-based learning method (a form of active learning) on students' academic progress in their English for special purposes (ESP) course. The research objective was to compare the actual change in students' language skills with the self-reported one.

Students' feedback is often used to make adjustments to the course to improve it. Our literature review results indicated that students' opinion often lacks objectivity and cannot be fully relied on when evaluating the usefulness of the course. In this study we called into question the validity of students' evaluations of the effectiveness of a corpus-based approach to learning ESP. In our experiment, we used two groups of third year ITMO university students, majoring in Biotechnology. We compared students' self-reported improvement of their language skills with the actual improvement of skills. The methods used in this study included a questionnaire and pre-, and post-tests.

The statistical analysis of tests' scores indicated that using corpus-based tasks, in addition to the regular ESP course, resulted in considerable improvement of students' language skills in the experimental group. Interestingly, in the experimental group, students' questionnaire answers revealed that the majority of them failed to realize the real scale of their language skills improvement due to their work with corpora. Therefore, the results of our study suggest that students might underestimate the value of using corpus-based activities in the classroom.

## Keywords

Corpus linguistics, ESP, language skills, DDL, corpus-based exercises

## 1. Introduction

One of the main teaching approaches of higher education nowadays involves making students participate actively in their own educational process. One of the branches of Computer Assisted Language Learning (CALL) is the active approach to learning called Data-Driven-Learning (DDL), in which students access corpora in order to discover the behavior of language themselves. Over the past three decades, the DDL approach has received a lot of attention in the English for Special Purposes (ESP) research community [1]. A number of studies have shown that using corpora for teaching a foreign language contributes to the development of autonomy and motivation of students. Student's ability to access corpora and study the meaning of science terms and their collocations is very important for the development of lexical skills. The vocabulary of ESP language includes numerous words related to science, which, being easily recognizable in writing, have completely different meanings or pronunciation in English. Corpora can provide students with the information about ESP terms pronunciation, collocations and usage in different contexts. Therefore, students' knowledge

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about how to use corpus technology can have a huge impact on their ability to self-correct errors in pronunciation, vocabulary and grammar, dramatically improving their language skills.

In reality, though, there is a gap between using corpora in linguistic research and for ESP classroom teaching. Based on the results of numerous studies, the gap is still growing [2, p.3; 3, p.32; 4, p.461]. Some reasons for this gap include teachers' fear that a DDL course might receive negative evaluations from students. Indeed, increased students' motivation and their high enthusiasm about DDL are regarded by many scientists as evidence of a successful outcome of using corpora tools to teach language [5, 6, 7, 8]. For example, a recent meta-analysis of 64 studies focusing on the effects of using corpus linguistics for teaching foreign languages demonstrated that DDL can be both effective and efficient in almost any context [6].

However, there is always the possibility that students might dislike using DDL and corpora. Some teachers also believe that technical issues and students' unwillingness to learn actively might result in negative learning outcomes. Furthermore, despite publications featuring successful use of corpus applications for a broad range of teaching language purposes, some teachers still believe that using corpora to teach language might affect learners' perceptions of the learning process and have negative impact on students' evaluations of their language course.

Although course evaluations by students are used as a tool of getting feedback in many colleges and universities, there's still much uncertainty on the objectivity of students' answers to questions about the usefulness of an ESP course enhanced with corpus-based exercises. According to some scientists, students may not accurately assess the changes in their performance. A critical look at the students' evaluations might reveal that students are not always capable of fully appreciating the benefits of active learning. For instance, the recently published research at Harvard University demonstrated students' misperception of their learning outcomes. This research studied students' reactions to active learning under controlled conditions and was conducted in a college physics course which was taught using both active and passive instruction [8, p.19251]. Having observed the students' self-reported perception of learning, researchers came to the conclusion that most of the students preferred the passive way of teaching and considered it more effective. However, at the end of the course, their test results proved the opposite. Students who were taught using an active approach got higher scores for their tests, compared to students who just listened to the lecturers. Therefore, the scientists reported an anti-correlation between self-reported and the actual results of active teaching [8, p. 19256]. The authors of the research claimed that students can't always fully appreciate the value of being actively engaged in the learning process, because, in their minds, it is associated with increased cognitive effort, which is often regarded by students as a sign of poor learning [8, p.19251]. According to the authors, this fact explains why students and faculty prefer traditional lectures to active learning [8].

In our study we called into question the validity of students' evaluations of the effectiveness of a corpus-based approach to learning ESP. In our controlled experiment, we used two groups of third year ITMO university students, majoring in Biotechnology. We developed corpus-based exercises promoting an inquiry-based learning (which is a form of active learning) for our experiment. The students in the experimental group were introduced to corpus technology and completed our corpus-based exercises in addition to the regular ESP course, used in the control group. The methods implemented in this study included a questionnaire, and pre-, and post-tests. We compared students' self-reported improvement of their language skills with the actual improvement of skills as indicated by their test scores.

## **2. Methods**

### **2.1. Research questions**

RQ1: Is there any statistically significant difference between the mid-course test results, before the experiment in both groups?

RQ2: Is there any statistically significant difference in the end-of-course (EOC) test results, after the experiment, in both groups?

RQ3: Does students' self-perception of their learning correlate with the actual change of their test scores?

In this section we describe the approach we took to answer our research questions. We describe tests and statistics used in order to evaluate differences in test scores between two groups. We also describe the questionnaire that students in both groups used to rate their courses. Finally, we describe the corpus-based activities designed for the experimental group in order to show how inquiry-based learning was implemented in our experiment.

## 2.2. Tests and questionnaire description

In order to find answers to our research questions, we used two groups of ITMO university students in their third year. The students from both groups majored in biotechnology and studied ESP. Group A (control) had 13 students and Group B (experimental) had 12 students. All students were randomly assigned, and had the same English language level, ranging from level B2 to C1. Both groups received identical ESP class content, but the students in Group B were taught using corpus-based exercises in addition to their main ESP course. Both groups completed two tests: the midcourse test, before the experiment, and the End of Course Test (EOC), at the end of the semester, after the experiment. Both tests were the same for two groups. Each test consisted of ten tasks: seven lexical tasks, checking the mastery of professional vocabulary; two listening tasks, which checked listening skills; one written task, in which students had to describe one of the methods for biomaterial processing. Students' speaking skills were assessed during their oral presentations on a biotechnology topic chosen individually by each student.

The first aim of our study was to check if both groups had the same level of English before the experiment. For this purpose, the midcourse test scores of Group A and Group B were statistically evaluated and compared, using unpaired t test. Our null hypothesis stated that there was no significant difference between the means of the two groups. The p value was calculated in order to see if the null hypothesis had to be accepted or rejected.

The second aim of our study was to check if both groups had the same level of English knowledge after the experiment. In order to answer the second research question, the EOC test scores of Group A and Group B were also statistically evaluated and compared, using unpaired t test. Then, the p value was calculated. Based on the p value, the null hypothesis, stating that there was no significant difference between two groups' test results, had to be accepted or rejected.

The third aim of the study was to see if students' self-perception of their learning correlates with the actual change of their test scores. Thus, in order to find an answer to our third research question, we compared actual changes in students' test's scores with their self-reports on language skills improvement. Therefore, both groups were asked to complete a questionnaire at the end of their ESP course.

In order to find answers to our third research question, we asked students to complete the questionnaire in which students rated their level of agreement with statements on a 5-point Likert scale. In this scale, the number 1 typically represents an answer "strongly disagree" and the number 5 is "strongly agree". Students evaluated 4 statements: "The course was boring", "I enjoyed the course", "The course was very interesting", and "My speaking and writing skills improved".

## 2.3. Corpus exercises description

The corpus-based exercises were created with the assumption that motivation is increased as learners become engaged in activities, that they base on their own intentions, concerns and interests. Students used corpora to complete tasks given by the teacher in order to study professional vocabulary. Then they used their findings to improve their productive skills in speaking and writing. Students were required to post their completed assignments on Moodle in a Forum task. This way they were able to share their research results, give each other feedback, and use corpora findings for writing and speaking. Students were also required to update their Moodle Glossary with new terms and collocations, found in corpora. Students used information about terms' synonyms and collocations to paraphrase texts from the research articles in their fields and write down the summary of the texts. The corpus-based exercises also included using corpora for making oral presentations in groups, pairs and individually. During this experiment students accessed two corpora: NOW [9] and

iWeb [10]. Below, there are some examples of the exercises used in the ESP course for the experimental group.

### 2.3.1. iWeb corpus exercises used in the experiment


The exercises demonstrate how an inquiry-based teaching approach was used in our experiment. This method taught students to discover different patterns in authentic language use.

#### **iWeb corpus exercises.**


Read the text from the article “Colony Sequencing: Direct Sequencing of Plasmid DNA from Bacterial Colonies” [11]:


“In sequencing projects, the preparation of templates, involving either the growth of bacteria and subsequent plasmid purification or the amplification by polymerase chain reaction (PCR) of inserts in vectors (1–3), is one of the most costly steps in terms of reagents and time. We have developed a simple method for directly sequencing plasmids from bacterial colonies that requires only heat-induced lysis of bacterial colonies followed by cycle sequencing (5), thus circumventing template preparation” [11].

1. Go to the website <https://www.english-corpora.org/iweb/> and create an account. Enter an underlined term from the text into the search window and highlight the option “Word” above it. Then click the button “See detailed info for word”. Please start with the noun “plasmid”.

2. Click on the  icon demonstrating the word’s pronunciation. Repeat the word as many times as you need. Repeat this activity for all the underlined terms.

3. Work in pairs and practice pronunciation. Ask your partner to read the text, focusing your attention on his/her correct pronunciation of the terms. Then switch your roles.

4. Click on the  icon and see the visual representation of the term’s meaning.

5. Click on the tab “Russian language” in the window next to the  icon and choose one of the applications (Google, WordRef, Reverso, or Linguee) to read the Russian translation of the term and its definition both in Russian and English.

6. Scroll down and click on websites/virtual corpora to see the table with websites ranked by the percentage of the term “plasmid” in them. Choose the website that has the word “plasmid” listed as one of the key words for this website. Click on the website, and find the information about your term and other key words that can be found there.

7. Click on ‘collocates’ of the word “plasmid” and see the list of nouns, adjectives and verbs that collocate with this term. Complete **Table 1** (below). and post your findings in a forum on Moodle.

8. Click on the tab “Clusters” above the table. The most frequent word clusters with this term are shown on the top of the table and are highlighted in deep blue color. Study the clusters for each term in **Table 2**. Complete **Table 2** and post your findings in a forum on Moodle. Think of 2 sentences with the clusters you found and complete **Table 3**. Did you use your cluster as a subject or an object in your sentence? Post your sentences in a forum on Moodle.

9. Click on the cluster number 60 “with the plasmid” and then on the source of the text. You will be taken to the website with the full text. Read this text and discuss it with your partner.

10. Choose another term and study clusters for it. Find full texts with the clusters of your choice. Read the text. Did you learn something new in your field? Retell this text to your partner.

Repeat this exercise for other terms and find more articles in the field of biotechnology. Choose one and get ready to make a short presentation about it (3-5 minutes). Use iWeb for reference to find synonyms, word clusters and collocations for your presentation. Make sure you practice the pronunciation of new terms. Give your presentation in front of the class and teach your peers new terms. Get ready to answer your peers’ questions about your mini-presentation.

**Table 1**

Collocations from the iWeb corpus

Term	Collocation 1(verb or noun)	Collocation 2 (adjective)
Example: Plasmid	Carry	Recombinant
	Contain	Circular
	Encode	Linear
Template	Your example	Your example
PCR	Your example	Your example
Vector	Your example	Your example
Purification	Your example	Your example
Amplification	Your example	Your example
Lysis	Your example	Your example
Reagent	Your example	Your example
Colony	Your example	Your example
Sequencing	Your example	Your example
Circumventing	Your example	Your example
Induced	Your example	Your example

**Table 2**

Clusters from the iWeb corpus

Cluster	Your Sentence #1	Your sentence #2
Example: Plasmid	Plasmid encoding	Plasmid transfection
Template	Your example	Your example
PCR	Your example	Your example
Vector	Your example	Your example
Purification	Your example	Your example
Amplification	Your example	Your example
Lysis	Your example	Your example
Reagent	Your example	Your example
Colony	Your example	Your example
Sequencing	Your example	Your example
Circumventing	Your example	Your example
Induced	Your example	Your example

Read the examples in the Table 3 and use the iWeb corpus to find answers to the following questions:

**Task1.** Read the sentences:

1. Researchers also gained some insight into how tea plants came to acquire the genes that encode for caffeine.
2. This way mRNA can encode for several different proteins.
3. The best approach is to encode to MP4 files, and then repackage as necessary for the target platforms.
4. You cannot encode to 10 bits with this system.

Can you explain the reason for different prepositions after the term “encode” in these sentences?

**Table 3**

Make sentences with clusters from the iWeb corpus

Cluster	Your Sentence #1	Your sentence #2
Example: Plasmid encoding	In this research we focus on characteristics of <u>plasmids encoding</u> these specific genes.	We have developed a new technique allowing the growth of <u>plasmids encoding for</u> specific proteins.
Example: Plasmid transfection	In our experiment we performed <u>plasmid transfection</u> into mammalian cells.	The possibility of viral <u>plasmid transfection</u> was eliminated.
Template	Your example	Your example
PCR	Your example	Your example
Vector	Your example	Your example
Purification	Your example	Your example
Amplification	Your example	Your example
Lysis	Your example	Your example
Reagent	Your example	Your example
Colony	Your example	Your example
Sequencing	Your example	Your example
Circumventing	Your example	Your example
Induced	Your example	Your example

**Task 2.** Use iWeb corpus to search the phrase “encode for proteins”. How many examples did you find? Now search the phrase “encode proteins”. Are there more or fewer examples of this phrase in the corpus? What conclusion can you make based on these findings?

**Task 3.** Use iWeb corpus to study the cluster “Plasmids transfection” and find texts containing this cluster. What does “transfection” mean?

How is the term “transduction” different from the term “transfection”? List three collocations and three clusters used with the term “transduction”.

### 2.3.2. NOW corpus exercises used in the experiment

#### Task 1. Fix mistakes

Work in groups of four-five people. Read the sentence:

“Why don't you pay your attention for investing cure?” What is wrong with it?

Use corpora iWeb or NOW to find and fix the mistakes in this sentence.

1. How many mistakes did you find?
2. What queries did you use to fix mistakes?

#### Task 2. Countable/uncountable nouns

Work in pairs and choose 3 terms to study. Access corpus NOW to study these terms:

Acid, alkali weight, liquid, pressure, light, achievement, evidence, knowledge, reference persuasiveness, guidance, advice, proposal, implication, distortion

What corpus queries can help you to find out if a noun is countable? Which of these terms are countable? What articles can be used with uncountable nouns? Can we use no article with a countable noun? What quantifiers can be used with uncountable nouns?

**Task 3** Singular/plural form. Access corpus NOW to get singular form these nouns: bacteria, data, criteria, analyses, theses, species, syllabi. What queries did you use?



**Task 4.** In research articles you can often see these two structures: "it is \_\_\_\_\_ believed", "It is \_\_\_\_\_ accepted". Access corpus NOW and study the most frequent adverbs used in these structures (list 4-5 adverbs). What corpus queries did you have to make? Use your findings to think of and write down 3 sentences relevant to your field of study.

### 3. Results

All calculations were conducted using an online t-test calculator [12].

Calculations of the statistical difference between the test results in the control and experimental groups before the experiment, showed no statistically significant difference.

**P value and statistical significance before the experiment:**

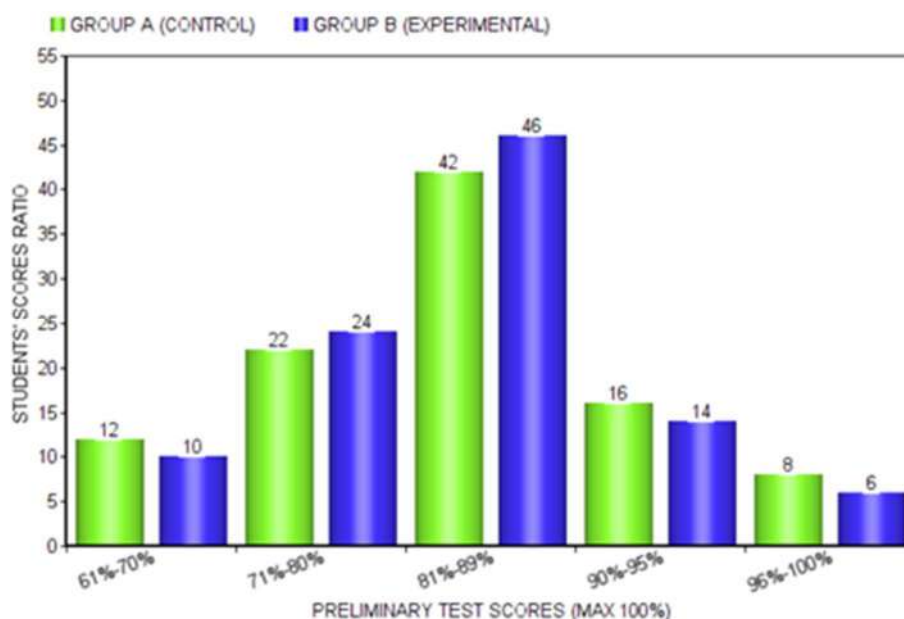
The two-tailed P value equaled 0.0868; so  $p > 0,05$ .

**Confidence interval:**

The mean of Group One minus Group Two equals -0.89

95% confidence interval of this difference: From -1.93 to 0.14

Thus, this difference is considered to be not quite statistically significant and the null hypothesis could be accepted. Our null hypothesis stated that there was no significant difference between the means of the two groups. This indicates approximately the same level of language skills in students of the two groups before the start of the experiment. Below, in Figure 1, there is a chart that clearly demonstrates the results of preliminary testing in the control and experimental groups. The graph shows that the spread of students' grades is approximately the same in both groups.



**Figure 1:** The chart of the preliminary test results (mid-course test) in the control and the experimental groups

Calculations of the statistical difference between the test results in the control and experimental groups after the experiment, showed a statistically significant difference.

**P value and statistical significance after the experiment:**

The calculated two-tailed P value was less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant.

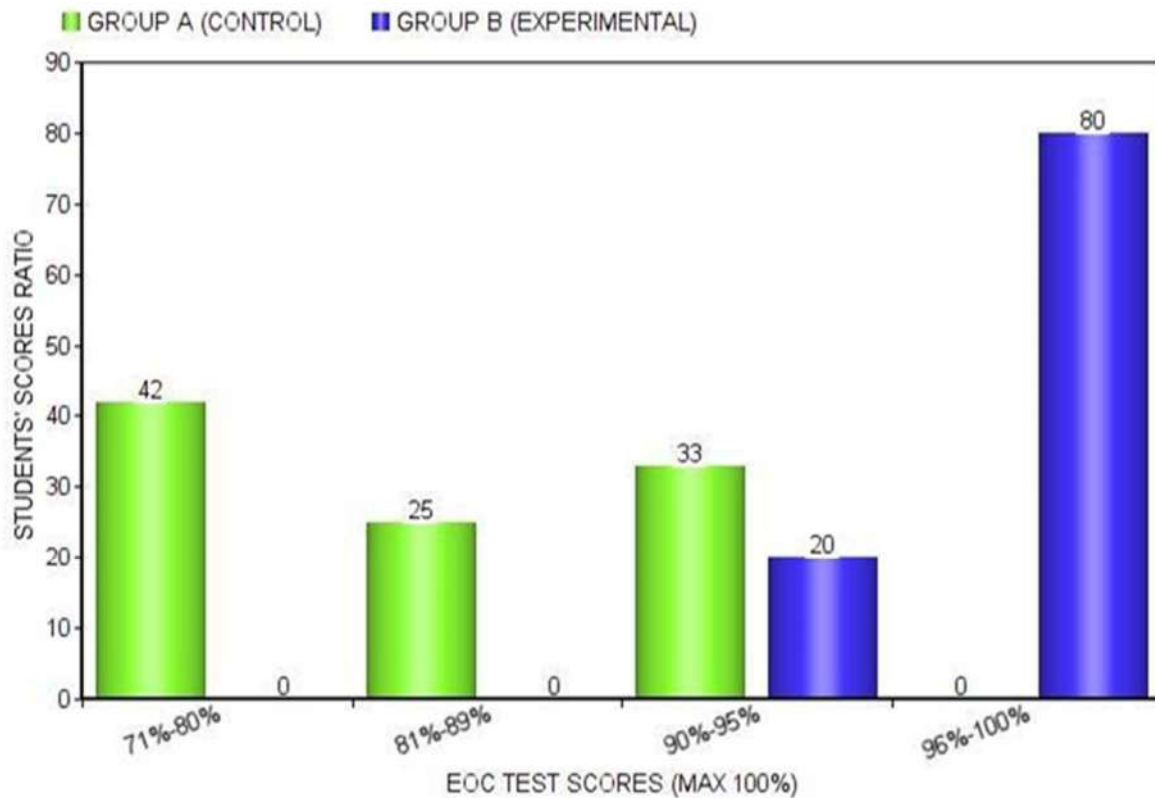
**Confidence interval:**

The mean of Group One minus Group Two equals -2.10

95% confidence interval of this difference: From -2.71 to -1.49

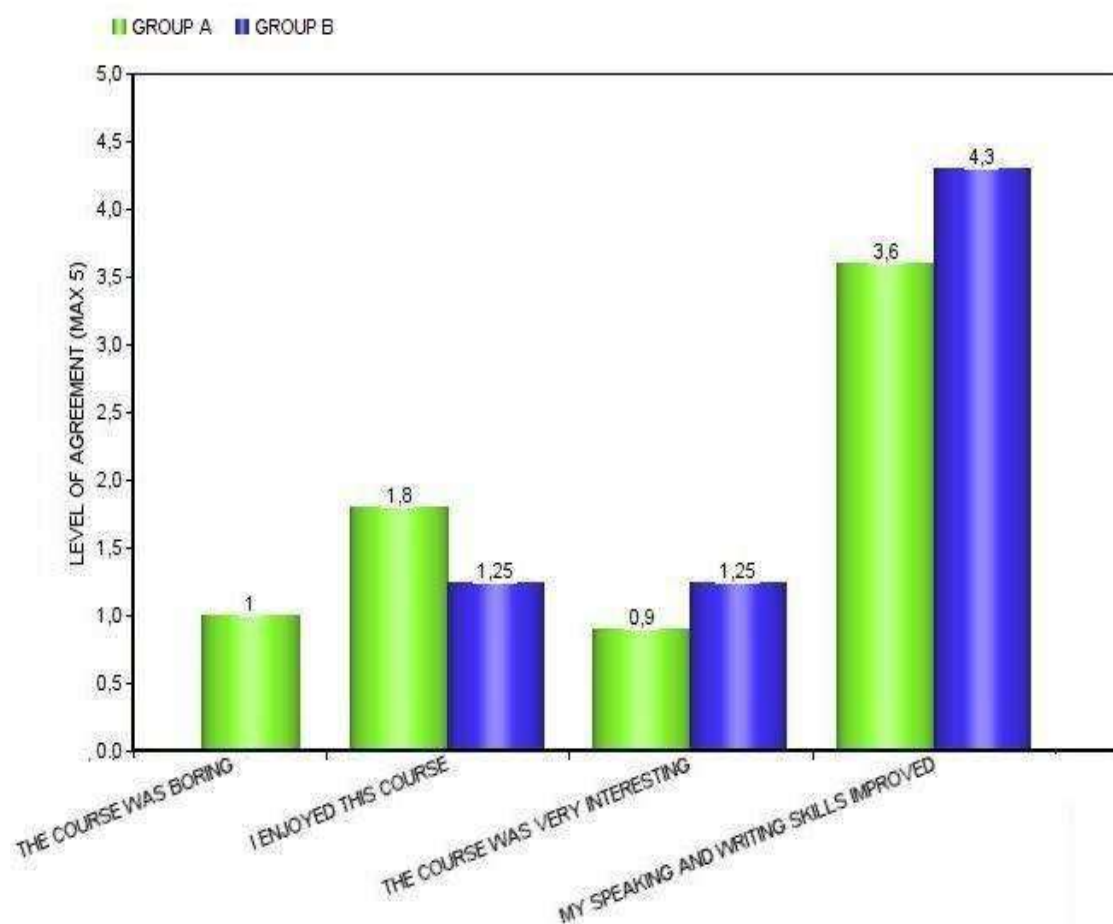
Our null hypothesis stated that there was no significant difference between the means of the two groups. Therefore, the null hypothesis had to be rejected.

The chart in Figure 2, shows that the students in the experimental group have significantly increased the level of their language skills, as assessed by the test at the end of the course. Unlike students in the control Group A, students in the experimental Group B had significantly improved their language skills, getting much better grades for their EOC tests. While nobody in group A received a score higher than 95%, around eighty percent of students from the experimental group B demonstrated excellent results, getting EOC test scores of 96% and higher.



**Figure 2:** The chart of the end-of-course test results (EOC test) in the control and the experimental groups

We also compared the actual improvement of the test scores in both the control and experimental groups with students' self-reports on their improvements (Figure 3). Slightly more students in Group B than in Group A claimed that their speaking and writing skills had improved. Analysis of the questionnaire answers also showed that nobody agreed with the statement "The course was boring" in the experimental group B. Higher percentage of students in Group B agreed with the statement that the course was very interesting; however, fewer students in group B enjoyed their course.



**Figure 3:** The chart of statements made by students in the control and the experimental groups

#### 4. Discussion

The students in the experimental group were introduced to active learning and had to complete corpus-based exercises in addition to the regular ESP course, which was used in the control group. The study participants in both groups took tests before and after the experiment. All tests' scores in both the control and the experimental groups were statistically evaluated and compared using unpaired t-tests and the p value. The experiment data showed the statistically significant difference between the end-of-course (EOC) test results of the experimental and control groups.

Based on the calculations, it can be concluded that, as a result of working with the corpus-based exercises, the experimental group has shown significant improvement in their test scores. Evaluation of students' oral presentations in both groups showed that students in the experimental group had better speaking skills by the end of the semester. Unlike students in the control group, the students in the experimental group spoke English with more confidence, made fewer grammatical errors, and used more complex grammar structures in their speech, compared to students of the control group. Thus, in general, the results of the experiment confirmed that corpus-based activities have a positive effect on students' English skills.

Students in both groups were asked to complete a questionnaire in which they self-reported the improvement of their language skills by the end of the semester and evaluated their ESP course. Students in the experimental group B showed statistically significant improvement in their mid-course and EOC test results; however, it did not correlate with their self-reports, which suggested only slight improvement in skills. These findings correspond to the results of Deslauriers et al. research at

Harvard University, which showed that students are not always capable of fully appreciating the true value of being actively engaged in the lesson [8].

In our study, fewer students enjoyed the course in Group B than in Group A. Students' answers showed that they resisted active learning and disliked being actively engaged in learning. Apparently, cognitive effort associated with active learning can influence some students' motivation in a negative way, making them perceive this effort as something unpleasant, or as a sign of failure [8]. This may explain why the DDL approach in teaching languages might be met by some students without enthusiasm. These results also confirm findings in the research [8], where students also preferred being taught in a passive way, while their actual testing results showed that active learning was more beneficial for them.

While students' surveys are often used for collecting data in language program evaluations, according to the research, students are not always able to understand the value of being actively involved in the learning process, considering it to be an ineffective way of teaching. Students might prefer passive learning; however, active learning is more beneficial for their language skills development.

The results of this study suggest that teachers should not feel discouraged from using corpora in their language classroom. Corpus-based exercises promote active learning in the classroom and encourage students to actively participate in the process of their language skills formation using corpora as a reference. Using corpora exposes students to authentic ESP language, teaching them to work autonomously on their language skills improvement. Corpora provides easy access to different types of authentic materials and can be used for designing various exercises for an ESP course.

## 5. Conclusion

In this study students in the experimental group used corpus technology as a learning tool (for vocabulary and grammar) and as a reference resource (for writing and speaking tasks and self-correction of errors). The research results demonstrated that students' motivation and their self-perceived improvement of skills did not correlate with the scale of the actual effectiveness of using corpora for teaching ESP. Therefore, we believe that students' perception of the data driven learning impact on their language skills does not always mirror the real improvement.

The limitation of the experiment is a small sample size. The results, therefore, require confirmation in a more representative sample. In the future, it is planned to conduct a similar study with a greater number of students, as this experiment included a small sample.

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# **E-Governance**





# Trajectories of India's Experiments with Digitisation: From Computerisation to Digitisation, Governance Shaped by Evolving Technology

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## Abstract

This paper analyses the evolution of e-Governance and examines its features with reference to India. It examines the impact of evolving technology on e-governance and evaluates the challenges posed in the governance of Digital Space, offers solutions to current problems and forecasts the global e-Governance framework of the future. The key objective of this paper is benchmarking various agencies of the government of India on their e-Governance-Service delivery performance. This paper attempts to ensure that the developing country perspective is clearly articulated

## Keywords

e-Governance in India, Digital Government Stage Analysis Framework, Benchmarking e-services, Assessment Survey

## 1. Introduction

India ranks third among the most attractive investment destinations for technology transactions in the world.

1. In September 2020, India moved four places up to reach the 48th rank and made to the top 50 countries in the Global Innovation Index (GII) for the first time.

2. India ranks in the top 15 for indicators such as ICT (Information and Communication Technology) services exports, graduates in science and engineering, government online services and R&D-intensive global companies.

3. India ranked 52 in Global Innovation Index (GII)-2019. It moved up to fifth rank in Global R&D Funding Forecast 2020.

India's gross expenditure in R&D was forecast to reach US\$ 96.50 billion in 2020. By 2022, R&D expenditure is targeted to reach at least 2 per cent of the country's GDP [2].

- Considerable investment and development have been incurred in different sectors such as agriculture, healthcare, space research, and nuclear power through scientific research.

- India is among the topmost countries in the world in the field of scientific research, positioned as one of the top five nations in the field for space exploration.

- The country has regularly undertaken space missions, including missions to the moon and the famed Polar Satellite Launch Vehicle (PSLV) [2].

India is likely to take a leading role in launching satellites for the SAARC (South Asian Association for Regional Co-operation) nations, generating revenue by offering its space facilities for use to other countries [2]. <https://www.natureindex.com> › indian-science-ascending

- Using PPP (Purchasing Power Parity) exchange rates, India already is the fourth largest economy in the world. India's key strengths are its large domestic market, its young and growing population, a strong private sector with experience in market institutions, and a well-developed legal and financial system [18,19,20].

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- In addition, from the perspective of the knowledge economy, another source of strength is a large critical mass of highly trained English-speaking engineers, businesspeople, scientists, and other professionals, who have been the dynamo behind the growth of the high-value service sector [18,19,20].

The United Nations Department of Economic and Social Affairs (UNDESA) conducts e-Government Survey across the globe every two years and comes out with its benchmark reports. India has made significant improvement in its e-Government Development Index from 118 in 2014. 107 in 2016 to 96 in 2018 [12]. <https://www.un.org › desa › dpad › publication>

Therefore, an analysis of the impact of evolving technology on e-governance in India provides a critical understanding of the implications of the digital revolution for developing countries and countries in transition.

## 2. Research Question/Problem Statement

Globally, e-Governance Developments (EGDs) are still progressing. Developing countries like India with a large population and distributed administrative structure, face many challenges towards this progression [9].

The key objective of this paper is benchmarking various agencies of the government of India on their e-Governance-Service delivery performance. This paper explores the EGD scenario in India and benchmarks it as per national standards using the UNDESA survey framework carried out by the United Nations. India faces many constraints like other developing countries and shows low indices on certain parameters [5]. The paper analyses the grounds for this tardy growth. The paper locates the lacunae in the e-Governance system of India. The results of this study can help strategize EGDs especially towards interoperability and integration issues. It is this perspective, plus the fact that the paper sets out to consider the implications of the Digital revolution for developing countries and countries in transition, which provides its unique approach. This paper attempts to ensure that the developing country perspective is clearly articulated.

## 3. Research Methodology

This paper presents a four-stage Digital Government Evolution Model comprising Digitization (Technology in Government), Transformation (Electronic Government), Engagement (Electronic Governance) and Contextualization (Policy-Driven Electronic Governance) stages; provides evidence in support of this model drawing upon the study of Indian Digital Government literature in published between 1990 and 2020.

The paper uses the Digital Government Stage Analysis Framework to explain the evolution, implementation, impediments, and forecasts for the future. The framework is based on the Online Service Index (OSI) of UNDESA e-Government Survey and further customized for the Indian federal structure and e-Governance landscape of the States and Union Territories of India. The parameters identified for assessment are from the service recipient perspective and therefore focused on citizen centric approach.

This assessment framework is applied as a benchmarking tool to evaluate common services provided to citizens (G2C), business users (G2B) and government departments (G2G). These services under the identified focus sectors of Finance, Health, Social Welfare, Education, Labour & Employment and Environment which are considered core departments and are provided by all States and Union Territories and respective Central Ministries.

As the paper consolidates a representative body of the Digital Government literature in India, it could be also used for defining and integrating future research in the area.

## 4. e-Governance in India

e-Governance comprises the use of information and communication technologies (ICTs) to support public services, government administration, democratic processes, and relationships among citizens, civil society, the private sector, and the state [31, 28].

### 4.1. Stage-1: Digitisation

Electronic governance or e-Governance is adopted by countries across the world. In a fast-growing and demanding economy like India, e-governance has become essential [24].

<http://www.mit.gov.in/content/informationtechnology-act>

The rapid growth of digitalization has led to governments the world over introducing and incorporating technology into governmental processes. Electronic governance or e-governance can be defined as the usage of Information and Communication Technology (ICT) by the government to provide and facilitate government services, exchange of information, communication transactions and integration of various stand-alone systems and services [2]. In other words, it is the use of technology to perform government activities and achieve the objectives of governance. e-Governance can take place in four major types of interactions: **Government to Government (G2G)** **Government to Citizen (G2C)**. **Government to Businesses (G2B)** **Government to Employees (G2E)**

The launch of National Satellite-Based Computer Network (NICENET) in 1987 and subsequent launch of District Information System of the National Informatics Centre (DISNIC) programme to computerize all district offices in the country for which free hardware and software was offered to the State Governments to provide the requisite impetus for e-governance, may be considered as the first phase. e-Governance thereafter developed with the growth of technology [13] [http://arc.gov.in/11threp/ARC\\_11th\\_report.htm](http://arc.gov.in/11threp/ARC_11th_report.htm)

#### 4.1.1. Stage 2: Transformation

The Transformation Stage is in principle internal to government organizations and how they interact with each other. The main mechanism to carry out such improvement is technological and organizational innovation, including a fundamental rethink of what a technology-enabled government, organization or sector does or should do in digital terms and how to align its business and technological developments. The main enabler to carry out such improvement is the digital and technological environment, including related capabilities and structures, established as part of the Digitization Stage [8].

Through e-governance, government services are made available to citizens and businesses in a convenient, efficient, and transparent manner. Examples of e-governance include Digital India Initiative, National Portal of India, Prime Minister of India portal, Aadhar (Unique Identity Number), Filing and payment of taxes online, Digital land management systems, Common Entrance Test etc [13]. <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>

The National e-Governance Plan approved in 2006 has made progress through Mission Mode Projects and Core ICT Infrastructure [13] [http://mit.gov.in/sites/upload\\_files/dit/files/Compendium\\_FINAL\\_Version\\_220211](http://mit.gov.in/sites/upload_files/dit/files/Compendium_FINAL_Version_220211). Today, there are a large number of e-Governance initiatives, both at the Union and State levels [13]. <https://www.scribd.com/document/44296404/E-Readiness-Report-202008> The second phase of the e-Governance programme to transform India into a digitally empowered society and knowledge economy is transformational in nature and meant to ensure that all government services are available to citizens electronically [24]. [http://www.mit.gov.in/sites/upload\\_files/dit/files/DraftEDSBill\\_11042011.pdf](http://www.mit.gov.in/sites/upload_files/dit/files/DraftEDSBill_11042011.pdf). It also brought in public accountability through mandated delivery of government's services electronically [13]. <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>

### 4.1.2. Stage 3: Engagement

In 2006, the **National e-Governance Plan (NeGP)** was formulated by the Department of Electronics and Information Technology and Department of Administrative Reforms and Public Grievances that aimed at making all government services accessible to the common man, ensure efficiency, transparency, and reliability of such services at affordable costs to realise the basic needs of the common man [12]. [http://www.mit.gov.in/sites/upload\\_files/dit/files/documents/12th\\_Nov\\_NAG\\_261110.pdf](http://www.mit.gov.in/sites/upload_files/dit/files/documents/12th_Nov_NAG_261110.pdf)

The NeGP has enabled many e-governance initiatives like: **Digital India** was launched in 2015 to empower the country digitally. Its main components are:

1. Developing a secure and stable digital infrastructure
2. Delivering government services digitally
3. Achieving universal digital literacy.

As on 31<sup>st</sup> May 2021 there are a total of 3,836 integrated e-services that the Government of India offers. However, a significant achievement is imparting sensitization on the importance of service delivery effectiveness and promoting participation of all Departments and Ministries at state, and Central Level to adopt the e- Government framework in their day-to-day functioning to reinforce the vision Of MINIMUM GOVERNMENT AND MAXIMUM GOVERNANCE.

### 4.1.3. Stage 4: Contextualisation

The Contextualization Stage includes responding to the changing needs and aspirations of the society, supporting self-governance for local communities to be able to govern themselves with no or little interference from government. Digital Government innovations employed at the Contextualization Stage include – emergency assistance and community response grids, usually through mobile apps, during disasters. For instance, the 112 India has buttons for 4 major Emergency Alert Options- Fire, Medical, Police & Other with a google map to pinpoint the location of the user. ‘MyGov Corona News desk’ and ‘Arogya Setu App’ provides all statistical updates on COVID. Mobile collaborative transport and social transport apps, for example ‘m-Indicator’ App provides live train & bus tracking in select Indian cities. There are public services for vulnerable groups, digital social innovation and outcome-based funding, remote and self-health monitoring apps. For crime mapping and crime hotspot monitoring, GIS (Geographic Information System) helps to identify such spots and analyse crime incidence patterns [12]. <http://mit.gov.in/content/framework-mobile-governance>

Developed over more than two decades of technology innovation and policy response, an assessment of e -governance in India shows that the greatest investment and progress have been made in enhanced public services and improved government operations [5]. [http://www.nisg.org/knowledgecenter\\_docs/A01000001.pdf](http://www.nisg.org/knowledgecenter_docs/A01000001.pdf)

Policy development has moved forward on several fronts, but new policy issues continually add to an increasingly complex set of concerns. The least progress appears to have occurred in enhancing democracy and exploring the implications of e-governance for administrative and institutional reform. ICT-enabled governance will continue to evolve for the foreseeable future providing a dynamic environment for ongoing learning and action [8]. <http://www.scopus.com/inward/record.url?eid=2-s2.0-70349160519&partnerID=tZOtx3y1>

### 4.1.4. Limitations of the 4-stage Digital Government Evolution Model

First, is the tension between the sharp logical characterization of different stages of the Digital Government Evolution Model and the fuzzy and complex nature of some Digital Government initiatives.

Second, the subjectivity of the classification into stages; as some borderline cases may cover more than one stage, the classification only demonstrates generic developments.

Third, unlike the stages of growth models, the Digital Government Evolution Model is not aimed at leading organizations toward higher stages of Digital Government maturity, but capturing their factual evolution at the macro level, often with different stages of their evolution co-existing in time.

## 5. Benchmarking / Qualitative Assessment of Digital services: An Analysis

The quality of state portals has been assessed on four parameters, viz., **Accessibility, Content Availability, Ease of Use, and Information Security and Privacy**. Based on the information provided by the states, to the NeSDA portal of Government of India, assessment scores for each the four parameters were calculated. Further, based on the overall score – average across all the four parameters, the States have been ranked accordingly [2].

### Sectors covered in Assessment of state portals

1. Finance 2. Education 3. Labour & Employment 4. Social Welfare (including Health and Agriculture) 5. Local Governance and Utility Services 6. Environment

Criteria for evaluating Accessibility. The criteria that were assessed are whether the website supports: • People with various disabilities (Auditory, Physical, Speech, Visual, Temporary Disabilities, People with Limited Bandwidth, etc.) • Multi-Lingual support • Compatibility with multiple devices • Compatibility of website with various search engines and resolutions, etc. • Compliance standards of the website • Multi-Media compatibility (Videos, Audio, Images and Animations, etc.) • Creation of personal Login profiles to avail the service • Provision to upload documents with online/offline support.

Criteria for evaluating Content Availability. The criteria that were assessed are whether the website has: • Presence of Reliable content • Availability of updated and relevant information • Presence of Timestamps and Sitemaps • Presence of Help and FAQ sections • In line with the various policies (Copyright policy, Open data policy, etc.) • Availability of statistics and factual data on the website.

Criteria for evaluating Ease of use. The criteria that were assessed are whether the website has: • Availability of essential, enhanced, and advanced features • Presence of user manuals, ‘how-to’ guides to avail the services • Efficiency and effectiveness of the website • Availability of internal workflow mechanism and service delivery charters • Presence of What’s New sections • Complaints resolution mechanism • Comfort and acceptability level of users

Criteria for evaluating Information security & privacy. The criteria that were assessed are whether the website has: • Been hosted on HTTPS protocol • Security policy to safeguard the user data • Mobile and email alerts during unauthorized changes to user profiles • Compliance with GIGW and W3C • Carried out TPA (Third Party Audit) for online security • Presence of copyright Statements and disclaimers.

### 5.1. Assessment Methodology

The assessment was done in 4 stages.

- Stage 1 - Basic Data Entry

In this stage, the uploaded URLs for the mandatory services from 6 identified sectors was examined. The services considered for this stage of data entry were in the Government to Citizens (G2C) (Citizen Services) and Government to Business (G2B) (Small Business Services) categories.

- Stage 2 – Review of Basic Data Entry

In this stage, the URLs uploaded were examined to verify whether the service links were functional.

- Stage 3 - Detailed Portal/ Service Questionnaire

In this stage, assessment questionnaires for the approved portals and services were given to the SPOCs (Single Point of Contact) of the Departments. They had the option to choose ‘Yes’, ‘No’ or ‘Not Applicable’ for each of the questions in the assessment questionnaire.

- Stage 4 - Review of Detailed Portal/Service Questionnaire Responses

In this stage, the responses to questions submitted by the SPOCs in Stage 3 were reviewed.

## 5.2. Calculation Methodology

**Binary Evaluation method.** Each parameter had specific numbers of questions. The responses submitted (Yes, No, Not Applicable) were evaluated in the binary mode (Accept / Reject). **The number of questions in each parameter for Services** were Accessibility (19), Content Availability (12), Ease of Use (11), Information Security and Privacy (8) **The number of questions for the portal**, was Accessibility (11), Content Availability (9), Ease of Use (13), and Information Security and Privacy (9)

The table below indicates the scores when a particular response is accepted or rejected. When a 'Not Applicable' is accepted, the total count (base) gets reduced by one. The scores for a particular service, across all parameters, were calculated in this manner.

**Table 1**

#	Response	Accept	Reject
1	Yes	1	0
2	No	0	-
3	Not Applicable	C-1	0

C indicates the total number of questions for the respective parameter.

**Step 1: Calculation of Score of an Assessment Parameter 'P' across all service portals of a sector.**

$$SP = \frac{RPY}{(QP - RP-NA)}$$

Where

- SP = Score of Parameter 'P' of a sector
- QP = No. of Questions under Parameter 'P' across all service portals of that sector
- RP-Y = Sum of Responses with Yes (Yes = 1) under Parameter 'P' across all service portals of that sector
- RP-NA = Total number of Responses with 'Not Applicable' under Parameter 'P' across all service portals of that sector

**Step 2: Calculation of Overall Score of a Department for a Sector.**

$$\text{Overall Score (OS)} = S1 + S2 + S3 + S4 + S5 + S6 + S7$$

Where

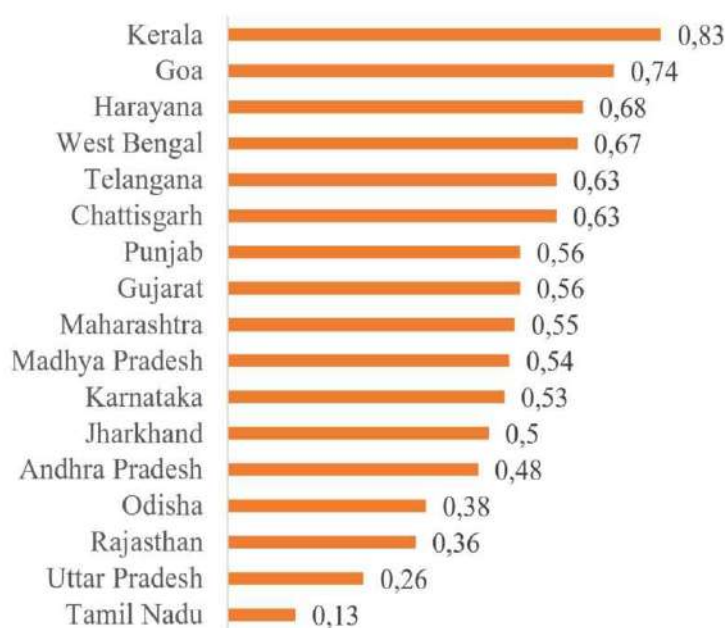
- S1 = Score of Accessibility Parameter of that sector
- S2 = Score of Content Availability Parameter of that sector
- S3 = Score of Ease-of-Use Parameter of that sector of that sector
- S4 = Score of Information Security & Privacy Parameter of that sector
- S5 = Score of End Service Delivery Parameter of that sector
- S6 = Score of Integrated Service Delivery Parameter of that sector
- S7 = Score of State and Request Tracking Parameter of that sector

**Step 3: Ranking of States within a sector:**

- a) Calculate the Overall Score of each State
- b) Sort the States in descending order of the Overall Score with highest overall score ranked as '1', and so on.

### 5.3. Assessment of states across all parameters

The overall assessment score of the state portals is depicted graphically below:



**Figure 1:** Assessment of Select states (India)

Kerala, Goa, Haryana, and West Bengal are leading state portals with more than 65% compliance to the criteria assessed across all the assessment parameters • States have higher compliance to the criteria assessed in Ease-of-Use parameter compared to other parameters

Note: India has 29 states (federating units) & 8 Union Territories (Union Territory is a small administrative unit that is governed by the central government). 8 North Eastern states and Himachal Pradesh (Northern state) and the 8 UTs have not been included in this list. 2 states had not provided adequate data. However, this is a representative study meant to analyse the efficacy of e-Governance in India in a brief and concise Research Paper.

#### 5.3.1. The analysis of the state portals on the four assessment parameters is mentioned below:

##### Key Observations

Accessibility • Gujarat, Kerala and Rajasthan are the leading state portals with more than 60% compliance to the criteria assessed under this parameter.

Amongst the other States in this category, four States have their portals with compliance between 50% to 60%, nine States have compliance between 25% to 50% to the criteria assessed under this parameter.

##### Content Availability

Kerala, Chhattisgarh, Goa, Punjab, and West Bengal are the leading state portals with more than 75% compliance to the criteria assessed under this parameter • Five States have their portals with compliance between 50% to 75%, while six States have their portals with compliance of 25% and lower to the criteria assessed under this parameter.

##### Ease of Use

Haryana, Kerala, and West Bengal are the leading state portals with more than 90% compliance to the criteria assessed under this parameter • State portals of ten states have compliance between 50% to 90% to the criteria assessed

### Information Security & Privacy

Goa, Gujarat, and Kerala are the leading state portals with more than 75% compliance to the criteria assessed under this parameter • State portals of seven states have compliance between 50% and 75% and four states have compliance between 25% to 50% to the criteria assessed.

## 5.4. Citizen Survey Assessment

The Citizen Survey was conducted to determine the satisfaction levels of respondents based on their experience in availing e-services in **one state**, the state of Maharashtra, which has a population of **126.2 million**.

### 5.4.1. Parameters

The respondents were requested to rate the following criteria for the assessment of e-services:

- a. Ability of the portal to support multiple languages
- b. Updated information on the portal
- c. Search feature on the portal
- d. Online payment facility of the portal
- e. Tracking of eService applications and grievances logged
- f. Alerts due to unauthorized changes in user profile
- g. Availability of e-Services within specified timelines on the portal
- h. Access to the portal through multiple devices
- i. User feedback facility on the portal
- j. e-Services User Manual on the portal
- k. Social media integration of the portal
- l. Status updates and alerts for e-Services
- m. Password recovery and reset facility on the portal
- n. Availability of end service online without manually visiting a government office/Kiosk

### 5.4.2. Methodology

The survey was launched on 25<sup>th</sup> April 2021 and closed on 25<sup>th</sup> May 2021. The sample size of the survey covering online service users and non-users was **3229 respondents**.

### 5.4.3. Key Inferences

1. A vast majority of the respondents were aware of the e-services available and 86% of the respondents had availed at least one e-service, highlighting the success of awareness efforts undertaken by the Government in this regard.

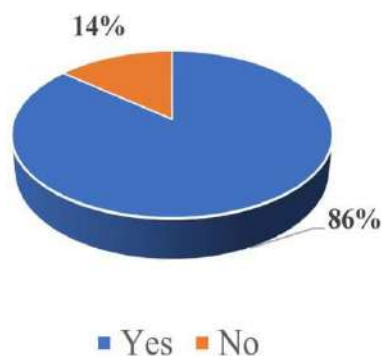


Figure 2

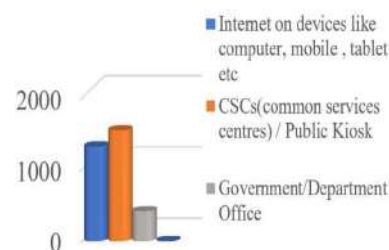


Figure 3



2. CSCs/Public Kiosks emerged as the most preferred choice of availing e-services, closely followed by access through computer/mobiles etc., clearly underlining the importance of focus on both physical and digital availability. Respondents preferred e-services over manual services owing to a more favourable experience with respect to all three factors of Cost, Time, and Effort.

3. Finance, Local Governance & Utilities were the sectors in which citizens availed e-services the most.

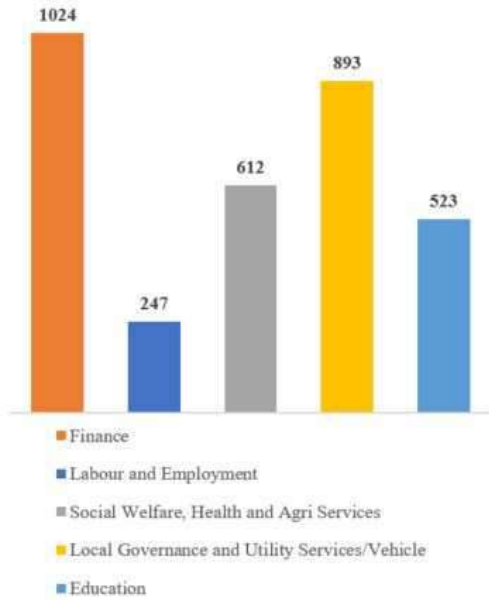


Figure 4: Sectors in which. citizens availed e-services the most

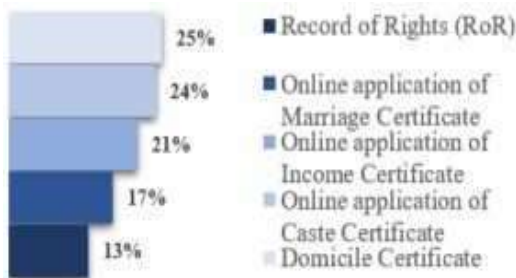


Figure 5: Finance

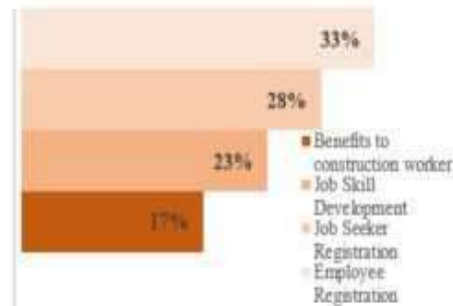


Figure 6: Labour & Employements

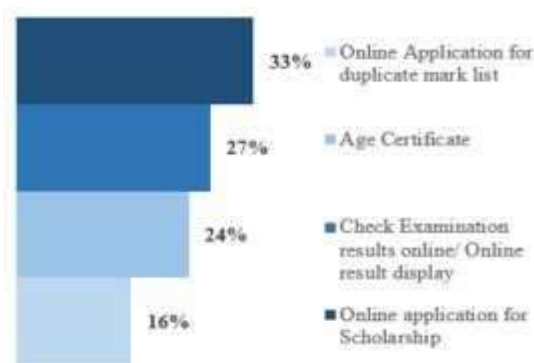


Figure 7: Social welfare, health and agriculture

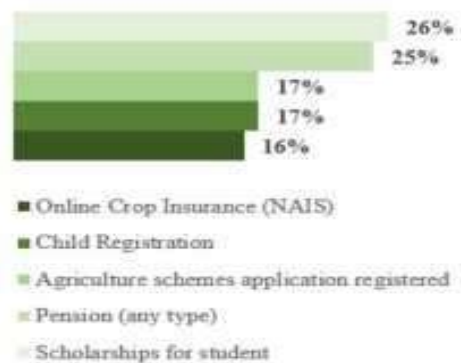


Figure 8: Education

4. In the Finance sector, the services availed are Record of Rights (RoR), Online application of Marriage Certificate, Online application of Income Certificate, Online application of Caste Certificate, Domicile Certificate. Domicile Certificate tops the list of most availed e-service followed closely by Online application of Caste Certificate.

5. In the Labour and Employment sector, the services availed are Benefits to construction worker, Job Skill Development, Job Seeker Registration, and Employee Registration. Employee Registration tops the list of most availed e-services followed closely by Job Seeker Registration.

6. In the Social Welfare Health & Agriculture Sector, Scholarships for students and all types of pensions emerged as the most opted for e-services.

7. In the Education sector, the most availed e-services included online application for scholarships and checking of examination results.



Figure 9: Environment including Fire Management



Figure 10: Local Governance & Utility

8. In the Environment sector including Fire Management, the most availed e-service was application for initial NOC or plan approval for building permit.

9. The most availed e-service in Local Governance & Utility Services category, was application for birth certificate followed by e-payment of electricity bills.



Figure 11: Gender Based Usage

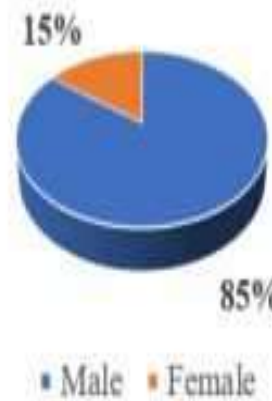


Figure 12: Educational Background

10. Of the total respondents who had availed at least one e-service offered, 85% respondents were male and 15% were female, which indicates a need to increase focus on awareness and engagement of female citizens.

11. Of the total respondents who had availed at least one e-service, 40% of them were graduates followed by the number of citizens who had studied up to Class 12: 25%, up to Post Graduation: 18%, and up to Class 10: 16%.

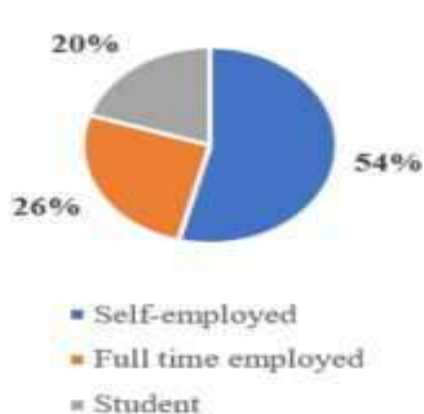


Figure 13: Age Based Usage

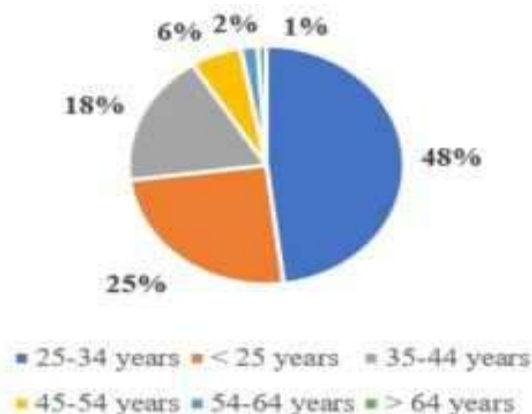


Figure 14: Occupation and Annual Income Range

12. The survey findings highlight that a younger citizen base (25-34 years) was the most willing to opt for e-services. Youth <25 years also showed a preference for e-services. However, with increasing age, fewer citizens opted for these services.

13. Of the total respondents who had availed at least one e-service as per the occupation and annual income range, most citizens were either self-employed or employed full-time, with an annual income range of more than INR 2,50,000 (\$3431.47). The income range was factored into the questionnaire.

## 6. Problems, Issues that remain unresolved in e-Governance in India

**1. E-Governance in E-Governance:** e-governance is not merely about technology; it is about reform. In a country with a huge digital divide, no culture of participatory governance and high rates of digital illiteracy, it was unrealistic to design programmes without these considerations and expect a positive response. Poor work culture and lax supervision resulted in web sites that were not regularly updated, slow response to online queries and clarifications, and online transactions that were plagued by delays and errors, causing dissatisfaction among the public [5]. For example, more than 6000 e-mail complaints pertaining to income and caste certificates, pending pension amounts, and drinking water shortages were lodged through these kiosks. However, on an average only 10% of these applications were being resolved. This happened because government began engaging with their constituents in a big way without actually looking at other aspects in the value chain simply because web-based technologies could enable them to do so [4].

**2. The Silo Effect:** Merely putting up a Web-enabled front office to existing back-offices without re-engineering the internal functions and networking of the back-offices can be a recipe for disaster. While citizens could come to a centre and apply online for a pension or a caste certificate, the back-office operations in these departments were still paper based and processing of an application would take the same amount of time as before. This severely affected the quality and speed of service delivery.

**3. Vendor Driven e-Governance:** Most Project consultants or Vendors who were hired by the government fell short on quality assurance. For instance, multiple copies of Voice to Text software were bought by the government as an e-governance application and to bridge the digital divide. These copies were bought on the premise that this will ease the workload of tele centre owners. However, these copies did not reach the tele centre level. Firstly, given their limited capacity, they could reach out to only 20% of the total number of kiosks [7].

Secondly, in case of any technical difficulties, government was contract bound to approach assigned vendors only. With their limited reach, vendors took a lot of time to fix the errors in the telecentres which kept telecentres out of work for days, resulting in losses and further disenchantment.

## 7. The Way Forward

The ‘Way Forward’ is to enhance the usability and utility of the portals, which would increase the acceptance and usage of portals among citizens. The parameters chosen to create a user friendly and glitch free e-Governance system for the future would be:

**1. Accessibility:** As this parameter is important to improve user perception and participation, Web portals should be usable, accessible, well coded, and mobile-device-ready. Availability of information related to key services like state holidays, online polls, call centre numbers to enhance usability of a portal. **Adherence to W3C** (W3C: World Wide Web Consortium) & **GIGW** (GIGW: Guidelines for Indian Government Websites) compliance displayed clearly on the portal homepage is a leading international practice. Portals should be multi device compatible to adjust to various mobile devices such as Tablet, iPad, mobile phones etc.

**2. Content Availability:**

To address multi ethnicity of India, at least one regional language should be provided along with English and Hindi.

The website should be easy to find in top search engines. Hence, it should be optimized by “key words” so that its visibility increases, and people know about the services provided.

To enhance user satisfaction, provision may be made for calling feedback regarding e-services & share results of user feedback.

There should be sitemaps in every portal along with information manual and help desk number to access the services easily.

**3. Ease of Use:** 1.e-Government service delivery portals should have facilities to log Grievances & Complaints on the portal itself. 2.Innovative processes and mechanisms for service delivery, and citizen engagement as well as empowerment are essential, to make services inclusive and accessible to all groups in society.

**4. End Service Delivery:** The following improvements are suggested.

- 1) Improve End Service Delivery.
- 2) Enactment of Right to Services Act in all states thereby ensuring the service delivery timelines and standards.
- 3) Introducing convenient channels of service delivery to all citizens.
- 4) Use of Digital tools like Digi-Locker to deliver services like certificates, RC book (Registration Certificate for vehicles), etc. which may not be provided manually.
- 5) Use of Government cloud account by officers to verify the documents of citizens for all services. [3]

**5. Integrated Service Delivery:** Some improvements suggested are: 1) Availability of multiple portal navigation routes for services and information enhances accessibility and ease of use for citizens to leverage e-Government services. 2) Service delivery portals should have features to enable access to people with visual/audio/motor disabilities. 3)Multilingual support for e-Governance portal will increase ease of use for citizens as well as help in reducing digital divide in India.

**6. Information Security and Privacy:** The following improvements are suggested. 1)e-Government service delivery portals should be secured through incorporation of HTTPS (Hyper Text Transfer Protocol Secure) and/or third-party security alliances. This would increase citizens’ trust in the service delivery portal. 2) STQC compliance (Standardisation Testing and Quality Certification) displayed clearly on the portal homepage is an international practice of security assurance. 3)Disclaimer and Privacy policy must be clearly stated on all government portals to make citizens aware of the purpose of collection and usage of their data and to maintain integrity of data transactions. 4.To improve user friendliness and to assure citizens of the safety of their data, password status alerts and password reset facility must be enabled for citizens.

**Fostering active citizen participation:**

Eventually, e-government should be directed to achieve citizen-centric and most importantly the involvement of citizens in the government affairs (participatory governance) to help the citizens improve their lives and to embrace them in decision making process that affect their future well-being [7].

The following improvements are suggested.

1. A single window which enables automatic tracking of service requests is recommended. 2. The facility should be accessible from anywhere across the web, easy to use, and reduce the issue / request resolution time which increases overall productivity. 3. Offer best-in-class experience to all citizens by providing multilingual national level call centres operating 24x7 4. e-mail based helpdesks and mobile based applications to ensure that citizens can access the services in a cost-effective manner [15].

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2. The Citizen Survey Assessment was conducted by online questionnaires forwarded to citizens in Maharashtra state. 3229 citizens filled in questionnaires were found valid. The Research Team of The Mumbai School of Public Policy, of which the author is a member, were instrumental in the distribution of the questionnaires, collation, and analysis of the data.

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# Digital Communication of the Russian Political Parties: Structure and Content Features in the Eve of All-Russian Referendum – 2021

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## Abstract

The paper concerns to the analysis of political parties' digital communications structure in the pre-electoral cycle of 2021. All-Russian Referendum – 2021 will discover public support potential for the current Russian social and political courses. There is a huge possibility for the State Parliament to be changed, the political balance in the State Duma seems to be restructured. The study focused on the automated analysis of the digital markers of the parties' communication and their regulation strategies in driving online network communities. The methods of data collection and analysis are the developing of social graphs (the structure and density of user connections within social media communities) via proprietary software and cognitive mapping of political party digital content with the creation of a database and its analysis via the SPSS Statistics 24.0. The cases of empirical analysis were the political parties of the Russian Federation - participants of the Referendum – 2020. The key outcome of the study – segmentation of all online political party groups (analysis cases) into three clusters: groups regulated by online macroleaders (more than 100 leaders with more than followers in a digital group); communities managed by online microleaders (less than 100 leaders with more than 100 followers in a digital group); groups with "horizontal connections" that do not have influential influencers. For each type of community, the features of the social media communication content are defined. In conclusion, recommendations on the organization of social and media support for the activities of political parties were formulated.

## Keywords

Social media, digital communications, political parties, social graphs, online community management strategies, cognitive map of party communication

## 1. Introduction

Social Media Management is a key challenge in the development of modern political parties seeking to scale electoral support through digital communications and trying to raise target audiences on social media. The process of Russian political parties' adaptation to the digital age is extremely uneven. The greatest efforts in this area made, as a rule, by parliamentary parties with a high level of electoral potential, as well as by party actors who initially, at the time of their creation, relied on "digital citizens". A special place in this process belongs to opposition party and pro-party formations, which use the capabilities of their digital infrastructures mainly in order to mobilize protest sentiments of social media users.

At the same time, a common problem for political parties with different statuses and spectral affiliations is the problem of effective digital communications with external target groups, since in

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most cases, digital infrastructures are aimed primarily at solving the problems of retaining the nuclear electorate and communication with activists and supporters.

The second common problem for various political parties in the Russian Federation is the limited use of effective practices for converting users' digital activity into voices. The solution to these problems is in direct proportion to which strategy for managing digital communities chosen and consistently implemented by party actors.

## 2. Theoretical Review

Research areas devoted to Internet communications of political parties are as follows.

The difficulties of adapting political parties to the digital needs and expectations of the electorate reflected in the largest group of works: D. Janssen [1], U. Klinger [2], G. Mascheroni [3], etc. The use of digital communications by political parties to resolve electoral tasks is the focus of R. Karlsen's studies [4]. The concept of a hypermedia campaign introduced in D. Lilleker's and coauthors' publications [5]. B. Kalsnes identifies three disadvantages when communicating with voters on the Internet: reputation risk, negative media attention and limited resources [6]. N. Browning, K.D. Sweater explore how the media agenda, party frames, candidates' traits and communication between a political organization and the public affects for the party reputation [7].

One of the leading directions of modern scientific research in the field of studying social media influence on the development of party systems and political parties is that party actors are better adapted to the conditions of post-materialist political culture due to digital communication technologies. Thus, A. Chadwick [8] hypothesizes that parties renewed under the influence of the digital environment, since citizens involved in Internet communication transform the format of the traditional party organization, rejecting the norms of hierarchical discipline and habitual party loyalty.

The idea that digitalization contributes to the formation of a new party model is supported by P. Gerbaudo, thanks to whom the concept of "platformization" was further developed. The essence of this concept is that in the digital age, political parties repeat the organizational principles of digital social networks to scale up electoral support [9].

The most relevant foreign works relevant to the research topic also indicate the need to improve the efficiency of information flow management in social media. In particular, N. Browning focuses on how the information agenda, frames and brands in social media affect the electoral potential of political parties. Researchers emphasize the need to manage information flow and party Internet content to effective use digital communications with targeted groups. In their opinion, dysfunctions in this area course risks of an overflow of electoral votes and a decrease in the stability of the electoral base of political parties.

## 3. Research Methodology

The research methodology based on the following approaches: new institutionalism in its historical and sociological versions [10], [11], as well as network approach [12]. The new institutionalism not only allows one to describe the nature of stability / instability of the positions of actors in the party system (the historical version of the approach), but also to take into account, when analyzing the electoral potential of political parties, the search for a balance between formal and informal components in the process of brand promotion in social media (sociological version of the approach) [13], [14], [15].

The application of the network approach in this study is due to the need to solve the problem of identifying the specifics of managing the network structures of political parties in social media [16].

Based on graph theory, software was used as a network analysis tool that allows identify such parameters of networks as size, density, uniformity, strength of connectivity, stability, etc.

The presented research is based on social - media predictive analysis (hereinafter – SMPA). SMPA [17] is a research approach based on intellectual search and analysis of digital traces in social media for modeling and forecasting socio-political processes. In the Russian Federation, this direction is developing mainly by the efforts of two research groups: the team of E.V. Brodovskaya [18]



(Financial University under the Government of the Russian Federation) and the team of A.S. Akhremenko [19] (National Research University Higher School of Economics).

SMPA is applicable for monitoring, diagnostics, scenario and forecasting of processes:

- legitimization / delegitimization of a decision / actor / institution;
- mobilization / demobilization of actions of collective actors;
- escalation / de-escalation of the conflict interaction between the subjects of the conflict;
- transition of online activity to offline; - the choice of strategies for the behavior of target groups;
- changes in social well-being, moods of large audiences, etc.

Research methods.

Strategies for managing social media groups of political parties were analyzed in the process of constructing and interpreting social graphs of online network communities. The graphs reflecting the density and nature of connections within digital groups were created using the author's software "Social Graph", an attachment to the blog hosting "VKontakte". The sample set of the study consisted of 98 regional social media communities of Russian political parties, the following parties became cases -participants of the Referendum – 2020: "United Russia" (hereinafter: UR), "Liberal-democratic party of Russia" (hereinafter: LDPR), "Communist Party of the Russian Federation" (hereinafter: KPRF), "Spravedlivaya Russia" (Fair Russia), (hereinafter: SR), "Communists of Russia" (hereinafter: CR), "Party of Pensioners" (hereinafter: PP), "Rodina" ("Motherland"), (hereinafter: "Rodina"), "Party Rosta" ("Party of Growth"), (hereinafter: PR), "Patriots of Russia" (hereinafter: Patriots), "Yabloko" (Apple), "Novie Lyudy" ("New People"), "Za Pravdu" ("For Truth"), "KPSS" ("Communist Party of the Social Fair"), "Zelenie" ("The Greens), "Parnas" ("Party of people liberty"), "Party Pryamoi Demokratii" (The Direct Democracy Party), and the "Russia bez Corruptzii" ("Russia Party without Corruption"). The selection was carried out according to the principle of continuous research: all digital groups of the VK network belonging to the regional branches of the listed political parties became analytical cases.

The content of party's communication in social media with the target audience was studied using the method of cognitive mapping of social media documents of Russian political parties.

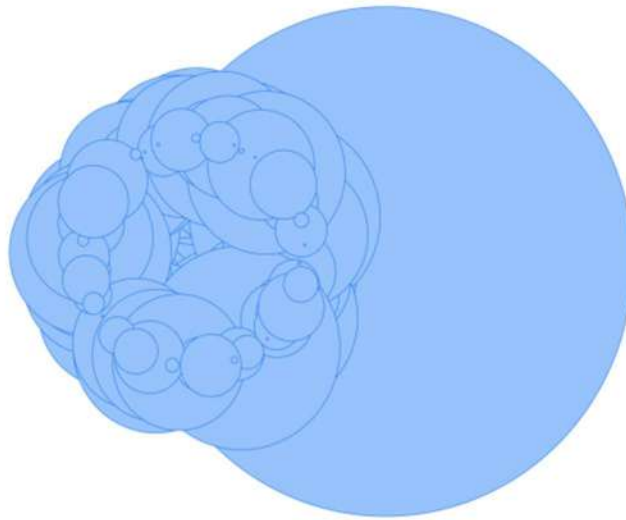
The calculation of the sample population was based on a systematic sampling method. The same parties that participated in the Referendum–2020 were selected as research cases (see above). For each of the listed parties, 2 of the most numerous social media communities of the official and unofficial type in various electronic social networks were selected: VK, Odnoklassniki, Facebook, Twitter, Instagram. For each community, the step of selecting messages with depth was calculated in the period from 08/01/2020 to 10/10/2020. The total number of analyzed documents was 1600. The logic behind the analyzed period was the possibility to study the specifics of political communication of parties with supporters in the pre-electoral, electoral and post-electoral intervals.

#### 4. Research Results

Strategies for managing social media groups of political parties were analyzed via social graphs of online network communities. The graphs reflecting the density and nature of connections within digital groups were created using the author's software "Social Graph", an attachment to the blog hosting "VKontakte". The sample set of the study consisted of 98 regional social-media communities of political parties: UR (the average number of online group subscribers is 52,558), LDPR (the average number of online group subscribers is 14,195), KPRF (the average number of online group subscribers – 26,864), SR (average number of online group subscribers – 3,787), CR (average number of online group subscribers – 3,041), PP (average number of online group subscribers - 616), "Rodina" (average number of online group subscribers - 2412), PR (average number of online group subscribers – 3227), "Patriots" (average number of online group subscribers – 673), "Yabloko" (average number of online group subscribers – 2462), "Novie Lyudy" ( average number of online group subscribers – 2483), "Za Pravdu" (average number of online group subscribers - 5132, KPSS (average number of online group subscribers – 561), "Zelenie" (average number of online group subscribers – 1007), "Parnas" (average number of online group subscribers – 5295), "Party Pryamoi demokratii" (average number of online group subscribers – 914). The selection was carried out

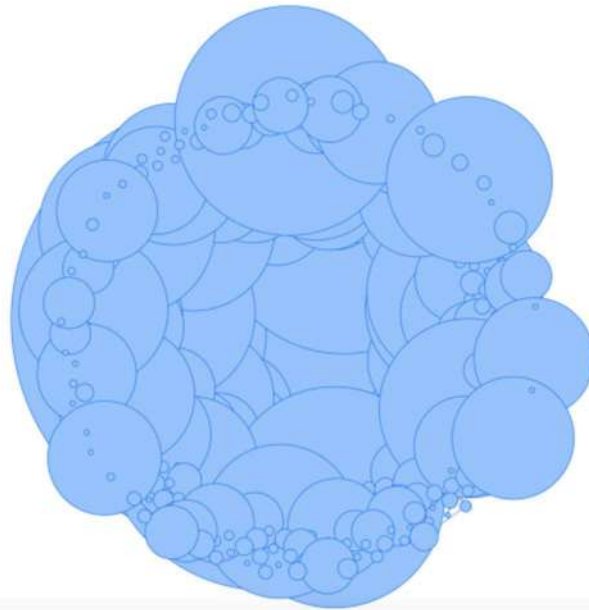
according to the principle of continuous research: all digital groups of the VK network belonging to the regional branches of the listed political parties became analytical cases.

The strategy of regulating an online group using macrosocial groups within the community is the most rarely implemented in the process of managing political parties' social media communities – Fig. 1. Only 13.1% of all analyzed digital communities showed signs of having large, influential online influencers numbering at least 100 and with an audience of more than 100 people. These subgroups within the digital community provide a high level of density of connections of the entire online group and a significant level of mobilization potential. The political party leading for this strategy is “UR”: about half of all social media communities (46.2%) identified as groups with a large number of influential influencers belong to this political party. The second position is taken by “KPRF”: 30.8% of its communities belong to the considered segment of online groups.



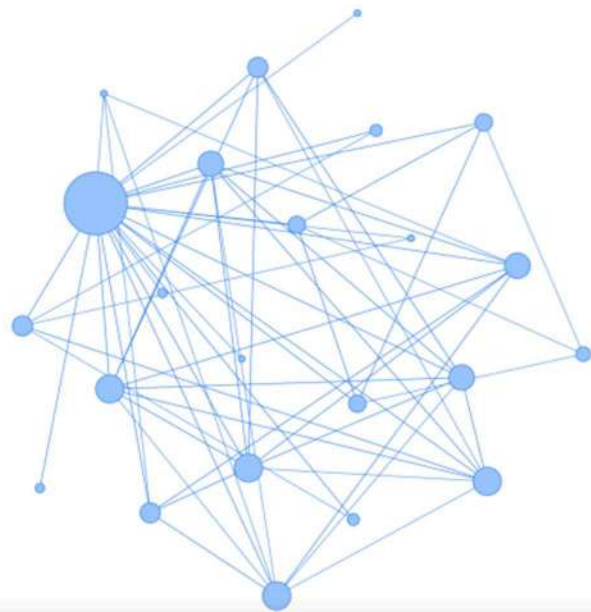
**Figure 1:** A typical graph of digital groups with a strategy: “Information impact using macrosocial groups within the community”

A more common strategy for managing social media political communities is the formation of many relatively small subgroups (from 60 to 100 people), each of which is led by one microleader (36.4% of all analyzed social media groups) – see Fig. 2. Such a community has an average density of connections and significant, but not extreme, potential for mobilizing political / civic activity. More than half of the social media groups (55.6%) in this cluster belong to two parties – “LDPR” and “KPRF” (27.8% each).



**Figure 2:** Typical graph of digital groups with a strategy: “Information impact using microsocial groups within the community”

Most often, political parties implement in social media a strategy of distancing themselves from purposeful and systematic work to strengthen ties between users of their communities see Fig. 3. More than half of the analyzed online groups (50.5%) ignore the technology of increasing the cohesion of the social media community and do not have influential microgroups with topic-starters that purposefully form the value and behavioral attitudes of community members. The political party “Yabloko” has the largest number of such communities (20.0%) of the entire analyzed segment of communities, and this strategy is also common among the online groups of “UR” (18%). A third of all communities in this cluster (30.0%), which are groups of non-parliamentary parties (“KPRF”, “Za Pravdu”, “PR”, “Rodina”), implement the strategy of neglecting systematic work with supporters in social media.



**Figure 3:** Typical graph of digital groups with a strategy: “Lack of regulation of the functioning of the community”

The structural characteristics of the relationship between online network leaders and representatives of the user audience of digital communities must be supplemented with a meaningful focus of party communication with the target audience. This will make it possible to fill with contextual meaning the techniques that political influencers use to shape the electoral attitudes and citizenship of Russians. The social media content of party digital groups was studied using the cognitive mapping method.

The cognitive map of online network party communication has shown that in the genre palette of messages from parties whose digital communities are most often regulated by means of informational influence using macrosocial or microsocal groups within the community: “UR”, “KPRF” and “LDPR” and “Novie Lyudy” are distinguished by the most non-standard content that goes beyond the typical genre repertoire. From a fifth to a third of the posts of their communities are materials of a wide variety of types: from the activities of the regional branches of the party, their successes in the field to legislative initiatives put forward by the party and the experience of tackling specific social issues in local territories. Biographical, diffuse and social technology-oriented posts should be recognized as literally isolated ones. At the same time, during the election campaign and in the post-election period, even the most successful parties in terms of social media representation ignore the genre of “life stories”, congratulatory content and the presentation of new legislative initiatives among the target audience are also rare.

According to the results of the analysis, the prevailing context of posts in digital communities regulated by leaders of macro- and microsocal groups is the problem of social welfare. Most of these party communities’ stake on discussing issues of social support for the population, obviously counting on the approval of broad strata of Russian citizens with low incomes and in need of a strong centralized system of social assistance to the population. Most often, among the groups – research cases, the context of expanding social care is articulated in the “UR” social media posts (45.1%) and “LDPR” (37.5%). Another discourse dominant of communities ruled by macro and micro social influencers is the foreign policy context, problems of Russia's geopolitical status, and its role in the development of the world political process. In this aspect, “KPRF” party dominates with 10.9% of posts on this topic. At the same time, this dimension of the electoral message to voters should be recognized as rather unpopular, since in the context of a general decrease in incomes and the quality of life of Russians during the pandemic, the demand for overcoming the inner social problems of Russian society has clearly increased, which is fully reflected in the thematic repertoire of social media communication parties during the pre-election period.

An important component of the political parties’ digital communications cognitive map is the method of influencing the target audience. In the analyzed online groups rational argumentation prevails: “UR” (67.3%) and a combination of methods of emotional and rational influence: “Novie Lyudy” (43.8%), “KPRF” (48.7%) and “LDPR” (44.8%).

Most often, party digital groups try to combine affective and rational influence to achieve the effect of the broadest targeting of their messages in social media. The achievement of the desired effect is confirmed by the data of correlation analysis (Pearson Correlation coefficients: -0.165 \* – for likes, - 0.123 \*\* – for comments, - 0.216 \*\* – for reposts). These coefficients mean that parties that use predominantly rational reasoning attract the least user resonance, and parties that rely on emotional content generate the most intense user activity.

Some social media groups, regulated by online "micro- and macro" leaders, quite often use a persuasion technique called "dehumanization", the nature of which is to dehumanize the opponent, denying the possibility of perceiving this or that political figure – the object of dehumanization from the standpoint of universal human morality. In a number of cases, the “Novie Lyudy” (17.5%) and “KPRF” (30.8%) parties are inclined to this method of fighting ideological opponents.

A special place in the opposition parties’ list is occupied by methods of emotional and rational stereotyping, a similar principle of which is the formation of social prejudice against the opponent using emotionally resonant characteristics (biography, personal qualities) or false argumentation in relation to the statements / actions of a political opponent. Emotional stereotyping is used by the “KPRF” (30.8%) and “Novie Lyudy” (30.1%). Rational stereotyping is also most often used by the “Novie Lyudy” (22.5%) and “KPRF” (15.4%).

The cognitive map of party digital communications also includes an analysis of the trigger, the event context of interaction with voters. For party communities ruled by "micro and macro" leaders,

there is a special trigger around which social media connection with supporters and potential audience is built. For example, the trigger for the arrest of Sergey Furgal (ex-Governor of Khabarovsk Region), one of the representatives of this political party. The human rights stream, formed by the "LDPR" party around the former Governor of the Khabarovsk Region, obviously has the goal of opposing the negativization of the image of a politician affiliated with the party.

Party communities that do not have influential online leaders and function on the principle of forming horizontal ties have a fundamentally different content of online communication, most often these are groups of the following parties: "SR", "Za Pravdu", "Yabloko", "Zelenie", "Rodina", "Patriots", "PR", "CR", "Parnas".

The greatest focus on political analytics for their online supporters is "Parnas" (60.0%), "Rodina" (53.6%), "Zelenie" (52.9%). Slightly less than half of all-party digital content falls on the analysis of political processes in the communities of "SR" (49.4%) and "PR" (49.3%).

Part of the communities in the cluster under consideration focuses on the coverage of the events held. The four leaders in this indicator are the "Patriots" (56.7%), "Zelenie" (41.2%), "Za Pravdu" (40.1%) and "Parnas" (40.0%). Based on a quantitative analysis of the party social media content, most often in online communities for their followers, parties post is about meetings of activists and party representatives. The exceptions are "Zelenie" and "Yabloko", which focus on the conducted actions aimed at constructing a certain social / socio-political / environmental problem. Thus, a huge part of the systemic Actors handling opposition, whose communities are most often focused on the formation of horizontal ties, is aimed at the representation in new media of political analytic content, focused on explaining the supporters of their position on certain socio-political issues. As before, reporting materials remain one of the dominants of the party content in this segment, with only the most opposition-oriented parties focusing not on party reporting conferences, but on held rallies, rallies, and flash mobs.

The leader in terms of the share of messages on the development of entrepreneurship, industry, and the economy as a whole is the "PR" party (52.2%), this context is almost twice as rare in the "Party pryamoi demokratii" – 29.5% and 23.3% in "Patriots" party, other parties either do not ignore this type of message to voters at all, or represent it extremely rarely. Thus, it is quite obvious that political parties came to the next electoral cycle with confidence in the demand for ideas of the "left ideology" in connection with the growing impoverishment of the population and a shrinking layer of voters for whom the development of entrepreneurship is an important argument to join the party's supporters.

Personal rights defense is a dominant topic for opposition party's social media content: "Zelenie" (70.6%), "Parnas" (45.0%) and "Yabloko" (25.2%). It testifies to their exploitation of triggers for mobilizing protest moods in connection with the so-called "resonant cases of human rights violation" by the current Russian government.

"Parnas" (35.0%) and "Rodina" (31.4%) parties devote digital content to the foreign policy context. Noteworthy is the fact that a big share of party communities' of "horizontal ties" social media content does not contain any problem at all, these posts do not indicate any contradiction in social life, which may be perceived by the audience of digital messages as emotionally close. Most often, without mentioning the problems to which the attention of a political party will be directed, the posts of the party "Za Pravdu" (65.2%), "PP" (44.7%) and "Yabloko" (39.0%) are published.

A significant proportion of party communities with "horizontal ties" prefer such a strategy of value influence on the target audience as "primitivization." Its essence is in the oversimplification of the perception of this or that event / decision / personality of the politician. This is an effective technique for undermining confidence in the political force in power. On a statistically significant scale, such parties as the "PP" (50.1%), "Yabloko" (26.1%), "Rodina" (22.3%).

According to the preferred methods of influence, the communities of the analyzed cluster are characterized by the dominance of affective influence on the social media audience: "Patriots" (60.0% of emotional posts), "Rodina" (59.0%), "PP" (57.4%), "CR" (50.0%). These communities of "party outsiders" use the most effective in terms of obtaining resonance – the technique of affective influence. He focuses on emotionally strong messages about social injustice, social inequality and the enormous stratification of Russian society. Emotional visualization of the plight of Russians socially unprotected is a basic technique for attracting supporters, potential voters in these digital groups.

The most popular triggers in the "horizontal link" communities for the groups of the "Yabloko" party is the case of Alexey Navalny, for "Parnas" – the Belarusian crisis. The exploitation of the

situation with Alexey Navalny and the distortion of its essence were quite intensively used by the communities of the Yabloko party during the Referendum-2020 election campaign and became more frequent in the beginning phase of the State Duma Election – 2021 campaign after A. Navalny returned to Russia and during the organization of the All-Russian protests against his arrest (40.7%). The context of the use of the Belarusian trigger by the online groups of “Parnas” is the idea of the Belarus scenario replication in Russia.

## 5. Conclusion

Summarizing the research results note that the strategy of maintaining high cohesion of the user audience can be implemented only by two parliamentary political parties – United Russia and the Communist Party of the Russian Federation, while the absolute number of regional digital communities of these parties with high mobilization potential and significant cohesion is rather small. The Russian Liberal Democratic Party social media communities and part of the digital groups of United Russia and the Communist Party of the Russian Federation are aimed at retaining the attention of their target groups in the process of informational touches of topic-starters within the framework of small subgroups. From a meaningful point of view, the digital communication of these online groups is focused on social issues, foreign policy agenda and involves the use of rational argumentation.

The social media communities of such a parliamentary party as “Spravedlivaya Rossia” (“Fair Russia”) and the majority of non-parliamentary political parties (“Yabloko” (“Apple”), “Za Pravdu” (“For truth”), “PR” (“Party of Growth”), “Rodina” (Motherland”) are characterized by the lowest density of social connections. These online groups are characterized by "horizontal connections", a lack of influential influencers in the community. These groups focus on opposition discourse, exploit triggers of high-profile human rights cases, and focus on the emotional manner in representation of social media content.

In general, the rather low level of political parties’ social media management in pre-electoral period is revealed. It increases uncertainty in predicting the results of voting for candidates for deputies of the State Duma in 2021.

At the same time, the traditionally strong positions of “United Russia”, the “Communist Party of the Russian Federation” and, in part, “Russian Liberal Democratic Party” are reinforced by the systematic work of these parties with their user audience. The rest of the parties need to activate the social media management strategy from the standpoint of strengthening the density of connections in the structure of digital communities and intensifying targeted, targeted and regular social media contacts.

## 6. Acknowledgements

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# Determinants of Digitalization in Developed Countries

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## Abstract

The work proposes to clarify the definition of the term "digitalization" and identify the determinants of digitalization using analytics and econometric analysis. To do this, first, a definition is formulated on the basis of separate copyright interpretations of the term "digitalization," which together reflects specific aspects of this phenomenon. The question of which factors are decisive in developed countries in the context of the emergence and development of digitalization is then explored.

Based on the proposed hypotheses of the study and the construction of the econometric model, the following answers to the questions raised were obtained and substantiated. First, digitalization has a positive impact on the well-being of developed countries. Secondly, at the moment, ordinary users demand such determinants of digitalization as information and communication technologies and the availability of public services in electronic format. The results obtained provide empirical confirmation of the process of transformation of information technologies at present.

## Keywords

Developed countries, GDP, information and communications technology, public online-services, digitalization potential

## 1. Introduction

Every year, the topic of digitalization, especially during the pandemic, becomes more and more relevant. The development of digital technologies and their implementation in public life requires new research to understand how this phenomenon affects the economy in general through particular ones. For example, in particular, attention to it has increased from corporate, budgetary organizations, as well as government agencies during the outbreak of the coronavirus pandemic. In addition, according to Google statistics, ordinary people are also interested in digitalization. The popularity of search queries containing the keywords "digit" or "digitalization" has remained quite high for several years.

Although scientists and experts put a lot of effort to promote the proper attitude to digitalization, there is still no unified approach to its definition or aspects of its use for today. However, there exist strong associations with gadgets, which became the part of our lives, – personal computers, smartphones, electronic watches and so on. This is not surprising because more than three quarters of American households are using one of the main digital technology gadgets, such as was mentioned above. At that time, the speed of digital technology evolution and distribution within the last 150 years is absolutely impressing. While telephone needed 75 years to reach 100 million users, the internet reached the same result for only 7 years [1]. The reason for such high tempo of technology diffusion is mainly explained by the reduction of costs on their use. The change in the international call costs from 1930 is the best illustration for this fact (Figure 1) [2].

Thus, the facts mentioned above point out the availability of a standard set of digital technology, which are not only the catalysator of digitalization promotion and further evolution of more complex

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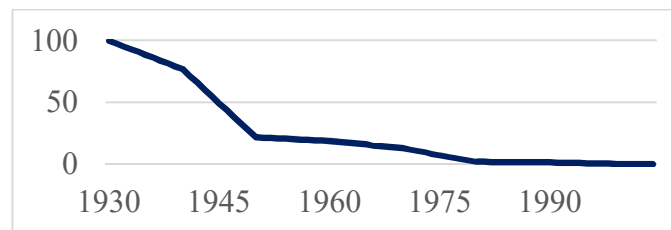
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technology, but also support significant technological transformations related to numerous spheres of our life. All this indicates the relevance of this study.



**Figure 1:** International calling costs from New York to London (relative to 1930), %

## 2. Use of digital technology

In terms of social relations invention of smartphone and cheap mobile internet caused a boom of social networks and messengers, which rapidly became a part of our everyday life and, hence, turned upside down our beliefs about sociocultural interaction.

Business made its contribution to digitalization, too. The internet expansion served as one of the major factors of its active evolution lately. First of all, the new trend of e-commerce was born. It allows customers to purchase goods at lower prices in comparison with classic retailers not even leaving their house. At the same time, sellers get the opportunity to save significant amounts of money on keeping offline stores. Secondly, now it is much easier for entrepreneurs to advertise their goods and services and look for clients through the new channels – websites and pages in social networks. This kind of approach reduced entering barriers into creation of their own business for novice entrepreneurs and cut marketing expenses for existing companies. An illustrative example is the largest online-retailer Amazon. This company, which not only realized its potential thanks to digitalization, but, in many ways, is at the forefront of its development, investing tens of billions of dollars in research and innovative developments [3].

Despite the fact that creation of all developments related to digitalization and its evolution became real owing to the work of scientists, further implementation of digital technology and advanced methods of collection and processing information allowed to boost science at a new level. First computers in universities simplified the process of research a lot: many operations were automatized, and calculations accelerated. Moreover, growth of the internet network opened an access to vast variety of data sources and databases and gave an opportunity of cooperation and experience sharing with abroad colleagues. To add more, the sphere of education was affected by the colossal breakthrough: it became able to get all necessary knowledge studying via open online courses from world leading universities.

Let us restate that many types of digital technology are a part of our everyday life, and scientists and developers all over the world hold even more researches and experiments. Yet, only now we start to assimilate it and identify the process of digitalization as a part of something great and very meaningful, namely, the Fourth Industrial Revolution. A lot is told about it by famous economist, founder and president of the World Economic Forum Klaus Schwab in his eponymous book.

Nevertheless, for the purpose of further active and sustainable growth of national and world economies it is necessary to understand what factors play the key role in establishment of main driver of these transformations – digitalization. In next section we analyze the literature in order to get basic concepts of terminology and digitalization determinants.

## 3. Literature review, terminology and problem statement

Literature review related to digitalization allowed to point out several features in formulation of this concept. On the one hand, when we talk about digital transformation, we often think that we are talking about the usual digitization of information. On the other hand, if we are talking about the application of digital technologies (blockchain, big data processing, artificial intelligence, etc.) to a specific subject area – finance, sociology, medicine, etc. [4], then we are talking about the development of the digitalization process [5]. Sometimes we consider the process of digitalization through the prism of

destabilizing structures that are currently used by non-digital tools in socio-technical systems [6]. Thus, we will clarify the definition of the term "digitalization" taking into account the wording of different authors. Digitalization is a dynamic process in which, on the basis of digital technologies, the transformation of existing socio-technical systems is carried out with the simultaneous creation of new or transformation of existing value systems for all members of society – individuals, organizations, businesses, and the state by involving them in this process through interaction.

It follows that as a result of the digitalization process, the use of new digital tools either focuses on solving certain groups of research tasks [4, 7, 8], or develops at the level of macro relations in a rather theoretical framework without using any data [5, 9, 10], or discover digitalization on a scale of particular countries [11, 12]. However, the problem of evaluating the impact of digitalization on the economies of developed countries is still, largely, unsolved. This study is going to fulfill this blank via construction of econometrics model in the next section.

To sum up, the search for determinants – factors of influence on the development of digitalization – is the goal of this study. At the same time, the object of our research is the independent reality of digitalization, and the subject is the determinants of this fact. Since the developed countries, as a rule, are the main engines of technological progress of mankind and transformations in various spheres of the economy as a result of previous industrial revolutions, we address our research to the developed countries. Work in a such context gives an opportunity to examine precisely original determinants.

The goals of the research are following:

- To specify the definition of the term “digitalization” on the base of other authors’ definitions;
- To identify the determinants of digitalization based on econometric analysis.

#### 4. Data and methodology

Let us take into consideration the fact that availability of digital technology played a crucial role in their establishment and dynamic increment of digitalization potential. Hence, it is logical to make the following assumptions. Imagine that the “starter pack” of digital technology is rather costly, or the access to it is associated with a range of special restrictions, such as signing of non-disclosure of information agreement or use of this technology within a strictly stated regulation. Presumably, that kind of approach would leave the access to digital technology among the small group of interested parties – scientists, military and large transnational corporations, – rather than allow distributing them broadly. Taking into account that determinant (after the Greek “determi nans, ntis” – defining) is a factor that conditions different actions or phenomena (in particular, digitalization), the preceding argument is considered to be necessary and sufficient for highlighting availability as one of the determinants of digitalization.

For detecting the other determinants of digitalization, it is needed to clarify some key ideas of the research. The group of developed countries might vary depending on selection criteria and methodology. Therefore, in order to avoid disagreement, within the framework of this study, developed countries are understood to be those who are given the appropriate status in the latest version of the UN report World Economic Situation and Prospects 2018 (Table 1)

With many massive and widespread phenomena, it often happens that terms related to them begin to be actively used by native speakers in everyday life. However, the use of such neologisms does not always occur consciously, with an understanding of the meaning of the word. Especially, this applies to those phenomena that have recently appeared, and digitalization in this case is no exception. Let's figure out what this broad concept implies.

The Cambridge Dictionary defines the word "digital" as "describing information about an object recorded or transmitted by computer technology" [12]. Their colleagues from Merriam-Webster interpret the term "digitalization" in a similar way: "the process of converting something into digital form" [13]. In the book Digitalization in Open Economies [14], Michael Vogelsang also emphasizes that digitalization means "expressing information in the form of strings of zeros and ones," the so-called binary or binary code.

**Table 1**

The list of developed countries regarding un world economic situation and prospects

Australia	Cyprus	Germany	Japan	New Zealand	Slovenia
Austria	Czech Republic	Greece	Latvia	Norway	Spain
Belgium	Denmark	Hungary	Lithuania	Poland	Sweden
Bulgaria	Estonia	Iceland	Luxembourg	Portugal	Switzerland
Canada	Finland	Ireland	Malta	Romania	United Kingdom
Croatia	France	Italy	Netherlands	Slovakia	United States

These definitions cannot be considered completely incorrect, but they refer to a completely different term, which is very consonant with digitalization (digitization) and is largely associated with it - digitization (digitization). Yes, data digitization is an integral part of digital transformation, but it is far from all digitalization. Unfortunately, not everyone fully understands this difference, from where confusion arises. Many authors investigating the phenomenon of digitalization note this in their works and, as a rule, make all the necessary explanations at the beginning of the articles so that the reader is not confused about the terminology used [15, 5]. Review the major versions and make a comprehensive definition.

Parviainen et al. [16] on the basis of the studied literature give several versions of the wording at once:

1. "Changes associated with the application of digital technologies in all aspects of human society";
2. "The ability to transfer existing products or services to digital counterparts, thus creating advantages over material objects";
3. "Adapting or increasing the use of digital or computer technologies by an organization, industry, state, etc."

Hagberg et al. [4] draw attention to the fact that, using the term "digitalization," we should mean by it a dynamic and open to change concept that continues its development, rather than something formed and completed. Moreover, it is accompanied by a wide involvement of people and organizations in the process of its formation through daily procedures of social interaction.

And finally, Yoo et al. [5, C.7] see digitalization through the prism of destructive transformations of existing sociotechnical structures, which were previously provided with non-digital means. In other words, the authors say that technological changes alone are not enough, since not all inventions have an equally significant influence on the further vector of development of society and are able to create or significantly change an established system of values. As an example, the introduction of digital switching by telecom companies in the 1970s and a digital camera are compared. Both technologies made a significant contribution to the evolution of technological progress, but, obviously, only one of them was able to change the appearance of modern society.

Given all the features of digitalization on which researchers emphasized, we can conclude that that digitalization is a dynamic, open process during which the fundamental transformation of existing sociotechnical structures takes place with the simultaneous creation or change of an established value system by increasing the use of digital technologies by all members of society - individuals, organizations, the state - and their active involvement in this process through daily interaction.

Thus, digitalization is a new, non-standard and rather large-scale phenomenon, and it is understood intuitively that this topic should be studied comprehensively. However, the number of problems arises in attempts to build a correct model evaluating the impact of digitalization on economic development.

In our study, we will take GDP per capita as an endogenous variable (in constant 2011 prices in international dollars). The choice of this variable is explained by the presence of the impact of any technological revolution on economic growth. This indicator serves as a rather adequate proxy of economic development because it expresses the average amount of goods and services per one citizen. Therefore, the higher the indicator the better. Furthermore, the values in international dollars allow comparing standards of living among different countries due to adjustment of real GDP per capita for purchasing power parity.

When choosing regressors, we followed the following arguments. On the one hand, the use of expanded massive of separate regressors in the model would lead to its overload: loss of degrees of freedom and, as a consequence, significant deformation of the coefficients estimates. On the other hand, selection of some limited set of regressors would make the model unrealistic. The optimal solution to this problem is the use of indices related to digitalization as regressors. In that case, the exogenous variables cover the wide range of aspects of digitalization not overloading the model. Undoubtedly, this is an advantage of exploiting such approach.

Also it is important to mention that the indices are constructed for various purposes by different organizations. That is why some of the sub-indices might be identical or contain similar indicators in them. It might directly lead to appearance of multicollinearity in the model and biased evaluation of coefficients. To avoid this issue, the selected indices were adjusted in a way that no correlating patterns were left in these indices. The methodology of indices calculation maintained.

Thus, the following digitalization indices are set up as the model regressors.

The first is ICT Development Index (IDI) without sub-index ICT Skills. We refused to take into account the sub-index of skills in the field of ICT in our study. Despite the fact that this skill is important, however, the informatization of society covers all areas of human activity for a long time. Therefore, the study of this factor in the context of this study will be incorrect.

The second is Online Service Index (OSI), the sub-index of E-Government Development Index (EGDI) that reflects the quality of access to public online-services (websites and Internet portals of ministries, social and health organizations etc.). Two other sub-indices of EGDI: Human Capital Index (HCI) and Telecommunication Infrastructure Index (TII) were dropped because the parameters coincident to TII were accounted in IDI, while HCI parameters were accounted in GII.

The third factor is the Global Innovation Index (GII) with four sub-indices - "Human Capital", "Business Complexity", "Knowledge and Technology Output" and "Creative Output". In our view, the adjusted GII almost fully reflects the potential for digitalization of the economy. At the same time, we take into account human capital, its efficiency and the effect of innovation. But to assess the net effect of this potential, we do not take into account the factors of influence of state and market institutions. Since the selected indicators are independently published by different responsible organizations, they may not coincide with each other. Thus, the data were collected in the most possible coinciding periods: 2008, 2010, 2012 and 2017. In total, the group has 144 observations "country-year".

The model is formalized as follows:

$$\ln(GDP\ per\ capita_{PPP}^{2011})_{it} = \beta_0 + \beta_1 OSI_{it} + \beta_2 IDI\_adj_{it} + \beta_3 GII\_adj_{it} + \varepsilon_{it}, \quad (1)$$

where the coefficients of all regressors are assumed to be positive and reflect a certain side of the formation of digital techniques in their micro - and macro-interaction with humans. The experience of technological breakthroughs during the period of industrial revolutions justifies our assumption about the positive impact on the standard of living of this symbiosis. We formulate hypotheses:

H1: The OSI coefficient is positive ( $\beta_1 > 0$ ).

The easier access to public services in a country, the higher the standard of living of the population.

H2: The coefficient IDI\_adj is positive ( $\beta_2 > 0$ ).

A well-developed ICT base in the country contributes to the automation of production processes, which in turn has a positive impact on increasing labor productivity.

H3: The coefficient of GII\_adj is positive ( $\beta_3 > 0$ ).

Each of sub-indices in GII adjusted reflect different features of digital technology evolution and its synergy with a human. Based on the accepted theoretical assumptions and their analysis, we can conclude that such a combination influences positively on standards of living.

## 5. Empirical results and discussion

The absolute values of each indicator vary depending on the methodology as follows: OSI - from 0 to 1, IDI - from 0 to 10, GII - from 0 to 100. Their relative value is in the range from 0% to 100%. Since multiplication by 100 and 10 of the OSI and GII indicators, respectively, does not affect the estimates of the coefficients, we apply this operation for convenience.

**Table 2**  
Descriptive Statistics

	(1) Mean	(2) Std. Dev.	(3) Min	(4) Max
OSI	66.46	18.06	28.89	100.00
IDI_adj	52.68	9.32	30.52	71.04
GII_adj	44.04	8.12	28.35	64.60
No. of obs.	144			

No. of countries: 36. Periods: 2008, 2010, 2012, 2017.

Analysis of descriptive statistics of regressors (Table 2) shows us not the most ideal results on the achievements in the field of digitalization on the part of some developed countries. The average value is close to the 50th percentile, 2 of the top 3 indicators have values no higher than 75%, and, in addition, the gap between leaders (max) and supporters (min) is quite noticeable. All of that demonstrates the existing improvement potential, which is only to be unleashed.

Although the matching patterns were removed from the selected indices as far as possible, the presence of a statistically significant correlation between the regressors is revealed by the correlation matrix (Table 3). In our case, this value is at the level of 1%, which is somewhat alarming. However, existing correlation of different degree between exogenous variables does not signal about the obligatory presence of multicollinearity. Let us make coefficients estimation and some necessary tests in Stata to prove that.

**Table 3**  
Correlation matrix of regressors

	OSI	IDI_adj	GII_adj
OSI	1		
IDI_adj	0.568***	1	
GII_adj	0.604***	0.770***	1

\*p<0.10, \*\*p<0.05, \*\*\*p<0.01

Besides the main model, the LSDV model (Least Squared Dummy Variable), which is similar to Fixed Effects, was built and estimated in order to run tests for multicollinearity and evaluate some parameters that Stata calculates incorrectly for panel data models, for example, R2 adjusted (Table 4).

Low values of VIF for the each regressor (Table 5) confirm that the minimal existing multicollinearity the model does not significantly affect the estimates of the coefficients. Therefore, the expected conclusions derived from this simulation may well be considered relevant (empirical rule: if VIF < 10, then the presence of multicollinearity in the model is not a serious problem).

The P-value of the F-statistic is below 0.05 and all the coefficients that are significant at the 10% level (one of them at the 1% level) demonstrate the overall quality of the model. At the same time, it can be noted that the hypothesis of positive coefficients with OSI and IDI\_adj is not rejected. Because improving the infrastructure of information and communication technologies and the availability of public services online undoubtedly have a positive impact on improving the social well-being of developed countries.

**Table 4**  
Results of model coefficients estimation

	(1) Panel FE		(2) LSDV	
OSI	0.0010*	(0.0543)	0.0010*	(0.0543)
IDI_adj	0.0045***	(0.0110)	0.0045***	(0.0110)
GII_adj	-0.0027*	(0.0015)	-0.0027*	(0.0015)
R2 overall	0.3298			
R2 between	0.5273			
R2 within	0.2108			
R2_adj			0.9730	
F-statistics	9.3487		136.5403	
p-value(F)	0.0000		0.0000	

Standard errors are represented in parentheses

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

The hypothesis that the coefficient of GII\_adj is positive is rejected. This can be explained as follows. Our assumption of a positive relationship between the development of technology and knowledge and living standards suggested achieving economic growth in the long term and did not take into account the fact that any technological innovations and the associated retraining of specialists have the practice of paying off not at the time of innovation, but after some time. This phenomenon is known in economic theory as an investment lag.

**Table 5**  
VIF values for regressors

Regressor	VIF
OSI	3.81
IDI_adj	4.20
GII_adj	5.59
Average	4.53

In summary, digitalization has a positive impact on the well-being of developed countries, but at the moment, the key drivers of digitalization growth are simpler and more understandable information and communication technologies and the availability of public services in electronic form.

## 6. Conclusion

By the end of the study the following results are obtained. The decisive factors of emergence and evolution of such a large-scale phenomenon as digitalization were considered. The accent of the research was made on developed countries for the purpose of detecting the most important pure determinants of digitalization. The definition of the term “digitalization” was specified and improved on the basis of other authors’ works in a way that it reflects all the aspects of this phenomenon. It was shown that in modern science digitalization is examined in a framework of practical works with differentiation into levels “individual – company – industry – country”, and in a framework of theoretical and methodological works.

At the stage of analytics and econometric analysis, the goals of the study were achieved: the concept of digitalization was clarified and the desired determinants of digitalization were determined. Based on the simulation results, you can draw the following conclusion: Developed countries are currently undergoing a transformation of information technology and acquiring the necessary knowledge to manage it. However, this stage is accompanied by certain investments that have not yet paid off. Therefore, the result of our study demonstrates the fact that progress in these areas of processes, caused by a one-time increase in the GII\_adj indicator (adjusted Global Innovation Index), which takes into

account human capital and its effectiveness in conjunction with the introduction of innovation, leads to a slight decrease in real gross domestic product per capita by 0.27%.

At the same time, this decline is offset by successes in other areas. Thus, the specific growth of the OSI (Online Service Index), reflecting the quality of access to public online services and the IDI \_ adj (adjusted ICT Development Index), reflecting the level of development of the ICT base of the country, lead to a cumulative growth of real GDP per capita by almost 0.55%. Clearly, this is more than enough to cover the undisclosed potential of progressive innovation.

Thus, digitalization positively affects the well-being of developed countries, but at the moment, simpler and more understandable technologies for common users are a key driver of growth in the framework of digitalization.

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# Digital Government Services Development Vector Assessment: Case of St Petersburg, Russia

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## Abstract

The article presents the results of two surveys in 2021 on government electronic services. For a detailed analysis of the digital government services structure and features use, polls were conducted among representatives of the St. Petersburg authorities as well as citizens. During the research, the levels of services use were determined, the advantages, disadvantages of the current state of services for users were identified. The interaction social environment between citizens and authorities using the services was analyzed separately. The initial perception and attitudes of citizens in electronic interaction have been determined. Based on the article results, ways of developing services to increase public confidence are proposed. A further research vector aimed at a detailed study of the trust parameters has also been identified.

## Keywords

e-government, smart city, political institutions, political governance, citizens' trust.

## 1. Introduction

The acceleration in digitalization has come from the COVID-19 pandemic, which has limited face-to-face interactions around the world. Currently, the availability of high-tech communications allows the introduction of remote technologies in almost all spheres of life, the pandemic together with isolation contribute to an increase in the demand for digital government services.

At the present stage, digital transformation concepts developers are paying close attention to the question how digitalization projects, which aimed at solving the pandemic problems through the electronic services and e-government, will help states, society, business [1]. They note that e-government solutions are becoming vital as they provide social distancing as well. Key benefits of e-government services include quick adaptation, efficient service and low cost scaling [2].

Despite the most important positive trends in the e-government development, the global pandemic has created many challenges for government, business, public non-governmental organizations as well as the media in the trust sphere. According to the study by the global company Edelman (Trust Barometer), the coronavirus has caused misinformation, influenced the growth of mistrust in politicians, leaders, public institutions around the world [3]. The countries have exacerbated the problems associated with the development on health, education systems, the fight against poverty and climate change, as well as effective measures to counter fake news.

## 2. Trust in Digital Services: Previous Assessment Attempts

The trust issue is one of the key problems for online services, especially in Russia, where there is an extremely low level of public trust in institutions. Among the 27 countries analyzed by Edelman in the Trust Barometer project, Russia ranks last in the spheres of public confidence in business (34% with an average value of 61%), in trust in NPOs (25% with an average value of 57%), also in last place in terms of trust in the media (29% with an average value of 51%). Moreover, Russia is in the position outsider

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in the trust in the government (34% with an average value of 53%) [4]. The low level of institutional trust largely affects the low level of public trust in electronic government services [5]. A high level of citizens' confidence in the Internet and in the Government as a whole influences positively affect citizens' e-government adoption [6].

Trust is one of the basic conditions for the acceptance and technology use [7]. The authors of recent studies note that today the electronic tools implementation problem for interaction between government and society is associated not only with digital infrastructure level development, population skills, but also with the users motivation, which is connected with trust in technological interaction [8]. So, the social interaction environment between citizens and authorities is formed from general institutional trust as well as trust in specific interaction mechanisms. Most researchers agree that there is a positive relationship between the increase in public confidence in local authorities that support the digital services functioning, also an increase in the levels of efficiency and e-government transparency [9]. Research shows that there is a clear connection between the e-government tools effectiveness and citizens' trust, where the services quality plays an important role [10].

Frequency of positive user experience, service quality and general perceptions of counterparties providing the services themselves can be the key factors for successful use. The empirical multifactor model of cybersocial trust proposed by the researchers includes the parameters trust in services, institutional, platform, information, transaction, communication trust [11].

The environment for using services should not only correspond to a certain public confidence level in the process itself, but also to the parameters that affect the trust itself. Other researchers cite the confidentiality and data security as the primary aspects affecting trust. Note that these aspects receive close attention in the electronic environment, although such attention is not paid to the archival or paper data security [12].

Thus, the interaction between citizens and authorities must be considered based on a systematic approach to the entire communication process because electronic services implementation can positively affect the social interaction environment. The functional digital tools availability for civil servants increases efficiency, transparency in decision-making and management, which in turn increases confidence in the officials' behavior [13]. At the same time, it is possible to consider the trust in Internet communication with authorities as a special trust type only until the algorithms for using Internet services become familiar, understandable, while face-to-face interaction is considered as something unusual, to which a special trust type may arise or distrust.

Since 2018, the eGovernment Center of ITMO University has been conducting surveys related to identifying assessments, determining the perception of the development vector, relevance, advantages, and disadvantages of electronic government services for interaction between government and citizens. In 2020, before the restrictions related to the coronavirus pandemic, a survey was conducted among St. Petersburg residents in order to identify the parameters of digital government services perception of interaction between the government and society, to determine the most relevant services for citizens, to assess the residents experience of use, as well as to identify friendliness environment parameters of interaction between authorities and citizens in electronic format. Then, primary data were obtained in a situation of the social deterioration and the new social threat emergence. In the course of this study, conducted in person on the multifunctional centers for the provision of state and municipal services, it was found that only 14% of the city's population do not use the Internet to interact with the authorities. In this regard, in 2021, an electronic residents survey related to the services perception was conducted and the parameters of the services use by citizens were analyzed in more detail. Also, a survey was conducted of St. Petersburg state power executive bodies employees in order to obtain expert assessments of electronic participation systems implementation. During the survey, were determined the government officials social capital developments indicators.

### 3. Research methodology

The residents survey was conducted in an online format using the Anketolog.ru system from May to June 2021. The respondents were asked to answer a questionnaire that contained parameters for assessing citizens' awareness of the available electronic mechanisms and channels of interaction with the authorities, determining the relevance, priority of electronic services for interacting with the authorities and receiving state, public, commercial services. A separate block of questions was devoted to which situations of interaction when using the Internet are affected. Also, several questionnaire blocks were drawn up to determine the citizens attitude to the existing mechanisms, their functionality and trust in interaction. Thus, the questionnaire included key parameters that allow assessing the impact of the pandemic on the trust level in the Internet, the frequency of its use depending on the goals, the citizens' assessment of the vector of service development. Note that, in comparison with the 2020 survey, it was found that in 2021 the share of those who do not use the Internet to interact with authorities decreased by half and amounted to only 7% [14].

To determine a representative sample population that makes it possible to assess the characteristics of the general population, that is, the entire population of St. Petersburg (5.38 million residents according to official data as of January 1, 2021), data on the age, sex composition of the population posted on the website of the Office of the Federal Statistics Service for St. Petersburg and the Leningrad Region were used [15]. Representativeness by gender and age was provided by the online panel of the Anketolog.ru system, which includes respondents verified in the system with fixing gender, age, location and other parameters.

As the survey results, questionnaires of 544 respondents were received, which provides a sampling error of 4.2% with a confidence level of 95%. The sample is representative by sex and age for the population of St. Petersburg. After the survey, a database in MS Excel format was obtained, with the help of which simple calculations together with visualization of the received answers were performed. SPSS Statistics was used to perform complex calculations, including correlations.

In April 2021, using the online survey method on a representative sample, a survey of the executive bodies of state power employees was conducted with the support of the Vice-Governor of St. Petersburg S.V. Kazarina. The questionnaires distributions was carried out through the official letters. The respondents filled out the electronic questionnaire on their own. The link to the questionnaires was posted on the resource Anketolog.ru, the questionnaires collection was also carried out on this resource. 354 employees took part in the survey. The sample size is proportional to the representation of the committees in the total headcount. Representatives of 43 departments, committees, inspections and services of St. Petersburg were interviewed. The sample reproduces the structure of the general population in terms of senior managers ratio including their deputies, heads of departments, departments and sectors of the executive body of state power to employees who do not occupy managerial positions. The first respondents were 25%, the second -75%. A random distribution was obtained by gender and age. Among the respondents - 64% of women, 36% of men. The age structure of the respondents was as follows: 18-25 years old - 7%, 26-35 years old - 34%, 36-45 years old - 30%, 46-55 years old - 19%, 56-64 years old - 9%, 65 and older years - 1%. As a result of such sampling, the reliability of the data obtained is 95.4%, the sampling error does not exceed 5%.

At the same time, the statements included in the survey questionnaire make it possible to analyze not only the parameters of assessing citizens' trust in interacting with the authorities through e-government tools, but also to determine the advantages and disadvantages of online interaction tools current state. Special attention in the survey is paid to the parameters for assessing social capital - to what extent, in the government officials opinion, citizens are aimed at positive cooperation, whether they have sufficient knowledge and whether they strive to solve collective problems.

After the survey completion, compliance with the sample positions was checked, then a text report and a database in MS Excel format were received. Using Excel, simple distributions and data visualization were carried out, more complex calculations (analysis of contingency tables) were carried out using the SPSS program.

#### 4. Research results

According to the survey results in 2021, it was found that the most relevant and useful services for citizens are: health and medical services (85%), services of a safe city for assistance in emergency situations and for interaction with district police (79%), as well as services for public transport passengers (73%). The least demanded services (48%) are civic initiatives portals. This distribution of services relevance has not changed compared to the results in 2020 [17], it should only be noted that all services relevance, in particular, healthcare services has grown. Thus, the pandemic has only enhanced the health and safety services relevance for citizens.

During the citizens surveys and government representatives, data was obtained on their experience of using e-government services. The respondents expressed their agreement degree with the statements on a scale from 1 to 5. For the convenience of the analysis, we will take scores 1 and 2 for the meaning "in general, do not agree", scores 4 and 5 for the meaning "in general, I agree", the value 3 will be considered neutral. The data obtained are presented in tables 1 and 2.

In general, citizens and government officials highlight the positive effects of the current state of online services for interaction between citizens and government bodies. First of all, citizens single out the information function of online tools, which allow them to quickly and better inform citizens about the authorities activities (57%), also allow more objectively identifying the opinions of St. Petersburg residents on issues of interest to the authorities (51%). Then citizens highlight the services ability improve efficiency by improving interaction between departments (37%), responsibilities distribution between departments (33%), as well as by taking into account the citizens opinion (31%). 28% and 27% of respondents agree that e-government tools increase citizens' satisfaction with the decisions they make and increase citizens' confidence in the authorities. A high share of negative answers was obtained when assessing the level of agreement with the negative effects of service implementation: 48% are confident that services do not increase the burden on employees and authorities, 49% are confident that time and administrative costs do not increase due to services, 54% are confident that the services do not complicate the processes of interagency interaction.

**Table 1**

Level of agreement with statements about the impact of e-government tools in the citizens opinion (data from 2021, E-Governance Center ITMO University, in percent)

In its current state, online tools for interaction between citizens and authorities	Level of agreement*				
	1	2	3	4	5
Allow faster and better informing citizens about the authorities activities	7	11	26	35	22
Allows to more quickly identify the citizens opinion on issues of interest to the authorities	8	9	32	30	21
Increase the efficiency of government bodies by improving the interaction of various departments	12	16	34	24	13
Increase the efficiency of government bodies due to a more competent and clear distribution of responsibilities between different departments	15	16	35	21	12
Increase the efficiency of decisions made by taking into account the citizens opinions	17	15	37	20	11
Increase citizens' satisfaction with decisions taken by the authorities	17	19	37	17	11
Increase citizens' confidence in government	19	18	36	16	11
Increase the burden on civil servants and authorities	24	24	28	15	9
Increase time and administrative costs during making decisions	21	28	31	13	7
Complicate processes of interagency interaction	26	28	31	9	6

**Note:** \* The level of agreement is recorded from 1 to 5, where 1 - strongly disagree, 5 - strongly agree

During the government officials survey results analysis, it should be noted that this group assess the positive factors of e-government tools much more strongly than the citizens. The obtained average values share is also noticeably lower.

E-government tools ability in the current state to better inform citizens is noted by 82% of respondents, 78% noted a more prompt identification of citizens' opinions. 74% of respondents believe that by improving the interaction of departments, the efficiency of government bodies increases, 64% noted that efficiency is increased due to a clear responsibilities distribution between departments, the same number of respondents agree that the decisions efficiency is increased by taking into account the population opinion. Among the government bodies representatives, there is also a high proportion of those who believe that services do not increase costs (47%) and do not complicate the interagency interaction processes (59%). It is important to note that among the interviewed employees of executive bodies of state power, a significant proportion of those who believe that services increase the burden on civil servants and government bodies (55%). It is extremely important to assess the services to increase citizens' confidence in the authorities - this was noted by 55%.

**Table 2**

Level of agreement with statements about the impact of e-government tools in the opinion of representatives of the executive bodies of state authorities (data from E-Governance Center ITMO University, in percent)

In their current state, e-participation tools	Level of agreement*				
	1	2	3	4	5
Allow faster and better informing citizens about the activities of government bodies	1	3	14	28	54
Allows to more quickly identify the citizens opinion on issues of interest to the authorities	1	4	17	31	47
Increase the efficiency of government bodies by improving the interaction of various departments	2	6	18	30	44
Increase the efficiency of government bodies due to a more competent and clear distribution of responsibilities between different departments	3	8	25	32	32
Increase the efficiency of decisions made by taking into account the citizens opinions	4	9	23	32	32
Increase the burden on civil servants and authorities	9	15	21	20	35
Increase citizens' confidence in government	4	10	31	28	27
Increase citizens' satisfaction with decisions taken by the authorities	4	11	35	27	23
Increase time and administrative costs during making decisions	23	24	26	14	13
Complicate processes of interagency interaction	32	27	25	8	8

**Note:** \* The level of agreement is recorded from 1 to 5, where 1 - strongly disagree, 5 - strongly agree

The key obstacles to the digital government services implementation now are the low trust level in the main institutions of society and the low level of Internet literacy, positive experience in using services.

In the broadest sense, trust in society can be viewed as the expectation or confidence of individuals that other social actors (both individuals and institutions) behave predictably and according to certain rules, act honestly, with a careful attitude to the interests of the individual.

The people's ability to work together for the collective purpose in the context of the social capital development has been studied in detail by the sociologist James Coleman. It is the values that are supported by members that determine the ability of each member to work for the group benefit. As a result, mutual trust arises, which is an important parameter for the well-being of the entire society. The current situation in Russia can be describe as the lack of "social capital", that is, using the term of

sociologist James Coleman, to talk about the citizens inability to work in a single team for a common goal with mutual respect [18]. In this regard, it is especially relevant to study the attitudes of power and society in relation to each other in interaction. This analysis is necessary to assess the possible effective use of services for the e-governance and territories development purpose with the citizens participation.

For a detailed context analysis of social interaction between the authorities and citizens, both polls included parameters for assessing attitudes, the level of knowledge and population attitudes towards the authorities, the problems being solved.

**Table 3**

Level of agreement with statements on the use of e-government tools in the opinion of citizens (data from E-Governance Center ITMO University, in percent)

People like me for the most part	Level of agreement*				
	1	2	3	4	5
Aimed at constructive dialogue with government authorities	8	10	36	29	17
Try to solve their personal problems, rather than solve the general problems of the municipality (region)	7	14	36	26	18
Have the necessary knowledge about the current situation and key problems of the municipality (region)	10	22	33	23	12
Have the necessary knowledge about the structure of government bodies in the municipality (region) and their activities	8	21	37	24	11
Initially configured negatively towards the authorities	14	20	38	17	12
Offer useful ideas to improve the situation in the municipality (region)	13	17	42	14	14

**Note:** \* The level of agreement is recorded from 1 to 5, where 1 - strongly disagree, 5 - strongly agree

A significant proportion of citizens believe that they are focused on a constructive dialogue with the authorities (36%) and try to solve personal rather than general problems (34%). A similar picture in the priority of answers is observed among representatives of the executive body of state power: 66% of the respondents are sure that citizens more often solve personal problems using e-government tools than the region's problems, 48% of the respondents note citizens focus on constructive interaction. More than a third of the interviewed government officials believe that citizens have the necessary knowledge about the problems of the region and the structure of government bodies. Also, about a third of citizens themselves note the availability of the required knowledge. It is noteworthy that the least popular in this block of surveys for citizens was the statement about their search for useful solutions to existing problems - only 28% of respondents agree with this statement, while among government representatives 43% are confident in the usefulness of the population's ideas for improving the situation. In the previously voiced context of general distrust, the point about the initial negative attitude towards the authorities is highlighted. Only 34% of the surveyed residents believe that they are not negative by default. This percentage practically does not differ among employees of executive bodies of state power (32%).

**Table 4**

Level of agreement with statements on the use of e-government tools in the opinion of representatives of executive government bodies (data from E-Governance Center ITMO University, in percent)

Citizens using e-government tools are mostly	Level of agreement *				
	1	2	3	4	5
Try to solve their personal problems, rather than solve the general problems of the municipality (region)	6	11	27	32	24
Aimed at constructive dialogue with government authorities	5	13	34	26	22
Offer useful ideas to improve the situation in the municipality (region)	5	12	40	27	16
Have the necessary knowledge about the current situation and key problems of the municipality (region)	7	21	31	24	17
Have the necessary knowledge about the structure of government bodies in the municipality (region) and their activities	9	22	31	21	17
Initially configured negatively towards the authorities	13	19	36	20	12

**Note:** \* The level of agreement is recorded from 1 to 5, where 1 - strongly disagree, 5 - strongly agree

## 5. Conclusions

The current state of electronic government services is characterized by a positive assessment of the information interaction between the authorities and society. On the one hand, services make it possible to inform citizens faster, better, also to identify public opinion and increase the government effectiveness through transparency, positive interaction and considering population's opinions. On the other hand, the survey conducted signals a growing burden on government officials, which may be associated with the addition of digital interaction to the existing built-in communication channels. As a result, this significantly increases the administrative burden on staff.

At the same time, today the population has a significant level of negative sentiment towards the authorities, as well as a desire to obtain personal benefits when using services, not use them for the local and larger communities' benefit. Nevertheless, the ability of services to positively influence the trust level in the authorities was confirmed. The new technology gives a chance to revise the established views of the population by creating a new communication environment and interaction rules. This is confirmed by the high proportion of respondents among citizens and employees of executive bodies of state power who have not decided how services affect the change in the trust level, in addition to those who unambiguously chose the positive impact of services on the formation of a trusting environment.

Further development of services should go through attracting the population to participate in management processes, involving them in proactive budgeting programs and territorial development, as well as developing functionality to solve larger problems of municipalities, districts and regions. This direction of services development will contribute to the formation of control over the government bodies efficiency. In the case of a positive use experience, this will increase the public confidence level in the authorities during interaction.

The service development structure should facilitate the use of the social environment positive elements, as well as strive to functionally limit its negative aspects. In this regard, the most relevant proposals are a complete transition to an interaction in electronic type, in which the main processes will not be duplicated on paper and create an additional burden on the performers. Citizens and government officials both should implement feedback systems for the functional services development in order to optimize the processes. Programs for public participation in the distribution of budgets as well as a decision-making should first acquire a sufficient number of regular participants at the local level through additional information through management companies, administrations of various levels then enlarge. Their goal should be a comprehensive solution to the municipalities and regions problems, by



building the interaction of the most active residents at state sites with the administration's support and control. Such a solution will allow using the services high potential for the solving municipal and regional problems. Ultimately, this can contribute to the digital transformation of municipal authorities in Russia, which directly through electronic services takes into account the opinions of citizens.

Further research will be devoted to identifying the most relevant local problems for citizens that can be resolved using electronic interaction services. In this analysis, should be separately identified services that are not aimed at obtaining services in electronic form, but at solving residents' local problems that require interaction between them and the authorities. The study also needs to analyze how the experience of using initiative budgeting services and a separate services functionality for solving urban problems will contribute to an overall increase in public confidence in the authorities by comparing the trust levels of citizens who regularly and actively use services to solve problems and those who do not use them. It is assumed that as a result of such a comprehensive study, a working model can be created that determines the weight for each group of problems (in the field of transport, improvement, health care, security, etc.) in the overall trust in the authorities. This will make it possible to identify the most pressing issues requiring urgent intervention, the absence of a solution to which will sharply affect the public's confidence in the authorities.

Today, there are a plenty of reasons to believe that confidence in electronic interaction will increase for some time due to the involvement of more and more users. Another reason for increasing is the further acceleration of digital development in the pandemic era and the limitations of face-to-face interaction. Although various psychosocial factors can play a negative role and leave face-to-face interaction more reliable in the residents' minds, electronic services create an opportunity for the authorities to restructure the system of interaction with citizens, make it open, transparent, and more effective. The interaction system created considering the current social interaction environment and negative and positive elements can establish strong trusting ties between the authorities and the inhabitants of the regions.

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# **Internet Psychology**



# Value Orientations in the Digital Era: Comparison of Adolescents and Parents

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## Abstract

The digital universe becomes a place where values and rules of communication are created, shaped and redefined, especially in children and adolescents. Objective. To compare value orientations of parents and adolescents and to reveal a possible role of user activity and digital competence in their value orientations. Methods. 313 adolescents aged 14-17 years and 356 parents of adolescents aged 14-17 years from five Russian Federal Districts appraised their user activity and excessive Internet use (based on EU Kids Online methodology), filled Mixed Activity Scale, Brief Index of Digital Competence, Schwartz's Short Portrait Values Questionnaire and Ten-item Personality Inventory. Results. Self-transcendence and openness to change values (benevolence, universalism, self-direction) dominate in adolescents but it is not because these values are more significant for them than for their parents but because conformity, tradition and security values are less important for them. Extraverts choose conformity and tradition less often and hedonism, stimulation and achievement more often than introverts. Higher level of agreeableness is related to higher benevolence and lower power value. Openness to experience is related to denying conformity and tradition values and to the importance of self-direction. Among the adolescents, user activity is not related to value orientations. Higher digital competence is related to weaker disposition to conformity. Among the parents, time spent online is related to power value, and combination of online and offline activities to hedonism and achievement. Among all the respondents, self-direction value is related to digital competence within the safety component. Conclusion. Data are discussed in accordance to the psychological model of digital socialization.

## Keywords

Values, digitalization, user activity, digital competence, generations, adolescents, parents

## 1. Introduction

Nowadays, the digital universe appears to be a place where values and rules of communication are created, shaped and redefined, where new digital 'cultural tools' are mastered [1], where world and one's image is transformed [2]. For children and adolescents, the Internet appears to be a place where digital socialization happens [3, 4]. And it is perhaps where they shape new values that differ from age to age, depend on user activity experience, on what a person does online and other factors. Some authors even suggest to describe a specific phenomenon of "digital childhood" as a specific historical type of the childhood [5].

According to psychological model of digital socialization [1], digital aspects of social situation of development are crucial characteristic of the development defining direction and content of child's development as well as social expectations and demands in the system of his/her relationships. Using the term suggested in the extension of Bronfenbrenner's ecological systems' model [6], there is a

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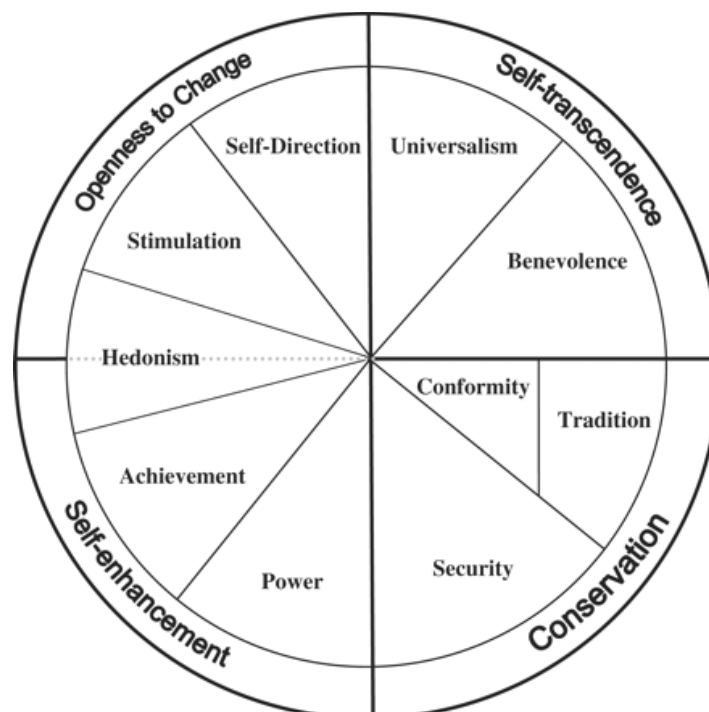
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techno-subsystem [7] that is becoming one of the most important ecological levels in the developmental perspective and that includes interactions between child, technologies and others.

However, taking into account that values and value orientations are universal in the world, digital universe raises a set of interesting questions: (1) Do values change with generations considering that these generations are going more and more digital? (2) Are differences in values between generations related to user activity and digital competence? Or maybe the differences are defined exclusively by personality traits?

For the authors of one of the most popular concepts of generations [8, 9] who offered to divide generations according to X, Y and Z classification, values and orientations act as one of criteria to differentiate generations along with social, historical and cultural factors. It is natural to assume that, by becoming a part of socialization of Z-generation children and adolescents, the digital world influences the children's value system and aspirations so that they might differ from and be unclear to the generations Y and X. Although the strict differentiation of generations based on analyzing social and cultural changes within one country is notional, the aim of comparing values of adolescents and adults and also comparing them to digital competence and user activity is a relevant task for modern studies on digital socialization of children and adolescents. The obvious difficulty for such comparisons is impossibility to differ between the role of socialization (including digital socialization) that is specific for generations and the role of age that is also important factor of values. However, such correlational comparisons could provide hypotheses for further research of values in "digital era".

The Schwartz model (see Fig. 1) provides a convenient methodology for such research that allows to assume that, for modern adolescents, self-transcendence and self-direction values are first, and conformity, tradition and security values recede into the background [10]. However, in our opinion, present value orientations, expectations for the future, and a vision of the future might be different for adolescents and youth. And their correlation is frequently left out by classical models. This especially applies to the digital universe with its changeability and transitivity, and its unapparent perspectives for further development.



**Figure 1:** Schwartz Model of Value Orientations

The aim of this study is to compare value orientations of parents and adolescents and also to reveal a possible role of user activity and digital competence in what type of values they prefer.

## 2. Methods and Procedure

### 2.1. Sample

A total of 669 participants took part in the study: 313 adolescents aged 14-17 years (129 boys (41.2%) and 171 girls (54.6%) and 13 people did not state their gender), 356 parents of adolescents aged 14-17 years (51 males (14.3%) and 276 females (77.5%) and 29 respondents did not state their gender). Among the parents, 133 people (37.4) are parents of boys, and 192 people (53.9%) are parents of girls, and 31 respondents (8.7%) did not state the child's gender. The sample comprised respondents from the following towns and cities in Northwestern, Volga, Central, Southern, Far Eastern Federal Districts: Vologda (14.9%), Kirov (18.8%), Moscow (23.0%), Moscow Region (6.7%), Rostov-on-Don (17.6%), Khabarovsk (18.8%). The parents' age varied from 29 to 65 years ( $41.99 \pm 5.78$  years). It should be noted that although the majority of parents referred to Y generation, some of them should be considered as X generation [8;9]. However, the aim of this study was to compare value orientations in adolescents (Z generation) with adults (X and Y generation). Exclusion of parents from X generation led to the same patterns of results. The sample of adolescents and parents was balanced in accordance with the place of their residence and socioeconomic status of the family.

### 2.2. Methods

The following methods were used in the study:

1. The *user activity* was appraised in accordance with the methodology of EU Kids Online [11] and Russian Kids Online [12] and included items on how much time children and adolescents spend online during the week and over the weekend. The answers to the questions were evaluated according to the scale from “Almost do not spend” to “12 hours and more” with an hour difference in between the questions (Cronbach's alpha of 0.82 for adolescents and 0.70 for parents).
2. Mixed activity as an activity that is combined with the Internet usage at daytime and nighttime was measured by 11 items describing different activities. The participants were asked to appraise how frequently they use the Internet during each of the activities using a 5-point Likert scale (from “Never” to “Always”): “Immediately after awakening”, “While eating”, “During classes / at work”, “During school breaks / during work breaks”, “While doing homework / while doing housework”, “While communicating with friends”, “On the way (on the bus, subway or in the car)”, “In public places (cafes, museums, shops, etc.)”, “In the bathroom”, “Just before bedtime”, “When up at night” [13] (Cronbach's alpha of 0.83 for adolescents and 0.82 for parents).
3. Excessive Internet use was assessed in accordance with the methodology of EU Kids Online [9] using 7 items describing disturbance in communication, habitual activities and other areas of life due to activities on the Internet (Cronbach's alpha of 0.78) and evaluating the answers by a 5-point Likert scale (“I did not sleep or eat because of the Internet”, “I felt discomfort when I could not use the Internet”, etc).
4. Brief Index of Digital Competence [14] consists of 32 items and designed to measure four components of digital competence (knowledge, skills, responsibility (safety) and motivation) in four areas (work with content, communication, technosphere, consumption). Index of digital competence is measured using percentage of the maximum possible value – 100%.
5. Schwartz's Short Portrait Values Questionnaire [15] consists of 21 items and measures 10 types of values: power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity, security.
6. Ten-item Personality Inventory [16] consists of 10 items that are consistent with Big Five traits model and designed to evaluate distinctiveness of personal traits like neuroticism, extraversion, agreeableness, conscientiousness, openness to experience.

## 2.3. Procedure

The respondents filled in paper questionnaires in the presence of a specially trained interviewer. The staff of the Faculty of Psychology of the Lomonosov Moscow State University controlled and supervised the interviewers' work. Data collection was performed in autumn 2019.

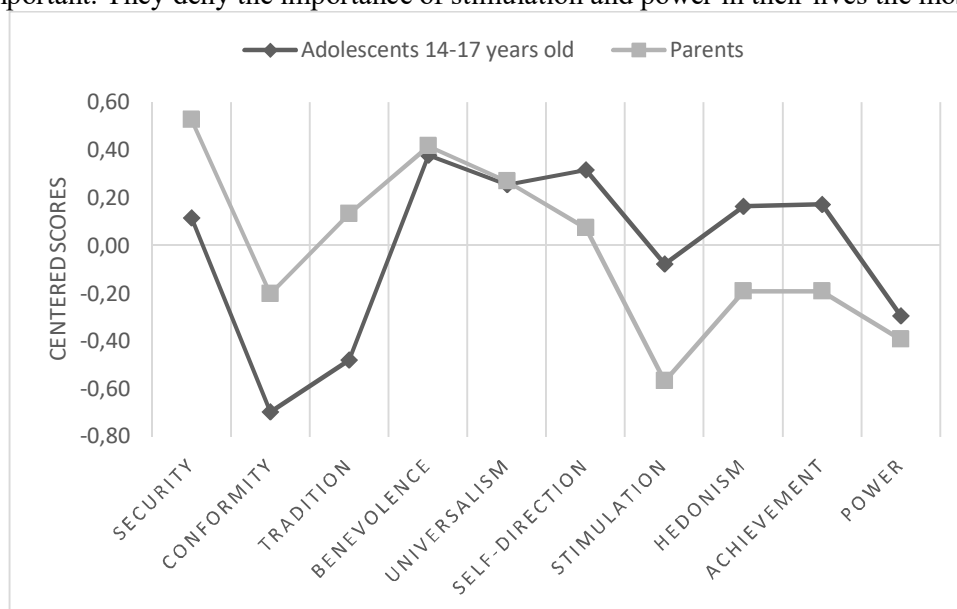
## 2.4. Data processing

Data were processed in SPSS Statistics 23.0 using descriptive statistics, Student's t-test (Cohen's  $d$  were reported as effect sizes), correlational analysis.

## 3. Results and Discussion

### 3.1. Value orientations of adolescents and parents

Core values of the older adolescents are related to self-transcendence and openness to change and to which benevolence, universalism, self-direction are related, whereas values like tradition and conformity are more likely to be denied. For the parents, security, benevolence and universalism are the most important. They deny the importance of stimulation and power in their lives the most.



**Figure 2:** Value orientations of adolescents aged 14-17 years and parents (upon centering, the mean score for the respondent in the whole method is deducted from the mean score on the scale)

The statistical comparison shows that (Fig. 2), comparing to the parents, for the adolescents, security, conformity and tradition are less important, and self-direction, stimulation, hedonism and achievement are more important. This result is intuitively comprehensible. As an adolescent, it is especially important to enjoy your life and gain independence, achieve as much as possible, whereas, with age, security and following established practices become more important than freedom and achievements.

In our opinion, the other result is interesting: the core values of the adolescents - benevolence and universalism - are not higher but on the same level with the parents. In other words, this is not about something new but about the fact that these values became a priority for the adolescents because security, conformity and tradition are less important for them than for the adults.

From the digital socialization perspective [1;3;4], it could be hypothesized that in adolescents early Internet-related experiences are related not to higher benevolence or universalism but to less emphasize on conformity, security and tradition that is related to the opportunity to see different social relationships.



**Table 1**

Comparison of value orientations of adolescents aged 14-17 years and parents: Student's t-test

Value orientations	Adolescents aged 14-17 years		Parents		Student's t-test	Cohen's d effect size
	Mean	Standard deviation	Mean	Standard deviation		
Security	0.12	0.84	0.53	0.79	-6.43**	-0.50
Conformity	-0.70	1.11	-0.20	0.79	-6.61**	-0.52
Tradition	-0.48	0.99	0.13	0.81	-8.61**	-0.68
Benevolence	0.38	0.76	0.42	0.72	-0.65	-0.05
Universalism	0.26	0.69	0.27	0.62	-0.21	-0.02
Self-direction	0.32	0.86	0.07	0.76	3.86**	0.30
Stimulation	-0.08	0.94	-0.57	0.93	6.72**	0.53
Hedonism	0.16	0.92	-0.19	0.90	5.00**	0.39
Achievement	0.17	0.82	-0.19	0.82	5.63**	0.44
Power	-0.29	0.90	-0.39	0.83	1.46	0.11

\* -  $p < 0.05$ , \*\* -  $p < 0.01$ 

No differences in value orientations were found between the boys and girls and also between the parents of boys and the parents of girls (see Table 1). The male parents said about the importance of power for them more often than the female parents ( $t=4.20$ ,  $p < 0.01$ ,  $d=0.64$ ). The older parents show a little bit less disposition to hedonism value ( $r=-0.17$ ,  $p < 0.01$ ) which can be explained by common age-related changes. Comparing to the adults, for the adolescents, hedonism appears to be more important. And for the younger parents, hedonism appears to be more important than for the older ones. Perhaps, that is with age when people are more often willing to live, as the famous saying goes, "not for satisfaction but for conscience".

### 3.2. Preference of value orientations with different personality characteristics: comparison of adolescents and parents

Differences in value orientations often raise a question whether we talk about differences in personality characteristics between generations or about the fact that, in a new situation, the same personality characteristics start to dictate other values and ways of their implementation.

**Table 2**

Relations of value orientations and personality characteristics among adolescents and parents (correlations are shown in the form of adolescents/parents)

Value orientations	Extraversion	Agreeableness	Conscientiousness	Emotional stability	Openness
Security	-0.08/-0.05	-0.04/0.07	-0.03 / 0.23**	-0.08/-0.10	-0.08/0.07
Conformity	-0.28**/-0.32**	-0.12*/-0.23**	0.02 /-0.12*	-0.01/-0.17**	-0.26**/-0.29**
Tradition	-0.30**/-0.28**	0.04 /0.05	-0.02 / -0.04	-0.02 /-0.11*	-0.34**/-0.25**
Benevolence	0.16**/0.04	0.27**/0.22**	0.13* /0.10	0.06/0.12*	0.10/0.03
Universalism	0.03/-0.04	0.09/0.17**	0.00/0.05	0.05/-0.02	0.04/0.00
Self-direction	0.10/0.23**	0.03/0.12*	0.02/0.18**	0.10/0.23**	0.23**/0.32**
Stimulation	0.17**/0.11*	0.11/0.02	-0.04 /-0.07	0.07/0.14**	0.21**/0.10
Hedonism	0.23**/0.19**	0.08/0.01	-0.12* /-0.05	0.00/-0.02	0.14*/0.10
Achievement	0.14*/0.14**	-0.12* /-0.12*	0.12* /-0.05	-0.09/-0.05	0.10/0.03
Power	-0.08/-0.04	-0.33** /-0.31**	-0.06 /-0.18**	-0.07/-0.04	-0.03/-0.12*

\* -  $p < 0.05$ , \*\* -  $p < 0.01$

According to the results of the correlation analysis, both the adolescents and parents' preference of certain values correlates to similar personality characteristics. The extraverts choose conformity and tradition more seldom and hedonism, stimulation and achievement more often. With a high level of agreeableness, the benevolence value is important, and power value is not important. Openness to experience is related to denying conformity and tradition values and to the importance of self-direction.

All these relations are clear and natural. But it is important that they are true for both the adolescents and the parents. This result is in line with universality of value orientation [10] although the profile of them could be different for adolescents and adults (Table 2).

### 3.3. Value orientations, user activity and digital competence

Among the adolescents, no time on the Internet, no disposition to excessive user activity are related to any of value orientations ( $r < |0.12|$ ). The disposition to combine different activities with online activities is typical of the adolescents for whom hedonism is important ( $r = 0.17$ ,  $p < 0.01$ ). For the parents, the time spent on the Internet is related to power value ( $r = 0.22$ ,  $p < 0.01$ ) and has a weak positive correlation with hedonism ( $r = 0.13$ ,  $p < 0.05$ ) and a weak negative correlation with benevolence ( $r = -0.13$ ,  $p < 0.05$ ). Combining online and offline is more common for the parents with stronger disposition to hedonism and achievement ( $r = 0.13$ ,  $p < 0.05$ ) and weaker disposition to universalism ( $r = -0.15$ ,  $p < 0.01$ ).

Digital competence is related to weaker disposition to conformity, especially among the adolescents, although the differences in values of correlation coefficients between the adolescents and parents do not reach the acceptable level of significance. In relation to safety, digital competence is related to the importance of self-direction. One could speculate that better skills for safety online are related to wider opportunity to various online activities and as a result more opportunity to find and compare different opinions. Importance of self-direction could provoke intention to realize it online safely and vice versa better safety skills could allow to become more self-directed because of higher confidence. These patterns seem to be closer related to general effects of informational society than to the age and experience of digital socialization as a child [2].

Among the adolescents, the importance of stimulation is in general related to different components of digital competence which is natural, given that the Internet offers maximum options for interesting experience that, basically, reflects stimulation value (Table 3).

**Table 3**

Relations of values and digital competence among adolescents and parents

Value orientations	Index of Digital Competence - knowledge	Index of Digital Competence - motivation	Index of Digital Competence - skills	Index of Digital Competence - safety	Index of Digital Competence - overall
Security	0.02/0.03	0.11/0.11*	-0.02/-0.01	-0.05/-0.05	0.02/0.02
Conformity	-0.26**/-0.12*	0.04/0.04	-0.22**/-0.09	-0.23**/-0.13*	-0.26**/-0.12*
Tradition	-0.12*/-0.09	0.02/0.06	-0.12*/-0.07	-0.13*/-0.12*	-0.14*/-0.08
Benevolence	0.07/0.01	-0.02/0.10	0.03/0.03	0.03/0.03	0.04/0.06
Universalism	-0.02/0.00	0.00/0.05	0.06/0.05	0.17**/0.05	0.08/0.05
Self-direction	0.13**/0.11*	-0.12*/0.01	0.13*/0.08	0.20**/0.20**	0.15*/0.17**
Stimulation	0.19**/-0.02	-0.01/-0.12*	0.13*/0.05	0.16**/0.04	0.17**/-0.01
Hedonism	0.06/0.11*	-0.05/-0.14**	0.02/0.07	0.05/0.15**	0.03/0.09
Achievement	0.06/-0.03	-0.02/-0.01	0.06/-0.06	-0.02/0.08	0.03/-0.08
Power	-0.07/0.03	0.00/-0.08	-0.03/-0.05	-0.17**/	-0.10/-0.10

\* -  $p < 0.05$ , \*\* -  $p < 0.01$

## 4. Conclusion

The major limitation of the study is its correlational design that did not allow to distinguish between effects of generation (especially social and ecological situation including techno-subsystem) and age. Moreover, although most of parents in our sample were formally from generation Y, there were some of them from generation X according to the classical typology [8;9]. While borders between generations should be considered as flexible and exclusion of them did not affect patterns of results, this study concentrates on general comparison of adolescents ("generation Z") with adults. In general, some results seem to be important for the further discussion of values changes in the digital era and their relationship to personality, user activity, digital competence.

1. In the structure of value orientations of modern adolescents, self-transcendence and openness to change values (benevolence, universalism, self-direction) dominate. But it is not because these values are more significant for them than for their parents but because conformity, tradition and security values are less important for them. Although in this study we could not differentiate effects of social situation (generation) and age, results are in line with the hypothesis that early digital experience provoke more flexibility as opposed to conformity and tradition [5]. In other words, we suggest that that digital socialization do not lead to higher openness to new ideas and behaviors than in parents but to less rigid point of view of different opportunities [1]. The other differences in value orientations between the adolescents and parents could possibly reflect age distinctions: stimulation, hedonism and achievement are more important for the adolescents than for the parents.

2. Personality characteristics of both the parents and the adolescents are equally related to the preference of certain value orientations. In other words, it is not argued that the new generation is a totally new kind of people who see values differently [10]. More likely they have their own personality characteristics that distinguish them from the previous generations [8;9], and for this reason they hold certain values in their lives. Thus, both among the parents and the adolescents, the extraverts choose conformity and tradition less often and hedonism, stimulation and achievement more often. With a high level of agreeableness, benevolence value is important, and power value is not important. Openness to experience is related to denying conformity and tradition values and to the importance of self-direction.

3. Among the adolescents, user activity is not related to value orientations which overturns the hypothesis on impoverishment of the value sphere of the adolescents who spend "too much time" on the Internet. Those for whom hedonism is important more often combine the Internet with other activities, and it makes sense: unpleasant activities can be combined with something pleasant without losing any productivity. From the perspective of techno-subsystem [7], it could be hypothesized that in adolescents not user activity but the content of this activity and its characteristics (e.g., combining online and offline activities) is important for value orientation [1].

4. Among the parents, the relation of time spent online to power value, and combination of online and offline activities to hedonism and achievement, in our opinion, is consistent with the model of digital socialization [1]: for the adults, that is values that appear to be an "engine" of their user activity, and that is not observed among the adolescents who do not need such "engine" for online activities. A combination of online and offline activities allows you to fulfil more tasks easier (and get distracted by pleasant online activities). And, for many adults, a need for power is easier to satisfy online than offline.

5. The correlation between digital competence and value orientations does not depend on group (adolescents versus parents). Greater digital competence (but not user activity) is related to weaker disposition to conformity. Probably, the reason is a better perspective and opportunity to compare different opinions. Among all the respondents, self-direction value is related to digital competence within the safety component. Probably, this correlation is bidirectional: the desire to be self-directed requires that the adolescents and adults protect themselves from the dangers related to self-direction. And the better you ensure safety, the better you understand the importance of self-direction.

6. Among the adolescents, the importance of stimulation is in general related to different components of digital competence which is natural, given that the Internet offers maximum options for interesting experience that, basically, reflects stimulation value [5;7].

## 5. Acknowledgements

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# The Characteristics of the Search Task that Mediate the Choice of Online Information Search Strategies by Schoolchildren in the Context of their Educational Activity

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## Abstract

The article presents the results of an experimental study aimed at identifying the objective and subjective characteristics of a search task that mediate the choice of online information search strategies by schoolchildren in the context their educational activity. The sample consisted of 44 schoolchildren (11–16 years old, grades 5<sup>th</sup>–9<sup>th</sup>), who consistently performed simple and complicated online search tasks. No statistically significant effect was found for influence of the degree of search task complexity on such characteristics of online search as the number of search queries, the number of viewed sites and the time spent on the search. At the same time, the characteristics of online search are determined by subjective assessments of the task itself and the conditions for its implementation. Significant mediators of the online search characteristics in the situation of performing a simple search task were the general user confidence, as well as the motivation to complete the task and its subjective complexity. The characteristics of performing a complicated search task were mediated by the motivation as well as by the degree of awareness of the problem field for searching.

## Keywords

Online search, schoolchildren, simple search task, complicated search task, motivation, user confidence, awareness in the subject field of search, subjective complexity

## 1. Introduction

In recent years, the search for educational information on the Internet has firmly entered the daily life of schoolchildren. Today online search takes a leading position in the structure of online educational activity throughout school time [1]. With the help of online search engines, schoolchildren solve a wide range of information problems in their educational activities, including the search for additional and reference information, training and testing materials, textbooks, etc. The widespread use of online search as an element of modern educational activity determines the relevance of studying the psychological mechanisms that determine its qualitative and quantitative characteristics and, ultimately, contribute to the successful achievement of search goals.

According to T. D. Wilson, online information search is the search for information on the Internet in order to meet an information need, which includes physical and mental actions aimed at assimilating the information found into the existing knowledge system [2]. Online search is a complex process that involves sequential realization of a number of actions related to finding, selecting and evaluating information, as well as the synthesis of information from different web pages to solve an information problem (see, for example, [3-8]). Among the most significant procedural characteristics of online search, the time spent on the search and the volume of analyzed information are distinguished, and the main resulting characteristic is the accuracy of the search result [9; 10]. These criteria describe a “necessary and sufficient” minimum to characterize online search behavior in the situation of searching for factual information that does not require subsequent assimilation into the

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knowledge system of the searching person. However, it is obvious that the educational online search activity of schoolchildren is not limited to the search for individual facts and involves the need for synthesis of the information in a system of representations, which has been formed earlier. The studies aimed at analyzing online search activity of schoolchildren show that extremely important characteristics of online search in educational activity are the relevance of search queries and information that is provided as a result of search activity [3], as well as the ability to use the information to improve subsequent search queries and to present the final search result [11]. Thus, if online search is related to educational activity, it is important not only the accuracy of the information found, but also the opportunity to use it for completing the educational task [12].

Previous studies show that the online search behavior differs depending on the characteristics of the task that should be completed. The most common classification of online search tasks suggests their differentiation into simple and complicated ones. A simple task involves searching for unambiguous answers to search queries, which do not imply a multi-meaning interpretation of the relevance of the found information to the initial search problem. A complicated task is an open question, which has no ready-made ways to perform the task and unambiguous requirements for search results [13]. The key difference between a complicated search task and a simple one is a much higher degree of interactivity in the process of completing it [14].

The complexity of the search task is determined not only by the features of the task itself, but also by the ways in which it is interpreted by the person performing the informational online search [15]. The degree of "simplicity" or "complexity" of the search task is determined by the objective characteristics of the task as well as by the subjective assessment of its complexity. Empirical studies show that subjective assessments of the complexity of the task have a significant impact on how effective the search will be recognized. People rate the performance of an online search lower when they consider the task difficult and do not have unambiguous criteria for evaluating the results of their search activity [16]. Thus, the complexity of the search task as one of the factors determining the characteristics of its completing has both objective and subjective components.

Subjective factors that mediate online searching behavior also include the experience of online search activity, interest in the search problem, and the degree of awareness in the subject field in which the search is performed. For example, the experience of online search activity determines the search strategies preferred by users [17], the ways for search queries phrasing [9], and the speed of switching between search engine responses [18]. The influence of the awareness factor in the subject field of the search ("background knowledge") determines the degree of flexibility of the search strategy [18] and the quality of assessing the relevance of the information found to the search goals [19; 20]. Motivation to perform a search task determines the relationship between the search performance and the evaluation of the effectiveness of one's own actions to search for information, while reducing the negative impact of search failures [21].

It is important to note that the information described above is obtained mainly from the analysis of online search behavior of students and/or adults, who solve search problems that are not related to educational activities. The question about the objective and subjective characteristics of the search task which have an impact on the search actions of schoolchildren in the process of solving educational problems is insufficiently studied.

## **2. The present study**

Our research is aimed at identifying the objective and subjective characteristics of the search task that mediate the choice of an online information search strategy by schoolchildren in the context of their educational activity. To evaluate online search strategies, we use indicators such as the number of search queries, the number of sites viewed, and the time spent on online search for the necessary information. In accordance with the results of previous studies, the objective characteristic of the search task is the degree of its simplicity/complexity, which varied by the instructions for participants of the study. Subjective characteristics are represented by the following parameters: assessment of the complexity of the task by schoolchildren who took part in the study; self-assessment of awareness in the subject field within which the search is carried out; self-assessment of experience in the online

search for the necessary information; assessment of satisfaction with the online search process and the intermediate results achieved; self-assessment of motivation to perform search tasks.

During the data analysis, the following research questions are answered:

1) What are the characteristics of the online information search strategies, which are carried out by schoolchildren in the process of completing simple and complicated search tasks in the context of educational activity?

2) What is the contribution of subjective characteristics of the search task to the online search strategies implemented by schoolchildren in their educational activities?

The hypothesis of our study suggests that the individual strategies of online information search that schoolchildren use for performing simple and complicated search tasks are different, and their features are mediated by the subjective characteristics of the search task.

### 3. Materials and methods

The study involved 44 schoolchildren of secondary schools (grades 5<sup>th</sup>–9<sup>th</sup>) aged 11–16 (13.66±1.92 years old), including 18 girls and 26 boys. All schoolchildren took part in the study voluntarily. Inclusion in the sample presupposed a preliminary interview with a potential participant and his/her parent (legal representative). Both the participant and his/her parent (legal representative) signed an informed consent to take a part in the study.

The study was conducted as laboratory experiment. The participants worked individually. Each of them was consistently offered two tasks, similar to the usual school task related to the search for additional information. The tasks varied in their degree of complexity. The schoolchildren completed the following tasks:

1) Simple search task: "Prepare a short message (up to 5 minutes) about the planet Mars"

2) A complicated search task: "Humanity has long dreamed of living on other planets. Mars is a planet adjacent to Earth in the Solar System, so its development, along with the development of Venus, looks most likely. Prepare a short (up to 5 minutes) message about what humanity needs to do to make Mars habitable".

To complete these tasks, schoolchildren were asked to use a computer with the Windows 10 operating system, a 17-inch monitor, a keyboard and a computer mouse, as well as a pre-installed Google Chrome browser. The browser icon was displayed on the desktop, which opened immediately after the computer took working mode. The online search process was recorded using the Bandicam screen capture program. We analyzed parameters such as the number of search queries (in absolute units), the number of sites viewed (in absolute units), and the time spent searching for the information to complete the task (in seconds). At the end of the work, the schoolchildren presented their answers to the experimenter.

Before the participants were presented with the main tasks, each of them answered the following questions:

- 1) How well do you know how to search for the information on the Internet? (the question for studying the self-assessment of competence in the issues of informational online search).
- 2) How well do you know astronomy, and in particular, how well do you know about the planet Mars? (the question for assessing awareness in the subject area in which the online search is performed).

After completing each search task, the schoolchildren were asked another questions:

- 1) How interesting was the task? (the question to assess the motivation for the completed task).
- 2) How difficult was the task? (the question for assessing the subjective complexity of the task).
- 3) How satisfied are you with the progress of the task, did everything work out as you wanted? (the question for assessing satisfaction with the online search process and intermediate results).

To answer each of these questions participants have 10-point scale.

Statistical data processing was carried out with the use of Statistica 10.0 software package and included the calculation of descriptive statistics (means,  $M$ ; standard deviations,  $\sigma$ ; medians,  $Me$ ), as well as analysis of variance ( $F$ ).

The program and protocol of the study were approved by the Ethics Committee of the Herzen State Pedagogical University of Russia, decision No. 17 (29.10.2020).

## 4. Results

At the first stage, we described the characteristics of online information search, which was performed by schoolchildren for completing simple and complicated tasks. The results showed that in both cases schoolchildren most often ask one search query, as a rule, almost verbatim repeating the phrasing of the task (29 cases for performing the simple task and 28 cases for performing the complicated task, 65.9% and 63.6%, respectively). During review the search results they usually work with the materials of one site for completing the simple task (30 cases, 68.2%) and one or two sites for completing the complicated task (26 cases, 59.1%), giving a stable preference to Wikipedia materials (in our study, all schoolchildren without exception used Wikipedia). In general, the performance of a complicated task is characterized by slightly higher indicators of the number of search queries, the number of sites viewed and the time spent on searching for information, but these differences do not reach the level of statistical significance (see Table 1). There were no significant differences in the characteristics of online search between groups of schoolchildren with different ages, as well as different genders.

**Table 1**

Characteristics of online search for performing the simple and complicated tasks

Indicators	Simple task			Complicated task		
	M	$\sigma$	Me	M	$\sigma$	Me
number of search queries	1.58	1.24	1	1.68	1.51	1
number of sites viewed	1.74	1.37	1	2.39	1.62	2
time for online searching	385.71	172.50	359	426.63	188.04	406

In the second stage of the study, we divided the sample into four subgroups on the basis of each task separately with the use of the median values for online search indicators: 1) fast analysis of a small amount of information; 2) fast analysis of a large amount of information; 3) slow analysis of a small amount of information; 4) slow analysis of a large amount of information.

According to the results of the simple task we identified four the following groups: fast analysis of a small amount of information – 16 participants (10 boys and 6 girls), 13.20±1.56 years old; fast analysis of a large amount of information – 8 participants (4 boys and 4 girls), 14.00±2.09 years old; slow analysis of a small amount of information-10 participants (6 boys and 4 girls), 14.00±1.85 years old; slow analysis of a large amount of information – 10 participants (6 boys and 4 girls), 14.11±1.96 years old. There were no statistical differences in the age or gender composition between the subgroups, although it can be noted that the subgroup of schoolchildren who quickly process a small amount of information is made up of relatively younger participants, in comparison with other subgroups. On the basis of the complicated task results the group was divided into similar subgroups: fast analysis of a small amount of information – 12 participants (7 boys and 5 girls), 13.55±1.63 years old; fast analysis of a large amount of information – 9 participants (6 boys and 3 girls), 14.16±1.47 years old; slow analysis of a small amount of information – 12 participants (6 boys and 6 girls), 13.33±1.87 years old; slow analysis of a large amount of information – 11 participants (7 boys and 4 girls), 14.11±2.14 years old. These subgroups also do not differ in age or gender composition, although (at the trend level) older participants usually worked with a larger amount of information during performing a search educational task than younger participants in the study.

A comparison of these subgroups showed that the complete coincidence of the characteristics of the search speed and the volume of the analyzed information occurs only in every third case (14 participants), which highlights that the simplicity/complexity of the search task affects the characteristics of the online search activity of schoolchildren.

The analysis of variance allowed us to identify objective and subjective characteristics of search tasks with varying degrees of complexity, which affect the parameters of the searching activity in



schoolchildren. For a simple search task, significant factors were interest in the task and self-assessment of competence in online search, which are associated with analyzing more information regardless of the speed of the task completing, as well as the subjective complexity of the task, which leads to an increase in the time spent on its implementation, regardless of how much information is analyzed. In the case of a complicated search task, a lower speed of task completion is determined by interest and awareness in the subject area (see Table 2).

**Table 2**

Contribution of the characteristics of the search tasks to the speed and time parameters of its completion (results of the variance analysis)

Indicators	Subgroups				F
	FS	FL	SS	SL	
<b>Simple task</b>					
self-assessment of competence in online information search	6.07±1.77	7.16±1.83	5.83±1.77	7.25±1.83	3.08*
motivation for the task	6.85±2.76	8.83±1.76	6.74±2.67	8.16±1.88	3,22*
subjective complexity of the task	2.71±2.23	2.16±1.69	5.01±2.67	4.88±2.09	3.16*
<b>Complicated task</b>					
motivation for the task	6.36±2.56	5.33±2.10	8.67±1.37	8.44±1.49	3.76*
awareness in the subject area	3.77±2.11	5.50±2.14	6.81±2.62	6.77±1.90	3.14*

Notes: FS – “Fast analysis of a small amount of information” subgroup; FL – “Fast analysis of a large amount of information” subgroup; SS – “Slow analysis of a small amount of information” subgroup; SL – “Slow analysis of a large amount of information” subgroup; \* –  $p \leq 0.05$ .

The assessment of satisfaction with the online search process did not demonstrate a significant impact on the speed of completing search tasks and the amount of processed information, regardless of the degree of task complexity.

## 5. Discussion

Our research allowed us to describe the characteristics of the online information search strategies, which is carried out by schoolchildren in the process of completing simple and complicated search tasks in the context of their educational activity. An important advantage of the study was its experimental format, which promoted studying the features of online searching behavior of schoolchildren in terms close to a real educational situations.

The results showed that regardless of the simplicity/complexity of the search task, schoolchildren, as a rule, use a small number of search queries (and often only one search query), the phrasing of which to some extent repeats the phrasing of the initial task. During scanning the search results provided by the search engine, schoolchildren most often view the materials of one or two sites from the first list of search results and give preference to materials from Wikipedia. The preference for online resources of the Wiki type is also highlighted in other studies [22].

In general, we should note that schoolchildren showed not too high skills of online search for educational information. Interestingly, that the lack of these skills in youth is also found by other researchers [23]. Schoolchildren often look through one or two pages and perform their educational task using the “copy-paste” method, and they often do not treat the found information critically enough [24]. However, this strategy of online search was the most common among schoolchildren who took part in our study (it was preferred by two-thirds of the participants), so we can assume that in the process of completing educational tasks with the use online information search, schoolchildren most often resort to this way to organizing their online activity. In this regard, the interesting and important question arises: whether the preference for this an online searching strategy is universal for all types of online search at school age, or whether it is typical only for the situation of performing educational tasks. The search for an answer to this question is the prospect of our future investigation.

Despite the fact that we did not get statistically significant differences in the parameters of evaluating online search strategies in the situation of performing a simple and complicated tasks, the statistical trends indicate that as the search task becomes more complicated, the amount of analyzed information and the time spent on its processing increases. This conclusion is consistent with the results of other studies [25], and, in all likelihood, characterizes the general trend of the dependence of the time and speed characteristics of online search on the degree of search task complexity. The lack of statistically significant differences may be explained by the relatively small sample size.

Dividing the sample into subgroups on the basis of median values of the information amount and the speed of searching, we noticed that the time and speed characteristics of the tasks with various different degrees of complexity for the same participant can vary significantly. This fact suggests that the choice of an online search strategy is determined not only by the objective characteristics of the search task (in our case, the degree of its complexity), but also by the subjective assessments of the task that should be completed. The results showed that the universal subjective factor that affects the characteristics of online search activity of schoolchildren in the situation of performing an educational task is the motivation to complete it, expressed in interest. In the case of the simple search task, interest primarily contributes to an increase in the amount of scanned information, in the case of a complicated task it determines an increase in the time that the participants spend on completing it. This probably corresponds with the patterns noted in previous studies, which showed that an increase in the information amount does not always lead to an increase in duration of online search, which is largely determined by the cognitive capabilities of a person [26]. User confidence, which contributes to an increase in the amount of information processed, as well as a subjective assessment of the task complexity, which increases the duration of its performing, also affect characteristics of the strategy for completing a simple search task. In the case of a complicated search task, the increase in the time characteristics of the search is also facilitated by awareness in the subject area, which is associated with the search task. These results generally correspond to the data obtained in other studies [16-21; 27] and allow us to specify the contribution of various subjective characteristics of the search task to the choice of its implementation online searching strategy. It is proved that the universal characteristic in this context is the motivation to complete the task, while other characteristics are selectively associated with either a simple or a complicated search task.

Special attention should be paid to the fact that the parameter of satisfaction with the search process and intermediate results did not demonstrate a significant impact on the characteristics of online searching behavior of schoolchildren. In our opinion, this is indirect evidence that schoolchildren do not fully take into account the current dynamics of online search, being focused mainly on the assessment of the task itself. As monitoring the online search process is an important resource for improving its effectiveness [28; 29], it is promising to develop training programs aimed at promoting the formation of students' skills for monitoring their online search activity.

Of course, our study has a number of limitations, primarily due to the relatively small sample size and the content specifics of search tasks, which may also be an independent factor that mediates the choice of an online searching strategy. We can also suppose that the empirical results (in particular, the search time) were influenced by information processing skills and especially reading skills [30-31]. Nevertheless, taking into account these limitations, we can say that the hypothesis of our study was only partially confirmed. On the basis of analyzing online search in the educational activity of schoolchildren, no statistically significant differences were revealed in the characteristics of online information search strategies which are used in performing simple and complicated search tasks, but it was proved that online search is mediated by the subjective characteristics of the search task, which differently manifest their contribution depending on the degree of task complexity.

## 6. Conclusion

The results of our research show that the choice of an online search strategy that students make during the course of an educational task is determined by the degree of complexity of the search task. The characteristics of search activity in the situation of a simple search task vary depending on the interest in it, the subjective assessment of its complexity, as well as the overall confidence of the user. In the situation of a complicated search task, in addition to motivation, the degree of awareness of the

problem comes to the fore. We believe that it is important to use these results for planning the educational activities of schoolchildren related to the search for additional information on the Internet. Further research may concern the studying the effectiveness of assimilating an educational information obtained through various online search strategies in school age.

## 7. Acknowledgements

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# Cyberreality as an Interdeterminant of Psychological Phenomenology

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## Abstract

The cyberpsychology transformation in extreme environmental change conditions (ecological, cyber, technical, technological, social), which has acquired special significance today, has not been practically investigated. The authors attempt to extend this problem viewing horizon provides sociocultural-dialogic interdeterminist metatheory. It is theoretically substantiated and demonstrated that changes in the natural, cyber, techno-technological, and social environment inevitably lead to substantive behavior changes. Furthermore, this impact cannot be reduced to a simple sum of its constituent parts. The result of interaction is the acquisition of a new quality, features, mechanisms, prerequisites, and consequences of the formation of which should become the object of psychological research. Theoretical explanations and evidence of innovativeness of the approach for the cyberpsychology phenomena's rethinking are presented. In general, we discuss the search for theoretical grounds for achieving qualitative changes in human functioning in current heterogeneous and heteroqualitative conditions.

## Keywords

cyberpsychology, cyberreality, digitalization, Homo Cyberis, interdetermination, sociocultural-dialogic interdeterminist approach

## 1. Introduction

Uncertainty is one of the most common characteristics of current being-in-the-world. Accelerating technical and technological progress, the digitalization of almost all spheres of life, the cyber expansion of the world wide web, periodically flaring pandemics are increasingly undermining certainty in the worldview and engendering a frightening sense of uncertainty. The certainty has been replaced by the absolute uncertainty of an interdisciplinary nature. The recently discovered coronavirus is a new pathogen of a biological nature. However, it relates to ancient, more intractable, and more contagious danger: the human fear. Fear changes human behavior, for better or worse. Fear is generated by high uncertainty and unpredictability that cause the need to rethink all previous knowledge. Many seemingly unshakable ideas concerning the advantages or disadvantages of various types of behavior were destroyed.

*Industry 4.0*, commonly referred to as the *Fourth Industrial Revolution*, is "an emblematic title for the current trend of automation, scaling and data exchange in manufacturing technologies, including artificial intelligence, virtual reality, cloud computing, cognitive computing, the Internet of Things and the Internet of Nano Things, or the Internet of Everything, and big data analytics. Besides, the interactive networking of human agents through social media platforms and the generation of big data is extended to machines so that networks of communicating machines are created" [22].

*COVID-19 extreme pandemic context* today focuses on the attention of the world's interdisciplinary scientific community. A vast number of pseudo-experts appeared promptly, providing peremptory explanations and recommendations on both the nature of the COVID-19 and ways of overcoming it. The vociferousness of this kind of pseudo-expert conclusion and the media flow of messages about the coronavirus's negative dynamics emotionally strain the audience with an increase in the number of

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deaths. Moreover, it leads to disorientation and frightening uncertainty in the audience, which, in turn, generates an epidemic of fear with even more significant negative consequences. Besides, although writing this article, it was possible to discuss only increasing fears in society [5, 25], it seems much more critical to determine socio-psychological consequences provoked by the current extreme situation that has become international. Due to the uncertainty as to what is happening and its prospects, fear and panic grow. This uncertainty is augmented with the lack of analogies, the psychosis injected by mass media, the search for quick and not always justified solutions, and the awareness that previous knowledge and experience do not allow any quick and effective solutions in the nearest future. This also led to a sharp increase in the influence of cyberreality as a popular means of uncertainty overcoming through Internet resources. A prolonged stay in conditions of self-isolation and uncertainty has led to an imbalance in the interaction of real and virtual reality.

Furthermore, these consequences for global mental health will be significant and, in many ways, destructive. It is evident today that overcoming them requires new insights and solutions [21]. The accelerating stream of great occasions and changes in the eventful world, uncontrollable technical and technological progress (with unknown consequences for humans), the growth of ecological problems, and others increase interest in finding certainty in this dynamic uncertainty. Hence, the interest in futurologists' work suggests even darker perspectives [6, 9, 13].

The above-described uncertainty context caused by the pandemic could not but affect cyberpsychology, which is faced with the need to rethink many of the previously obvious ideas. Just like the awareness of the need to find fundamentally new approaches and solutions. One of the possible innovative approaches that propose problem area analysis horizons expanding presents the author's sociocultural-dialogical interdeterminist metatheory. A general description of the approach and its capabilities concerning cyberpsychology is presented in the proposed article [27-29].

The initial premise lies in the thesis that psychological phenomenology is not homogeneous and static but heterogeneous and dynamic. Nevertheless, it lacks critical comparison, integration, and synthesis in this theory body, resulting in conceptual clouding and ambiguity. When we reflect on the current state of existing knowledge, we can state the presence of an infinite number of local theories and empirical findings in it, leading to the drowning in the unlimited of disparate fragments, not accompanied by a holistic understanding of the researched phenomenology particularity as the integral reality of human existence that determines its functioning. In the proposed metatheoretical approach, an author's attempt to solve this fundamental problem is relevant for developing psychological knowledge.

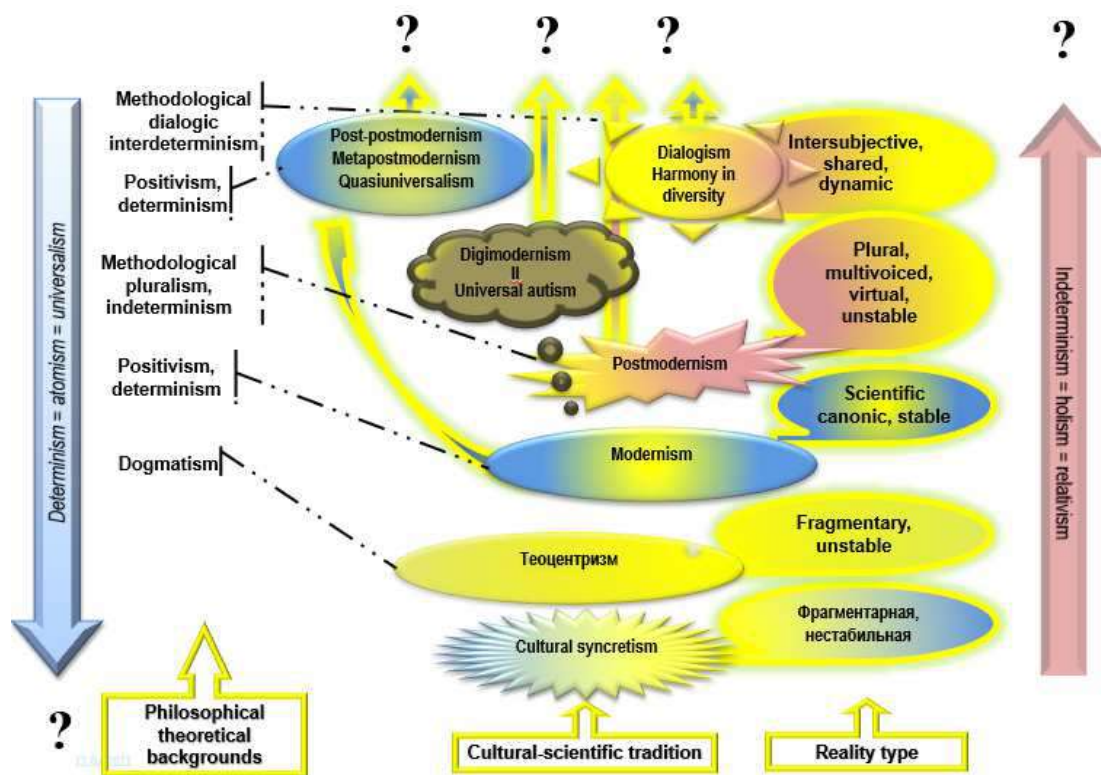
The metatheory starts from the pluralistic character of modern knowledge and its philosophical and epistemological grounds. Existing crisis debates in social science in general and psychological science (towards replicability, disintegration, empiricism) are considered in the context of deterministic and indeterministic development directions. Is proposed an interdeterministic alternative in social science development and its innovative potential and attempt to integrate the variety of existing psychological knowledge in the form of positioning in the psychological knowledge heterogeneous-multidimensional-multiparadigm spaces in the form of three interconnected four-dimensional continua, allows integrating all the existing traditions and diversity of approaches. The metatheory proposes the mechanism of heteroqualitative natures, psychic spheres, and behavior determinants interaction – sociocultural-dialogic interdetermination. At the same time, interdetermination is understood as a process and result of interaction, which manifests itself in the acquisition of a new qualitative state by the whole. It focuses the audience's attention on acquiring a whole new quality, not reducible to its constituent parts' simple sum. A sociocultural-dialogical interdeterminist solution of the psychological knowledge integration is unfolding, and it demonstrates applied possibilities of metatheory and prospects of its development.

## 2. Theoretical Background

The current state of the discussed problem and cyberpsychology knowledge area is characterized as a state of self-determination in absolute uncertainty conditions. Assessing the current state of psychological science, Robert Sternberg uses the metaphor of a climber climbing a mountain peak in complete darkness: "The climb up the mountain, I believe, is a metaphor for scientific progress. We try in small steps to climb the top, aiming to learn "the truth" about a scientific phenomenon. However, we

are climbing in the dark because we really cannot see the entire terrain. Moreover, after small steps, we reach what seems to be the top—understanding of a scientific phenomenon—we should know that, most likely, our feeling of being there is not really the same as our being there. We may have settled upon a local maximum." [20, P. 650]. Furthermore, this movement in absolute darkness is carried out with increasing speed in the conditions of a catastrophic lack of time for making verified and scientifically reasoned decisions. Considering the explanatory and prognostic functions of scientific knowledge, the proposed research's primary goal is to search for metatheoretical foundations to define uncertainty and instability conditions.

It is helpful to turn back to history at such critical moments and consider changes in worldview over its extension. The analysis of this evolutionary singularity was done using the previously introduced theoretical construct of "cultural-scientific tradition," which allows tracing the changes in society's ideas about the world order. Cultural-scientific tradition is defined as a multivocal and dynamically mobile complex of philosophical, epistemological, scientific-theoretical, and emotional-aesthetic representations depending on the historical, social, and national context ... characteristic of a certain mentality, particular way of world perception, attitude, and evaluation of both the cognitive capabilities of the person and his place and role in the world around him. The application of this construct allowed tracing the dynamics of the worldview in various traditions' (cultural syncretism, theocentrism, anthropocentrism, modernism, postmodernism) foundations, supplementing them with the tradition of dialogism, which found its supreme embodiment in dialogue as a prerequisite, mechanism and propulsion of culture and science in conditions of diversity. Figure 1 provides a general characteristic of the main sociocultural-scientific traditions. Unlike previous versions of the scheme, this modification adds the cultural-scientific tradition of digimodernism



**Figure 1:** The evolution of the cultural-scientific traditions

The process of social development is represented in the form of evolution of worldview over historical eras, occurring in various forms of human thought, including philosophy, literature, architecture, the arts, and several other disciplines and human activities [30, P. 33]. Today we can talk about a kind of competition between the two lines of development – post-postmodern (metamodernism, digimodernism), which represents the modern development of modernism and postmodernism ideas. The fundamental difference between them lies in the search for universal foundations of the universe (original primordial atoms) in the first case and the negation of those in the second, by stating the

holistic nature of the universe and its infinity, which cannot be covered in thinking because of its infinity and, accordingly, the absolutization of multivoicesness in the world description. In social reality, this competition is offered in the form of opposition conservatism – liberalism, globalism – antiglobalism, and others.

From Fig. 1, it is evident that the primary debate regarding the direction of humanitarian knowledge development is of an epistemological nature and reduced to the two directions competition: Aristotle's atomism, oriented to the existing reality construction primary atoms discovery (in the context of psychology in the form of behavior or psyche functioning universal laws) and Galilean holism, recognizing the infinity of interrelated and interdependent psychic functioning elements. Aristotle's atomism was unsuccessful in finding the first atoms to build an integral building of the psychic understanding, Galilean holism – in the impossibility of the immense infinity of psychological phenomenology embracing.

At the epistemological level, the dichotomy of atomism-holism reduces to the determinism-indeterminism dichotomy. Today, it is entirely justified to speak about the apparent opposition of determinism and indeterminism as its antithesis in the deep philosophical sense. It should be emphasized that the apparent advantage of the former over the second in positivistically oriented empirical studies. Nevertheless, if the virus's qualitative specificity and its nature are not understood, its treatment becomes unclear. An indicator of this is the application of the methods of treatment used to its known predecessors. Mainly, we see the use of the trial-and-error method, but not a conscious movement towards understanding its nature. All this clearly shows the need for a systemic understanding of the phenomenon, and not the endless finding of more and more new elements that do not lead to the comprehension of its quality, which cannot be reduced to their simple sum.

Indeterminism is an alternative to determinism. It emphasizes free will and freedom of choice as not determined by antecedent causes that not all events have causal reasons. Fundamental analysis of the role of indeterminism in psychological and behavioral development presents the manuscript "Dynamics and Indeterminism in Developmental and Social Processes" [8]. The indeterminist approach appears in the historical, philosophical, and theoretical aspects of the dynamic systems approach, which later became the subject of the same fundamental analysis in the methodology of dynamic processes in the social and developmental sciences [23]. However, the indeterministic line of thought has a significant drawback – it contributes to drowning in infinity and promoting non-stop movement in diversity, leading to a loss of certainty and uncertainty prevalence. The latter is just the basis for increasing anxiety about a promising future or loss of temporality.

Epistemologically, it is possible to speak about the apparent competition between determinism and indeterminism as its antitheses. It should be emphasized that an advantage of the former in positivistically oriented empirical studies is apparent. However, recognizing the minimal heuristic possibilities of empiricism and its inability to act as a basis for sophisticated psychological phenomena understanding led to a trend towards the growing popularity of the indeterministic direction in psychological cognition supporters. Indeterminism is associated with the postmodern psychological tradition, standing on anti-universalism positions and proclaiming multivoicesness as the mechanism and resource for overcoming the limitation of universalism in psychological knowledge. However, multivoicesness has an essential weakness – it leads to discordance and loss of definiteness in studied phenomena interpretation owing to lack of the agreed and conventional meanings and accepted mechanism of their negotiation. In the deterministic approach, such a mechanism is evident and unchanged throughout the history of its existence – operationalization and verification. Thus, strengths and weaknesses are present in both directions. The solution is traditionally in the middle. In the discussed context, P. van Geert is very suggestive. Van Geert is one of the leading specialists in the problem field, and he infers: "A deterministic universe is dead because it has no degrees of freedom: Everything is predestined, and no information is created because all information is contained in the initial state (whatever that may be). An indeterministic universe is lifeless because it contains an infinite number of degrees of freedom. No information is created because every event has a similar probability. However, where the two principles meet, information and order are created in the form of highly reduced degrees of freedom, in which differences between events become meaningful and informative. The new concept of complex order emerging out of self-organization. For a complex order to emerge, both determinism and indeterminism are needed" [24, P. 21].



A particular case presents a cultural-scientific tradition of digimodernism or informational autism, a reality digitalization product that permeates today literally all spheres of human life [11]. Since its first appearance in the second half of the 1990s under the impetus of new technologies, digimodernism has decisively displaced postmodernism to establish itself as the twenty-first century's new cultural paradigm. "It owes its emergence and preeminence to the computerization of text, which yields a new form of textuality characterized in its purest instances by onwardness, haphazardness, evanescence, and anonymous, social, and multiple authorship. These, in turn, become the hallmarks of a group of texts in new and established modes that also manifest the digimodernist traits of infantilism, earnestness, endlessness, and apparent reality" [11, P. 1). In the most general sense, according to A. Kirby, "digimodernism," properly understood as a contraction of "digital modernism," is a pun: it is where digital technology meets textuality and text is (re)formulated by the fingers and thumbs (the digits) clicking and keying and pressing in the positive act of partial or obscurely collective textual elaboration (Ibid). It is this cultural-scientific tradition that resonates most closely with the discussed problems of the cyberpsychology phenomenology.

Immersion in the digital world coexists with qualitative changes in a cyber-technological environment. We have seen a convergence of three principal technologies (computers, the internet, and mobile telephony) and a move from the limited desk and text-based interactions to more sophisticated and mobile forms of perpetual contact, which allow us to exchange all kinds of media from synchronous text to photographs, synchronous video, and audio clips. Internet use has become a ubiquitous, pervasive, and sometimes invisible part of our everyday lives, being accessed through all kinds of digital devices from satnavs and games consoles to tablet computers, mobile phones, and smartwatches. Therefore, the awareness of the "need for shift the focus of Cyberpsychology away from quantitative, experimental approaches exploring the 'effects' of human-computer interaction and towards a focus on the subjective experiences and sense-making of users in everyday contexts" [10, P. VIII].

The presented three scientific knowledge development lines raise the need to find integrative solutions, requiring definition in epistemological and methodological grounds. Within the framework of the cultural-dialogical interdeterminist approach, a new type of integration is proposed – dialogical, in essence, involving the joint development of mutually acceptable and sheared decisions having an inertial effect for a relatively definite period until the resource is exhausted for their productivity. Humans must be able to negotiate and adhere to the agreements reached, just as scientists and politicians should do this.

### 3. Method

The primary research method is the theoretical analysis of an existing psychological knowledge broad range, accumulated within the framework of different paradigm coordinates, traditions, and research fields. This analysis was actualized using the author's integrative-eclectic approach for psychological phenomenology analysis, which justifies the efficiency of a multiplicity of sources application [27]. The approach proposes the mechanism of interparadigm dialogue. It makes it possible to find consistently shared meanings in the applied conceptual apparatus and research methods. As an alternative to traditional logic, "or/or" is proposed dialogical logic "and/and." In the analysis of ontological-epistemological foundations of existing psychological knowledge diversity, is used the author's epistemological constructs "cultural-scientific tradition» and "sociocultural-dialogic interdeterminism" [29]. A synthesis of the psychological knowledge existing diversity and trends in its development understanding results is given in the sociocultural-dialogic interdeterminist metatheory of psychological knowledge integration. The system-forming construct of metatheory is interdetermination, denoting the process and result of the interaction of the whole elements, expressed in the acquisition of a new quality, not reducible to a simple sum of its constituent elements. At the same time, psychological phenomenology is considered from a systemic-synergetic approach, within which the system is viewed as heterogeneous, nonlinear, dynamic, and self-organizing. The focus of attention is the transitions from one qualitative state or the so-called bifurcation points and their prerequisites or attractors that provide them. Considering psychological phenomenology in general and cyberphenomenology, particularly as a process and result of bio-psycho-symbolic hetero-quality nature interaction, consciously-unconsciously-existential psychic spheres, actualizing in the spaces of

personality-environment-activity interdeterminants, conditions of balanced and disbalanced functioning are analyzed.

#### 4. Results and Discussion

Radical changes in the conditions of human existence, associated with the doubling of reality due to technogenic and cyber, cause a rethinking of almost all psychological knowledge areas. This kind of rethinking involves reflection or available knowledge audit in terms of its ability to provide time-appropriate explanations and the basis for predictions. Moreover, this kind of reflection becomes extremely popular as a resource for psychological knowledge development. [19].

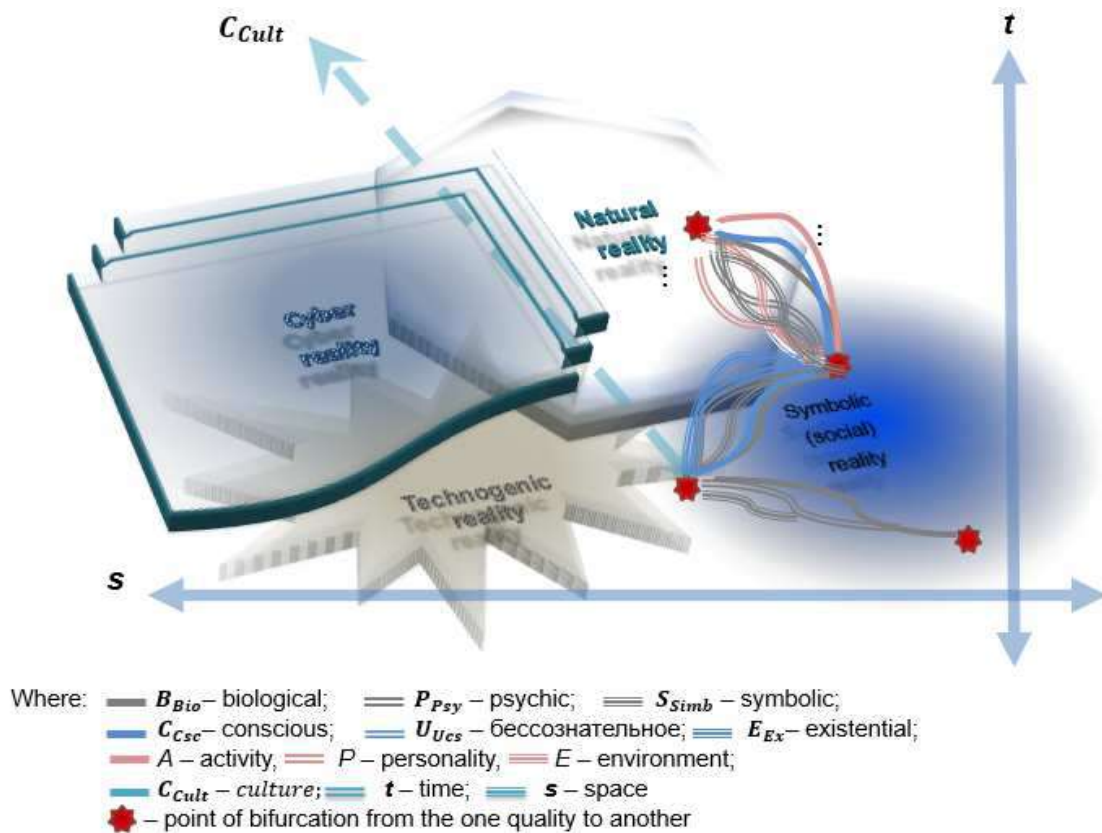
In essence, we are talking today about a kind of parallel existence of two types of humanity, *Homo Rationalis* and *Homo Virtualis*, who expands the received, old or traditional "ideal human model," "escapes the ideal human proportions, goes beyond the limitations of the natural environment by taking advantage of the technological developments and the emerging virtual, cyber environments" [12, P. 1). *Virtual reality* materialized from the fantasy world into real life and began to compete with real reality with all possible positive and negative consequences. Virtual reality is currently theorised as a symbolic heterogeneous medium, a complex semiotic technological digital environment or ecology (without hierarchy), which "strongly tends to replace its actual physical detonates. A semiotic complex technological digital environment, which shows a tendency not only to compete with the immediate physical and social environment, but to assimilate, to control, and to dominate it" [7, P. 142]. In the context under discussion, it is entirely appropriate to talk about the *Homo Cyberis*, immersed in cyberspace and drowning in it.

This calls for further theoretical-empirical research and careful scrutiny on complex patterns in our speedy, digitalised, and networked world, paving the way for exciting intellectual developments, scientific findings, and interdisciplinary conclusions. Especially now that the "post-Internet," or the "Next Internet," is emerging (from the dynamic convergence of Cloud Computing, Big Data Analytics, and the Internet of Things), new ambivalences, risks and challenges are being energised and posed for the quality of democracy, citizenship, and the political public sphere [17].

The most challenging task is to find the basis for ordering the knowledge infinity in the field of psychological phenomenology, connected with the person's being in the conditions of the social, cyber, and technogenic environment. First, this being is multifaceted. Secondly, it is actualized in the complex interaction of the biological, psychic, and symbolic heteroqualitative natures. Moreover, we must consider that purely psychological components outside the biological substrate's context can be isolated in abstraction only. Thirdly, the social nature itself is multifaceted in its representation in the multicultural context. The context introduces an aspect of the pronounced hidden presence of cultural differences, which cannot be ignored either in psychology or sociology and biology. Fourthly, on what concretely or subjectedly, these fields are based on inventing the infinity and the variety of psychological knowledge.

Human behavior is not a separate system. It functions under the conditions of a specific natural, social, technogenic, and cyber environment, forming particular types of reality, the influence of which psychology does not consider. Ignoring bodily substance in its interaction with the social environment through the psychic's unique ability to translate the external into the internal and vice versa is nonsense; however, it is typical for modern psychological knowledge. Not considering the heterogeneity of human natures (bio-psycho-symbolic) is nonsense, the complex interaction of which results in behavior. Likewise, this interaction has a mutually influencing and interdependent nature, leading to the formation of a new quality that cannot be reduced to a simple sum of its constituent parts or elements. A human (like the highly developed animal) adapts to environmental conditions, responding to external stimuli and adapts to his abilities, finding a compromise of adaptive properties or a state of internal-external balance. Furthermore, this state of balance is not static but fluid and follows the change in the social and natural environment. Explicit confirmation of this is the growing popularity of the biopsychosocial approach in various fields of knowledge, particularly in medicine [4].

The described qualitative features of being-in-the-world served as the basis for constructing a generalized author's multidimensional synergetic model of psychological phenomenology interdeterminants space's continuums presented in Fig. 2.



**Figure 2:** Multidimensional synergetic model of psychological phenomenology interdeterminants space's continuums

Psychological phenomenology is not static. It changes itself and the surrounding environment and vice versa in space and time. The system elements interaction is carried out in the conditions of multiple surrounding realities – natural, social, technogenic, and cyber, which in turn are in a constant process of mutual change and development. We understood a model as an integral set of internal and external bases, which interdetermines the behavior's uniqueness. These dynamic processes are precisely nonlinear, stepwise. Its general orientation is subordinated to achieving a state of balance between internal and external interaction with the natural and social environment, and now with the cyber-technogenic one.

Moreover, often these changes are asynchronous, leading to states of imbalance with the external and internal world, both at the level of heteroqualitative natures and psychic spheres. Additionally, all this takes place in changing nature, technogenic, social, and cyber environment in individual psychological and activity dynamics. In this process, there are peculiar bifurcation points that figure out the transition from one qualitative state to another.

A special issue is an interaction between the system elements, which leads to acquiring a new quality that cannot be reduced to its components' simple sum and mechanisms. The most known attempts of this problem solution relate to the names of outstanding metatheorists – K. Lewin [14] and A. Bandura [2]. In his Field Theory, K. Lewin describes the behavior as a function of the personality and its external environment  $B=f(P, E)$ . Characterizing K. Lewin's approach as unidirectional, A. Bandura has offered partly directional transformation of its formula  $B=f(P \rightleftharpoons E)$ , later being transformed into the principle of reciprocal determinism, representing the interaction of elements as mutually directed.

Interdetermination has been proposed as such a mechanism. At the same time, interdetermination is understood as a process and result of interaction, which manifests itself in the acquisition of a new qualitative state by the whole. The interdetermination relation emphasizes the mutually affecting and

mutually changing character, leading to qualitative changes in the interdeterminants components. Any change in one of the elements inevitably leads to a change in all interconnected elements. The changes that have occurred lead to the heterogeneous system quality transformation itself, receiving growths in the form of expansion (or narrowing), rethinking, and re-experiencing the acquired experience. In this case, we are talking about the dynamic aspect of phenomenology, and the nonlinear dynamic systems approach productivity to the analysis in the psychic functioning temporary transformation [1, 3, 26]. These mutual influence on what is happening resources presents the R.M. Ryan and E.L. Deci self-determination theory [18]. A person can influence what is happening, but he/she must also be aware in its turn, what is happening has a direct impact on him/herself. Passive inaction leads to an increase in external influence, and activity that is not burdened with cultural heritage involvement dooms him/her degradation and increasing dependence on circumstances.

Interdetermination is dialogical in nature – an interaction based on the unconditional acceptance of the heterogeneous (polyphonic = multivoiced) nonlinear dynamic systems elements Otherness, aimed at finding the mutually acceptable structurally-substantive basis and forms (often of a compromising nature) that contribute to the formation of jointly created, coordinated, and internally accepted states of homeostasis (intersubjectivity, inter-existentiality, bio-psycho-social balance, and others), providing their optimal co-existence in the context of a specific social and natural environment in the framework of local (zone of proximal development) space and time and a more distant life perspective (zone of distant development). Currently, it is becoming increasingly clear that the conditions of social existence interdetermine consciousness [15]. Similarly, it is clear that this existence is affected by changes in the natural, technological, and cyber environment, and the influence of the latter on human behavior, including organizational and, especially, intercultural behavior, is extremely poorly understood. The psychological phenomenology and its components have a staged nature, implying a transition from one qualitative state to another, in a synergetic version, through the passage of specific points of bifurcation.

The sociocultural-dialogic nature of interdeterministic interaction is manifested in the interaction between the elements of a heterogeneous nonlinear dynamic system, suggesting the dialogic nature of thinking, manifested: firstly, unconditionally accepting the Other, secondly, expanding horizons of comprehension, thirdly, gaining a new quality by the interacting parties; fourthly, the formation of community, compatibility (intersubjectivity, inter-existentiality), contributing to mutual understanding and coordinated interaction.

Due to intersubjectivity and inter-existentiality, it becomes possible to form shared meanings and experiences that make up the formation of the shared sociality, without which society ceases to be so, transforming into the mechanical unity of isolated individuals of a hedonistic sense, organizational and acting according to external management. As I. Markova notes, "The loss of commitment to one's words could result in the author's loss of self-identity and authenticity. Dialogicality implies a contract: responsiveness and responsibility. There can be no word without a speaker—words have their history. There can be no word without the self" [16, P. 258].

It should also understand that humans are not passive temporizers to this "new reality." They should actively participate in its co-construction, co-building, striving to achieve a balanced state of interaction with the social, natural, technogenic, and cyber environment. In turn, the achieved state of balance has an inertial effect on a particular time perspective before achieving contradictions of the critical mass state or bifurcation point. The transition to a qualitatively new state always presupposes changes in worldview, attitudes, habits, behavioral algorithms, experiences and feelings, and many other things determining their existential being-in-the-world.

Today it is becoming more and more evident that the new and innovative are displacing the old and the obsolete in a dynamic process. In search of a new meaning of "being human (and of being social as well), what we urgently need is to embrace exponential transformation and build a shared digital future in an agreed, reflective, sustainable, inclusive, and value-sensitive manner, over against fault lines and rifts" [22, P. 10].

## 5. Conclusion and theoretical implications

First, the system-synergetic analysis considers the psychological phenomena as heterogeneous, nonlinear, and dynamic, not as closed and static. Second, cyberpsychology phenomenology should be

understood as having a sociocultural-dialogic-interdeterministic character. Third, overcoming the limiting framework of personocentrism and environmentalism in isolation by giving them an interdeterminist character and connecting an active interdeterminant acts as a mutually conditioning part of the behavior process. Forth considers the ongoing changes in the context of acquiring a new quality by the system, which cannot be reduced to a simple sum of the elements composing the whole.

Characterizing the presented metatheoretical approach in general, we can state the following:

1. The starting point is the complex bio-psycho-social culturally conditioned heterogeneous nonlinear dynamic nature of the cyberpsychology phenomenology functioning in natural, social, cyber, and technogenic reality. Awareness that many personalities, psychic disorders, and psychological problems are associated with biological disorders manifested in psychic activity disorders and, conversely, many of the biological level dysfunctions have a psychological underpinning (a glaring example of which are numerous psychosomatic disorders). These and others are often provoked by social disharmony (and, in turn, determine it), which is actualized in interpersonal contradictions and related interpersonal and intrapersonal conflicts, which cause discomfort in social interaction resulting from dissatisfaction with oneself.

2. The biological – psychic – symbolic, as well as the conscious – unconscious – existential, personality – environment – activity, and natural – social – technogenic – cyber realities, are in a state of dialogic interdetermination, manifested in their interdependence and mutual influence, expressed in acquiring a new quality not reducible to the simple sum of its constituent parts. A qualitative change in one element inevitably leads to changes in designated heterogeneous system interconnected elements and vice versa. In particular, unbalanced immersion in technogenic and cyber reality leads to various kinds of dependencies. The acquiring of dynamic heterogeneous system new quality presupposes the preliminary preparation of each of the elements for the future qualitatively new state, including the bio-psycho-symbolic and cultural preparedness formation, awareness of the new state uniqueness and the potential changes associated with its acquisition, preventive correction of potential unconscious contradictions and inconsistencies fixed in the experience of the old new, contributing to the existential acceptance of the altered self in his being-in-the-world and recognizing himself as a self-interdependent agent.

3. The heterogeneous nonlinear dynamic system's optimal state is provided through the dialogue of heteroqualitative natures, psychic spheres, and behavioral interdeterminants, ensuring the holistic functioning balance by finding and mutually developing mutually acceptable compromises and co-existence optimums. Once this balance is broken, various disharmonies and dysfunctions begin to manifest, stimulating the overcoming resources search. The specificity of the dialogical form of interaction in the dynamic heterogeneous system is manifested in the co-participants Otherness unconditional acceptance in the functioning process, orientation toward finding mutually reinforcing solutions, the formation of special kind bio-psycho-symbolic, consciously-unconsciously-existential homeostasis, creating a common basis for coordinated and synchronized mutual understanding and mutual development in the context of the specific natural, social, technogenic and cyber environment and being carried out activities.

4. The deepening and expanding interaction with a qualitatively new type of cyber-technogenic reality can lead to ecological balance violation of functioning in society. Digi- and cyber- autism manifest in this kind of imbalance, expressed in self-isolation and existential loneliness. The destruction of the being-in-the-world balance, in turn, can lead to severe mental disorders, the growth of which is becoming increasingly evident. Therefore, one of the cyberpsychology's primary tasks should be searching for possible forms of restoring the eco-balance and its conditions. Otherwise, *Homo Ludens* may be replaced by *Homo Cyberis* and *Homo Virtualis* with all the ensuing destructive consequences. As well as the need to shift the focus of cyberpsychology away from quantitative, experimental approaches exploring the 'effects' of human-computer interaction and towards a focus on the subjective experiences and sense-making of users in everyday contexts.

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# The Experience of Distant Psychological Help Organization in Telemedicine During COVID-19 epidemic

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## Abstract

The COVID-19 epidemic changed the possibilities of traditional psychological help due to social isolation mode. The demand for psychological help increased in difficult and complicated time of health and life threats and movement limitations. Many psychological problems were developed during epidemic: fears, anxiety, depression, destructive coping strategies, aggressive behavior, feeling of losses. The project of distant psychological help organization in telemedicine during COVID-19 epidemic was realized with the participation of more than 3026 clients. New algorithms of psychological work were developed and realized, The data allowed to analyze client's demands in dynamic in different stages of COVID-19 epidemic. Age and gender differences of preferences for distant psychological help are defined.

## Keywords

Distant psychological help, telemedicine, COVID-19 epidemic

## 1. Introduction

The spread of COVID-19 epidemic led to sharp increase of quantity of people that were isolated to save their health. Up to fifth month of COVID-19 epidemic more than 2,6 billion of people were in isolation and limits of free movement [1]. In further the expansion of restricting measures to prevent the COVID-19 epidemic increased the amount of people that were forced to follow the rules of social isolation. The stress feelings are linked with the fear to infect yourself and your family with the deficit of effective treatment models and limits of coping behavior including orientated on social support. That situation creates space to degradation of psychological well-being, somatic health and social relations [2; 3; 4; 5; 6; 7; 8]. The method of struggle with developing infections such as movement limitations, quarantine restrictions are the factors of development of psychopathology symptoms [9; 10]. The recent investigations in countries affected by the COVID-19 epidemic showed bad dynamics. In China cities closed due to the COVID-19 epidemic were revealed the increasing of symptoms of post-traumatic stress, depression and anxiety disorders [11; 12].

The research in Italy showed that more than a quarter part of respondent's esteem depression symptoms, intensive fears and distress. The distress factors are the fear to get infected by potentially fatal illness, the feeling of constant nonvisual threat as radiation [13; 14]. Earlier research about psychological reaction on infective illnesses showed that high speed and stealth uncontrolled disease transmission develop high anxiety level and fears [15]. The decreasing level of resilience in conditions of prolonged experience of anxiety and fear can effect on use of destructive coping strategies [16]. The results on US sample showed the increasing level of aggressive behavior orientated on myself: the increasing level of suicide feelings and actions to deliberate infection of yourself [17]. The results on Russian sample showed that quarter of respondents point the necessity for psychological help and support (22,3% of the sample). People with higher demand for psychological help showed higher level of psychopathology symptoms, higher suicide risks. The

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increasing level of anxiety, depression symptoms, somatization, psychoticism, paranoia symptoms were defined [18]. The investigation allowed to define that people need the prophylaxis and prevention of suicide behavior, decline of perfectionism in the situation with no chances to do everything ideally due to limitations, recovery of image of future, education of emotional self-regulation practices, development of repertoire of ways of complacency, mastering of effective and available active coping strategies in COVID-19 epidemic and orientation in digital alternative for usual leisure. Thus, the necessity for organization of effective distant psychological help in situation of movement limitations and social isolation mode became obvious.

There are a lot of investigations that demonstrate the rather high efficiency of distant psychological help in different forms of somatic disorders (oncology, diabetic) and mental (depression) disorders [19; 20; 21; 22; 23]. Thereby the effective organized distant psychological help can be the equaling to traditional forms of psychological practice [24].

The distant form of medical help by telemedicine technologies was working well in Russia up to the moment of quarantine limitations in spring 2020. In 2018 the Federal Law about telemedicine was accepted and it led to increase of different services and platforms with mostly medical help. The telemedical service during spread of COVID-19 epidemic became an opportunity for patients to get quality medical help with no risk to health without leaving homes and shelters [25].

The experience of psychological help through telemedical services was not so big up to the moment of COVID-19 epidemic limitations. The experience of countries that earlier confronted the of COVID-19 epidemic demonstrates that the psychoprophylactic measures were very different. In China the online services with social networks and electronic mails were activated, online lessons of psychological support aimed on educational content how to overcome frustration and affective reactions were realized [26]. In Italy the initiative #psicologionline aimed to define forms of psychological intervention during COVID-19 epidemic was realized: online questionnaires to define risks and factors of potential psychological ill-being, psychological support of medical service and medical workers through smart devices, distribution of informational materials about psychological consequences of limitations and social isolation. The fast development of programs to manage online-consultations with video connection and message exchanges for patients that got used to personal consultations with psychologist and psychiatrists [27]. In Spain the idea of early psychological intervention included informational support by distribution of psycho hygiene, distant therapy through application and mobile phones [28]. At the same time telemedicine in remote regions was regarded only as a phone consultation [29]. In our country, hotlines for psychological help have been opened by various foundations and government agencies; private counseling platforms announced "open days," setting aside «pro bono» hours for those who cannot afford paid counseling. An analysis of phone calls for psychological help to the round-the-clock emergency telephone of the Moscow psychological service for the population during the COVID-19 epidemic in the spring of 2020 showed that there is a sharp increase in calls for urgent acute stressful experiences, anxiety, panic attacks [30].

However, there were practically no proven strategies and guides for psychological assistance in the telemedicine format. It wasn't until June 2020 that an adaptation of the Cognitive Behavior Approach (ICBT) protocols was published to help people with exceptionally high levels of anxiety and distress associated with COVID-19 [31]. In the fall of 2020, the results of the development of a protocol for telemedicine medical care, recommended by World Health Organization experts to solve the problems of telepsychiatry during the COVID-19 epidemic, appeared [32]. Thus, in the situation of the need for measures to prevent the spread of the SARS-CoV-2 virus, the use of telemedicine tools was considered by the community as the most accessible and practical way to alleviate the psychological state of the population. Strategies for providing such care by mental health professionals had to be practiced on the fly.

## 2. The Method

The author of the article was one of the leaders of the organization of distant psychological assistance in the framework of a large telemedicine project. During the work on providing free online consultations with psychologists for residents of all regions of Russia, 3026 people ask for distant psychological help. The project of the psychological support hotline involved 25 psychologists from

various psychological schools. Each of the candidates passed the selection and preliminary training in a new format of work: technical features of the platform, basic information about the current situation with coronavirus infection, the specifics of the psychologist's work on the hotline in various formats. Psychologists were helped to navigate the needs of clients who applied to the line by personal work experience, as well as the passage of mandatory supervisory and intervention meetings. The former were carried out in individual and group formats, the latter only in group formats. In addition to the control and support function of such meetings, supervision also performed an educational task, implying the integration of the experience of psychologists working on the hotline, and the development of a common understanding of the schemes and formats of work in the conditions of telemedicine psychological support [33]. During the work of the line, 5 collective supervision meetings were held, dedicated to the work on the most relevant blocks of requests: 1) empathy opportunities in the telemedicine format; 2) the planning horizon of the future client; 3) assistance in dealing with anxiety and fears in the format of a hotline; 4) work with grief and loss in a telemedicine format; 5) work with family crises.

The capabilities of the telemedicine platform made it possible to consult with the client within the framework of a chat message, audio call or video call. To improve the quality of work, the video communication format has always been declared preferable, however, the choice has always remained on the client's side. The choice of the form of work was determined by the preferences of the client, as well as the specifics of possible technical restrictions: violation of the signal quality, disruption of the video image during use, delay in video and sound, disruption of the audio signal. In distant psychological work when a lot of attention was paid to establish and maintain confidential contact, such technical difficulties can significantly reduce the effectiveness of the psychologist's work, including in conditions, when these difficulties are not caused by the psychologist's own mistakes [34].

The peculiarities of psychological counseling in these modalities entailed a necessary stage of adaptation of the manner of conducting clients by psychologists to the new format. Despite the fact that in the modern world consulting using Skype or Zoom platforms has already gained sufficient popularity among specialists, the need to introduce a setting framework was actual, taking into account such factors as:

- spatial placement (a person can be anywhere and do anything while contacting a psychologist on the hotline);
- maximum anonymity (with the exception of the video format of the appeal, the psychologist does not see his client: his emotions, non-verbal manifestations, environment);
- unpredictable dynamics of contact and limited time (the client can interrupt the conversation at any time, simply by disconnecting the connection or being distracted by personal affairs);
- disinhibition effect (decrease in the level of ethical and moral qualities of the interlocutor due to remoteness and anonymity).

With an understanding of the specifics and limitations of the telemedicine consultation format, unified guidelines for work were developed, which included several stages:

Stage 1. Establishing contact and identifying customer needs. Determination of the purpose of the call, the presence of a request for consultation with a psychologist, clarification of the current emotional state of the client. The main theoretical prerequisite for work at this stage is the understanding that the first condition for psychological changes in the state is contact with a psychologist [35].

Stage 2. The main part of the consultation.

2.1 Normalization / empathic confirmation - using the technique of recognizing the client's feelings and thoughts as natural and understandable in a given situation, if you look at the situation from his position [36]. With the help of responses, the psychologist confirms that the client's position and feelings are recognized by him. This reduces anxiety and increases the sense of security in the advisory alliance, and also gives the client freedom to explore their own feelings [37].

2.2 Support - using feedback techniques, demonstrating understanding, caring and acceptance, helping to build trust in your own experiences, motivational support

2.3 Resource - assistance to those who applied in the mobilization of their intellectual, personal, spiritual, creative and physical resources to get out of the crisis. Expanding the range of socially and

personally acceptable means for clients to independently solve problems and overcome existing difficulties, strengthen self-confidence.

2.4 Building an "event horizon" in the short and medium term. Determination of a plan of small, but sequential actions, designation of the zone of immediate human actions, client routing within the framework of the decisions made and the desired result.

Stage 3. Conclusion.

Generalization, recommendations, informing clients about the activities of other services and organizations of psychological support; accompaniment of the consultation with the text of the exercises (if necessary) and memos.

Thus, if at the first stage of work there was a rapport between the client and the psychologist, then the principle of organizing the further work of the psychologist made it possible to achieve different levels of elaboration of the request, but to provide feasible support to the client at any of the available levels of immersion in the problematic.

The manifestation of empathy in the telemedicine format prevailed of particular importance. Empathy, as a phenomenological understanding of the experience of another person, acts as the primary link of acceptance and forms the basis for the formation of empathic contact between the psychologist and the client [38]. Skills in empathic listening techniques include the use of pauses, clarifications, paraphrases, echo statements, reflection of feelings, analysis of linguistic parameters of speech, paralinguistic and extralinguistic aspects (sounds, intonation, tempo, pitch, timbre), non-verbal communication ("body language" - facial expressions, pantomime, proxemics, tactile contacts). Showing empathy in telemedicine has proven to be a non-trivial task. Researchers have repeatedly pointed out that patterns of empathic acceptance, especially expressions of empathy, in the format of online communication are less obvious to a person [39; 40; 41].

While working on the hotline, psychologists faced the following difficulties:

1) Asynchronous communication. The pauses provided to the patient could be used not for intrapsychic work, as the psychologist-consultant implied, but for distracting the client to everyday issues, communicating with others, changing one's location. On the other hand, the patient's dissatisfaction with the speed of the consultant's reaction could be due to technical overlaps, the speed of the Internet connection, the need for time to write recommendations or attach the necessary document, instructions, memo.

2) Difficulty interpreting non-verbal cues. The format of telemedicine consultation makes it difficult to interpret both a person's body language and limits access to information about the state of his autonomic nervous system (redness, blanching, sweating, etc.). In this regard, the video format is certainly more informative, but it also limits the visual field only to a certain position of the client and the consultant's body [42].

3) Maintaining visual contact. The difficulty of maintaining eye contact can be caused by distractions, a decrease in the importance of the communication environment with the use of gadgets, and the inability to keep a gaze on the screen of a technical device for a long time (for example, due to a feeling of pain in the eyes).

When determining the duration of communication with a client on the psychological support hotline, we were guided by the boundaries adopted in full-time practice of 50-60 minutes. At the same time, in the course of the work, a dynamic modification of the time frame was also allowed. Inappropriate requests (not directly or indirectly related to COVID-19 issues) could be shorter - about 20-30 minutes; if necessary, for example, with acute symptoms, the duration of the dialogue could reach up to 1.5 hours. In their work, the hotline psychologists were guided by the central postulate - the need to provide primary psycho-emotional support. That is, the emotional state of the person who applied after communicating with the psychologist should be more stable than before contacting the line.

### 3. The Data

The analyzing data consists of 3026 subjects – clients of distant psychological help service. All subjects were voluntary demanding for psychological help on their own initiative. The information about free distant psychological help was distributed through the internet resources. The age of the

clients varied from 19 to 69 years with the following distribution: groups of 19-24 years old constitutes 16% 25-29 years - 33%, 30-34 years -25% ,35-39 years – 16%, 40-44 years – 6%, 45-69 years–4%. The sex distribution was 76% of women and 24% of men. The geography of calls included regions from all Russia, regions residents were more active than Moscow residents. Due to confidential rule of psychological help no social information (professional status, family status and etc.) was collected. No special diagnostic questionnaires were used – only the dialogue between psychologist and client realized according to the telemedicine consultation format described above.

#### 4. The Results

The analysis of dynamic and content of requests for distant psychological help during the COVID-19 epidemic on the bases of 3026 clients demands allowed to define several tendencies.

First, there is a clear dynamic of the total number of people who applied to the line, depending on the time perspective and the growing or declining nature of the epidemic. Since the introduction of quarantine measures and the launch of the online psychological support line, the increase in requests has been systematic. The percent distribution of calls for psychological help in months of work of distant psychological help was the following: end of March and April – 25% of all calls, May – 41% , June – 34%. The peak of requests fell in May 2020 and lasted until the end of June, when the number of requests was also systematically decreasing with a gradual improvement in the epidemiological situation in the country. The resulting dynamics can be associated both with the popularization of the very format of distant forms of interaction in conditions of self-isolation, and with the search by the population for new forms of coping with increased anxiety and other unfavorable psychological symptoms (sleep disturbances, phobia, obsession, depression).

Secondly, we can talk about the gender specificity of requests for distant psychological help - 76% of requests came from women and 24% from men. The women showed high readiness to addressing for psychological help in distant format as the same it happens in traditional forms of psychological support. That correlates with different results of other investigations: women are more active in search for psychological help both in offline and online forms.

Thirdly, the analysis of age specifics showed that the greatest demand for online consultations of the hotline of the psychological service was demonstrated by the age group from 25 to 34 years old – 58% of the sample. The question of extension of popularity distant psychological help between clients from other age groups is actual. The age group of special interest is 35+ that often are ready to ask for psychological help but are not confident in efficiency of distant forms and don't feel comfortable in internet format. For the group of younger than 25 years old the reason for lower popularity of distant psychological help is the fact that they often don't perceive psychological help as necessary at the moment.

Fourthly, we can talk about the time dynamics of the hotline requests themselves. At the beginning of epidemic and period of self-isolation for April 2020 data, the most popular requests were: anxiety about their health and the health of their loved ones (the need to attend work, outrage at non-observance of the mask regime on the part of other citizens) – 27% of requests, fear of the uncertainty of the future in conditions of blurred boundaries of social restrictions (where to get food, how to pay for electricity , if there is no work, etc.) – 21%, a feeling of loss of control over life in the current living conditions – 18%, depression symptoms – 11%. Anxiety and fears have been in demand throughout the entire operation of our psychological support hotline. About 80% of requests included fears of contracting a new coronavirus infection. The hotline's therapeutic area faced a stream of worried patients: in a situation of uncertainty and the threat generated in the media, people were inclined to interpret their physical condition (cough, fever, shortness of breath, diarrhea, conjunctivitis) in favor of carrying SARS-CoV-2 symptoms, and contacting a telemedicine doctor was considered as one of the possible coping strategies for overcoming the state of increased anxiety.

People talked to psychologists about the restrictive measures used: increased attention to hygiene procedures (washing hands, wearing masks and gloves), avoidance and self-distancing behavior (refusal to travel on public transport, visit public places, restriction of going out). At the same time, there were many complaints and concerns about non-compliance with the recommended preventive measures among their social environment. In their consultations, the hotline psychologists also

observed a wide range of reactive reactions to fear of infection - from concerns about their health to the use of violent measures to impose isolation. Among the physiological manifestations, panic attacks, sleep disturbances, apathy or hyperexcitation were often mentioned.

While empirical research on fear and anxiety about COVID-19, or "coronaphobia," as Asmundson and Taylor put it in March 2020, is still in its early stages of development, practice has clearly demonstrated this new phenomenon. The latest research traces the relationship between the fear of infection with a new coronavirus infection with psychological stress, depressive manifestations, generalized anxiety and fear of death, draws attention to the correlation with some factors of vulnerability - neuroticism, anxiety about health and behavior aimed at seeking support [43]. Dealing with fear of infection and viral anxiety in the telemedicine format of providing psychological assistance had several advantages. Firstly, it did not imply direct contact between the psychologist and the client and, therefore, completely eliminated the risk of transmission of the disease. Secondly, the remote format removed the tension of social stigmatization, expressed in the spread of bias, stereotypes and discrimination against carriers of the virus and patients, which, according to WHO, was one of the most urgent consequences of the 2020 pandemic.

The second most popular queries were those related to discomfort from the inability to leave the house, anxiety due to the lack of a unified treatment plan for coronavirus infection, panic attacks that first manifested themselves or worsened against the background of the influence of stress.

After a long stay of the population in self-isolation (end of April-May 2020), the focus of inquiries has shifted somewhat. Problems in marital relations, relations with children, relatives, neighbors, associated with the need to stay in a confined space for a long time (27% of the data), as well as the emerging feeling of guilt from violating the prohibition on self-isolation in the prevailing family circumstances, came to the first place (22% of the data). Appeals appeared related to the experience of grief about a serious condition or the loss of a loved one (14% of the data). The prevalence of treatment of people with psychopathological symptoms (sleep disturbances, phobias, obsessions, depression) continued to increase.

There was an increase in the situation of actual population requests for psychological assistance in connection with grief and loss from the loss or grave condition of loved ones. If at the beginning of the hotline's work, such requests were sporadic, then by the time the level of epidemiological indicators reached the maximum estimates in spring 2020, the number of people who faced the death of loved ones from COVID-19 began to grow steadily. In addition, the growing barriers to access to health care, the decline in the priority of mental health, the economic downturn, neglect and violence at the level of interpersonal relationships, catastrophic media coverage of what is happening, all of this led to the actualization of such manifestations as: a sense of loss of health, time, relationships, expectations, trust, money, etc. The emergence of such requests has turned the work of psychologists to differentiate between primary and secondary losses [44].

At the final stage of self-isolation, in June 2020, before the lifting of quarantine restrictions, the nature of the requests also changed. More and more "inappropriate" calls appeared. People addressed the accumulated problems and questions about getting out of self-isolation: how to restore the study schedule, how to change jobs, how to wean the child from the uncontrolled use of gadgets - which spoke about the natural processes of the population coming out of the self-restraint regime and expanding the horizon of planning their lives (84% of the data).

Thus, the dynamics of population requests when citizens contact the hotline for psychological support in the first wave of self-isolation demonstrated well-known mechanisms of a person's reaction to stress factors - anxiety, concern about real and hypothetical problems, loss of life resource, and an increase in the level of psychopathological symptoms. She also discovered the necessary adaptive reactions - limiting the scope of contacts and areas of responsibility, shifting the focus of attention to personal problems, making short-term decisions, limited by the lack of clear prospects for the development of the epidemiological situation [45].

The experience of distant psychological help organization in telemedicine during COVID-19 epidemic showed the effectiveness of that form in limitations of social contacts. The distant of psychological service was demanded by population with high internet involvement, mostly women with different requests connected with different problems caused by COVID-19 epidemic.

## 5. Conclusions

The experience of distant psychological help service showed good efficiency and it was in demand by Russian population. Clients from different regions of Russia used the free service to reduce their anxiety, overcome fears, stress and loses feelings. The work with affective state was highly demanded. The role of psychological support and possibilities for emotional reaction in save space was important for most subjects. The dynamic of requests for psychological help depending on the stage of COVID-19 epidemic was revealed. The practical significance of the empirical experience is the proved efficiency of distant psychological help. The limitations of online psychological help shown in the investigation are the enough narrow age range of most clients, the restriction of quantity of meeting with one client due to online format, the importance of technical possibilities for constant interaction during the session. The perspectives of the distant psychological help service are the creation of constant working online psychological support with differentiation for various types of psychological demands of the potential clients.

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# Aggression, Impulsiveness and Gaming Motivation in Young Adult Video Gamers: An Empirical Study

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## Abstract

The study aims to investigate the connection between video gaming motivation, aggression, and impulsiveness in a sample of young adult video gamers from Russia. Literature analysis suggests specific gaming motivations, e.g., competition, can contribute to higher general and verbal aggression. Gaming motivation and impulsiveness are both believed to partake in gaming addiction development, which in its turn raises aggressive tendencies and further enhances impulsiveness, according to some studies. An empirical study was conducted on a sample of 102 voluntary participants (48 men, 54 women) aged 18-33 years. Participants anonymously answered online versions of the following questionnaires: Buss-Perry Aggression Questionnaire; Barratt Impulsiveness Scale; Boiko's Integral Forms of Communicative Aggression Questionnaire, Yee's Motivations of Play in MMORPGs Questionnaire. Most participants showed normal levels of trait-level aggression and impulsiveness (according to the normative values suggested by questionnaires' authors). Gamers who played more than 10 hours per week showed higher physical, trait-level, and communicative aggression scores compared to those who played less than 4 hours per week. None of the gaming motivations were positively correlated with impulsiveness or aggression, except for a positive correlation between hostility and immersion motivation. No significant differences in gaming motivations were found between gamers with different lengths of regular gaming time. Generally, the study results neither support that video gaming increases aggression or impulsivity in young adults nor that higher gaming motivation contributes to those traits.

## Keywords

Computer games, video games, gamers, aggression, impulsiveness, motivation

## 1. Introduction

Video games are arguably one of the most popular forms of modern technology-based entertainment. Business analytics report there were almost 2.7 billion active video gamers worldwide at the end of 2020, and the estimates suggest there will be more than 3 billion in 2023 [1]. Such popularity and its rapid growth in the past years enhances scientific and social debates surrounding video games since the 1980s-1990s, including the question of whether violent video games (and video games in general) can increase aggression and impulsiveness in those who play them regularly, especially at the young age.

According to Christopher Ferguson, the history of violent video games research in the context of aggressive behavior is more than 30 years long already [2]. Still, the general agreement is yet to be achieved. For instance, in March 2020 American Psychological Association (APA) reaffirmed its position on violent video games as a risk factor for aggressive behavior, aggressive affect, aggressive cognitions, and a decrease in prosocial behavior, empathy, and moral engagement [3]. This

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resolution's scientific background and why many academic scientists disagree with its implementation due to methodological faults and weak statistical effects have already been explained in numerous articles (e.g. [4, 5, 6, 7]). APA's resolution is mostly based on General Aggression Model (GAM), proposed by Brad Bushman and Craig Anderson [8]. GAM suggests that violent media, including video games, can lead to the formation of aggressive cognitive scripts. Those scripts automatically provide the information on how to behave in certain situations and can also lead to interpreting ambiguous situations as threatening or hostile, thus leading to a more aggressive response. This model, to some extent, assumes that cognitive scripts cannot distinguish virtual and real-life situations, thus transforming virtual aggression experience into real-life situations. However, studies done under a different paradigm have found teenagers as young as 12-14 to fully recognize violent video game content as something that "you cannot do in real life," suggesting that at least consciously, they are quite capable of correct interpretation of real-life and virtual events [9]. A recent large-scale study also failed to find a link between violent video games and teenagers' aggressive behavior, supporting the idea that the relationship between video game violence and aggression is at least not as direct as supposed by GAM [10]. Yet, another model of violent behavior proposed by Ferguson, which includes more genetic and environmental factors and less relies on learned behaviors, suggesting that media violence has no causal but only a "stylistic" role in aggression, currently remains much less popular to GAM [4].

Along with aggression and violence research, numerous studies explored the connection between video gaming and impulsiveness [11]. Many video games require rapid responses to certain stimuli to succeed. Along with the possibility to replay part of the game in case of a mistake, this led many scientists to believe that video games encourage "trial-and-error" behavior with little critical thinking and reflection [12], provoking impulsiveness. If aggression can be taught through aggressive scripts, as GAM suggests, then impulsive behavior can probably be taught by certain video games in a similar way. Metcalf and Pammer found addicted first-person shooter gamers (first-person shooter or FPS is a game genre characterized by high levels of violence and requiring dynamic navigation through virtual environments and shooting multiple computer or player operated enemies) to have higher impulsiveness scores, compared to non-addicted FPS gamers or those who prefer strategic video games [13]. On the contrary, addicted MMORPG gamers were significantly less impulsive than non-addicted gamers of the same genre [14]. No significant impulsiveness specifics were found in non-addicted adult gamers, preferring online and offline games [11]. Thus, as supported by a recent systematic literature review, video gamers' impulsiveness seems to be associated with video game addiction more than with regular gaming experience [15] but should be considered genre-specific as well. There is also a link between aggression and impulsiveness in video gamers, as suggested by Gentile et al. longitudinal study report [16]. This study claims there is a bidirectional causality, in this case, meaning that not only more impulsive and violent teenagers are more likely to engage in violent video games, but that excessive gaming prevents normal cognitive control development, increases impulsiveness, and can even lead to the development of attention deficit disorder. Another study made during this longitude on the same sample also linked teenager gamers' impulsiveness to their chances to become pathological (addicted) gamers. No direct link between addiction, impulsiveness, and aggression was stated. Still, the authors suggested becoming an addicted gamer led teenagers to higher exposure to violent video games and the development of "normative beliefs about aggression, hostile attribution biases, and aggressive fantasies and to engage in more physically and relationally aggressive behaviors" [17, p. e325].

The third aspect we want to discuss in this study concerning the previous two is video gaming motivation. There are very few studies linking gaming motivation directly with aggression or impulsiveness. In a 2010 study, Xuemin Zhang et al. found both violent video games and competitive situations in non-violent video games to increase aggressive cognition and aggressive behavior [18]. In a more recent French study, the authors found that high achievement motivation, impulsiveness, and longer gaming time per week contributed to higher verbal aggression in online gaming situations. Socializing gaming motivation, on the contrary, performed as a protective factor against changing the gamer's behavior into being more "toxic" or verbally abusive during playing games [19].

Additionally, some studies explore the role of video gaming motivation in the development of gaming addiction (which, as mentioned above, can contribute or be the result of higher impulsiveness and/or aggression). Nick Yee, the author of a popular model of online gaming motivation, considered

high escapism and, to a lesser degree, advancement motivations to be gaming addiction development factors [20]. Escapism motivation means that the game is used to hide from real-life problems and conflicts, and advancement motivation describes the gamer's desire to progress in the game, to get more levels, resources, and status for their character. Other studies named immersion [21] and social [22] gaming motivations as possible predictors for video game addiction, suggesting that various motivations can be associated with video game overuse but do not inevitably do so.

Thus, while there is some empirical evidence that video gamers' aggression, impulsiveness, and gaming motivations are interconnected (possible through their role in video gaming addiction development), there are not enough studies to fully establish or understand those connections. To contribute to this field, we conducted empirical research on our own.

Based on the review above, we assumed the following hypotheses for the empirical testing:

1. A considerable part of the video gamers sample has high levels of trait-level aggression and impulsiveness based on normative values proposed by the authors of corresponding questionnaires.
2. Different aspects of aggression (physical and communicative aggression, anger, hostility) positively correlate with impulsiveness in the video gamers sample.
3. Gamers who regularly spend more time playing video games have stronger gaming motivation, specifically – higher escapism and advancement motivations.
4. Gamers who spend more time a week playing video games have higher scores in aggression and impulsiveness.
5. Gamers with higher competition, advancement, and achievement motivations have higher aggression scores.
6. Male gamers have higher achievement, advancement, and competition gaming motivations and higher physical and communicative aggression levels than female gamers.

## 2. Materials and Methods

### 2.1. Participants

The sample included 102 voluntary participants (48 men and 54 women) from Russia, aged 18-33 years (mean age 22.62; median age 22; standard deviation 2.96) who participated in anonymous online research using Google Forms. The link to the online form was shared through social networks. To proceed with the questionnaire, the participants had to agree with the informed consent form and answer positively to the question of whether they currently (during their adulthood) occasionally play computer-based video games.

### 2.2. Methods and Procedure

The online response form consisted of five parts, presented to the participants in the following order:

1. A socio-demographic survey also included questions about time regularly spent playing video games (less than 4 hours; 4-10 hours or more than 10 hours per week) and preferred video game type (online, offline, or both).
2. Buss-Perry Aggression Questionnaire (BPAQ) [23] in Russian adaptation by Enikolopov and Tsybulsky [24]. This adapted version consists of 24 5-point Likert scale items. It includes three sub-scales (instead of four scales in the original questionnaire): physical aggression, anger, and hostility. Trait-level aggression is measured as a sum of those three sub-scales.
3. Barratt Impulsiveness Scale (BIS) [25] in Russian adaptation by Enikolopov and Medvedeva [26]. The questionnaire consists of 30 items. For this research, we only used the general impulsiveness score.
4. Integral Forms of Communicative Aggression Questionnaire by Boiko [27]. Due to the Russian BPAQ adaptation lacking the verbal aggression scale, this questionnaire was added to the

battery. The questionnaire consists of 55 yes-no items, and only the general communicative (verbal) aggression score was used in this study.

5. Yee's Motivations of Play in MMORPGs Questionnaire in Russian adaptation by Epishin, Bogacheva, Milyanskaya [28]. This adapted version of the questionnaire retains the original questionnaire structure. It includes three main scales representing the main types of online gamers' motivation (according to Yee): achievement motivation, social motivation, and immersion motivation. Each of the scales includes several subscales as well. Those are mechanics, advancement, and competition sub-scales in the achievement motivation scale; socializing, relationships, and teamwork sub-scales in the social motivation scale and discovery, escapism, role-playing, and customization sub-scales in the immersion scale of the questionnaire. This version consists of 24 5-point Likert scale items.

Due to most data's non-normal distribution, non-parametric statistical methods were used, including Mann-Whitney U-test and Kruskal-Wallis H test for group comparisons, Spearman's rank correlation coefficient for correlation analysis. All statistical procedures were performed in IBM SPSS Statistics ver. 23.

### 3. Results

#### 3.1. Aggression and Impulsiveness in Adult Video Gamers

While the study's design did not include a control non-gamers group, the questionnaires we used allowed us to compare our sample with normative values proposed by the authors of the corresponding questionnaires [24, 26, 27]. For BPAQ scales, those levels were based on mean and standard deviations and allowed to assign participants to "low level," "medium level," or "high level" groups separately for each of the scales and the trait-level aggression. BIS only recognized a "non-clinical" level of impulsiveness (below 70 scores), clinically significant high impulsiveness (70-75 scores), and very high impulsiveness, which might indicate impulsiveness control disorder (above 75 scores) [26]. Boiko's Integral Forms of Communicative Aggression Questionnaire provided normative values for five levels of communicative aggression [27]. According to those values, none of the participants in our sample scored either "very low" or "very high." Most of the current sample participants had low to medium impulsiveness and aggression levels (see Table 1).

**Table 1**

Descriptive statistics and levels of aggression and impulsiveness among video gamers sample

Measurement	Means and standard deviations in the sample	Min-max scores in the sample [min-max scores possible]	Number of participants with different levels of the measurement (%) in the sample
Physical aggression	M = 20.27; SD = 4.92	9-36 [9-45]	Low: 38 (37.3%); Medium: 61 (59.8%); High: 3 (2.9%)
Anger	M = 18.16; SD = 5.06	7-30 [7-35]	Low: 27 (26.5%); Medium: 71 (69.6%); High: 4 (3.9%)
Hostility	M = 20.24; SD = 4.68	8-32 [8-40]	Low: 26 (25.5%); Medium: 70 (68.9%); High: 6 (5.9%)
Trait-level aggression	M = 58.67; SD = 10.19	35-85 [24-120]	Low: 39 (38.2%); Medium: 62 (60.8%); High: 1 (1.0%)
Impulsiveness	M = 63.58; SD = 8.25	49-87 [30-120]	Normal: 76 (74.5%); High: 18 (17.6%); Very high: 8 (7.8%)
Communicative aggression	M = 21.46; SD = 6.30	12-37 [0-55]	Low: 47 (46.1%); Medium: 45 (44.1%); High: 10 (9.8%)

Those results suggested that most of our participants had medium levels of physical and communicative aggression, hostility, anger, and trait-level aggression. However, about ¼ of the sample had increased impulsiveness levels (according to [26]).

According to  $\chi^2$  statistics those highly impulsive gamers were relatively equally distributed between different preferred game types ( $\chi^2 = 7.580$ ;  $p = 0.108$ , insignificant) or regular gaming activity ( $\chi^2 = 2.947$ ;  $p = 0.567$ , insignificant) subgroups.

Table 2 shows correlations between BPAQ scales, impulsiveness, and communicative aggression.

**Table 2**  
Aggression and impulsiveness scales correlations

	BPAQ trait-level aggression	BIS impulsiveness	Communicative aggression
Physical aggression	-	0.185 ( $p = 0.062$ )	0.517 ( $p = 0.000$ )
Anger	-	0.290 ( $p = 0.003$ )	0.398 ( $p = 0.000$ )
Hostility	-	0.070 ( $p = 0.483$ )	0.228 ( $p = 0.021$ )
Trait-level aggression	-	0.258 ( $p = 0.009$ )	0.567 ( $p = 0.000$ )
Impulsiveness	0.258 ( $p = 0.009$ )	-	0.297 ( $p = 0.002$ )
Communicative aggression	0.597 ( $p = 0.000$ )	0.297 ( $p = 0.002$ )	-

As seen in Table 2, physical aggression, anger, and trait-level aggression had significant positive correlations with impulsiveness. Communicative aggression positively correlated with physical aggression, hostility, anger, trait-level aggression, and impulsiveness.

In Table 3, we compared video gamers groups with different levels of regular gaming activity. To specify the obtained differences, a pairwise comparison was performed with Dunn's test with Bonferroni correction.

**Table 3**  
Aggression and impulsiveness scales in groups with different regular gaming activity

Scale	(1) Less than 4 h/week (n = 28)	(2) 4-10 h/week (n = 30)	(3) Over 10 h/week (n = 40)
Physical aggression*	M = 18.79; SD = 4.83 <sup>(3)</sup>	M = 19.73; SD = 5.38	M = 21.59; SD = 4.40 <sup>(1)</sup>
Anger	M = 15.89; SD = 4.86	M = 18.63; SD = 4.23	M = 19.27; SD = 5.33
Hostility	M = 19.71; SD = 5.35	M = 20.20; SD = 4.41	M = 20.59; SD = 4.47
Trait-level aggression*	M = 54.39; SD = 9.23 <sup>(3)</sup>	M = 58.57; SD = 10.19	M = 61.45; SD = 10.19 <sup>(1)</sup>
Impulsiveness	M = 64.18; SD = 10.05	M = 62.63; SD = 7.59	M = 63.84; SD = 7.52
Communicative aggression**	M = 18.89; SD = 5.50 <sup>(3)</sup>	M = 20.63; SD = 6.57	M = 23.66; SD = 5.95 <sup>(1)</sup>

\*\* - significant,  $p < 0.01$ ; \* - significant,  $p < 0.05$ ; <sup>(n)</sup> – significant difference when pairwise compared to group n

As seen in Table 3, there were no significant differences between groups in anger, hostility, or impulsiveness. However, the least active gamers, who regularly played less than 4 hours per week, had significantly lower physical aggression, trait-level aggression, and communicative aggression compared to the most enthusiastic gamers, who played more than 10 hours per week.

No significant differences were found between gamers, who preferred online, offline, or both types of video games in physical aggression, anger, hostility, trait-level aggression, or impulsiveness. However, offline gamers had significantly lower communicative aggression scores than online gamers ( $H = 6.363$ ;  $p = 0.042$ ;  $M_{\text{online}} = 23.78$ ;  $SD_{\text{online}} = 7.75$ ;  $M_{\text{offline}} = 19.35$ ;  $SD_{\text{offline}} = 5.75$ ).

### 3.2. Sex-related Specifics of Aggression, Impulsiveness and Gaming Motivation

Most of the studies suggest there are differences between male and female gamers in their motivation for gaming. According to Yee, male gamers have higher achievement, advancement, mechanics, and competition motivations and lower relationship and customization motivations than female gamers [20]. Men are also usually considered more aggressive than women [24], and video gamers' research also tends to find them more verbally aggressive [19, 29].

In our study, there were no significant differences between men and women gamers distribution across groups with different regular gaming activity ( $\chi^2 = 3.296$ ;  $p = 0.192$ , insignificant). However, women were more likely to prefer offline games only, while men were more likely to choose online games only ( $\chi^2 = 6.291$ ;  $p = 0.043$ ).

In our sample, male and female gamers did not significantly differ in physical aggression, hostility, trait-level aggression, communicative aggression, and impulsiveness. However, women had significantly higher anger scores, and some differences in gaming motivations were also found (see Table 4).

**Table 4**

Parameters showing significant differences between male and female samples

Scale	Male gamers (n = 48)	Female gamers (n = 54)
Anger**	M = 16.58; SD = 4.43	M = 19.56; SD = 5.20
Achievement**	M = 16.79; SD = 3.25	M = 14.76; SD = 3.29
Competition sub-scale**	M = 4.54; SD = 1.77	M = 3.57; SD = 1.68
Relationship sub-scale*	M = 6.48; SD = 2.20	M = 5.48; SD = 2.50
Escapism sub-scale*	M = 6.69; SD = 1.93	M = 5.87; SD = 1.92

\*\* - significant,  $p < 0.01$ ; \* - significant,  $p < 0.05$

According to Table 4, male gamers in our sample have higher achievement and competition motivation, which corresponds to the previous studies. Interestingly enough, men also score higher in relationship and escapism motivation, which contradicts Yee's earlier findings [20].

### 3.3. Gaming Motivation in Relation to Aggression and Impulsiveness

In our sample gaming motivation scales showed mostly small or insignificant correlations with each other, suggesting their relative independence from each other. Among three main scales: achievement, social and immersion only achievement and social motivations were significantly correlated ( $\rho = 0.222$ ;  $p = 0.025$ ). Among sub-scales, mechanics had no significant correlations, discovery ( $\rho = 0.236$ ;  $p = 0.017$ ), escapism ( $\rho = 0.221$ ;  $p = 0.025$ ) and customization ( $\rho = 0.352$ ;  $p = 0.000$ ) all significantly positively correlated with role-playing only. Two sub-scales from the social motivation scale were positively correlated with both social and achievement motivations. Socializing as the motivation to play video games to communicate with others positively correlated with advancement ( $\rho = 0.196$ ;  $p = 0.048$ ), competition ( $\rho = 0.242$ ;  $p = 0.014$ ), relationship motivation ( $\rho = 0.617$ ;  $p = 0.000$ ) and teamwork ( $\rho = 0.430$ ;  $p = 0.000$ ), while relationship motivation also correlated with competition ( $\rho = 0.246$ ;  $p = 0.013$ ) and teamwork ( $\rho = 0.324$ ;  $p = 0.001$ ) scales.

There were no significant differences in gaming motivation between gamers who played regularly for a different amount of time. The only difference between gamers who preferred different game types was in social motivation. Those who only preferred offline games had significantly lower motivation than those who preferred online games only ( $H = 12.820$ ;  $p = 0.002$ ), which was relatively predictable and matched previous works [30].

A few significant correlations were found between gaming motivations and aggression (see Table 5), while impulsiveness had no significant correlations with gaming motivation whatsoever.

**Table 5**  
Aggression and gaming motivation correlations (significant only)

	Competition	Discovery	Achievement	Immersion
Physical aggression	-	-0.269 (p = 0.006)	-	-
Anger	-0.203 (p = 0.041)		-0.215 (p = 0.030)	-
Hostility	-	-	-	0.219 (p = 0.027)
Trait-level aggression	-	-0.234 (p = 0.018)	-	-
Communicative aggression	-	-0.206 (p = 0.038)	-	-

As seen in Table 5, most correlations between gaming motivation and aggression were negative, with discovery motivation having the most connections. Discovery motivation in video games is described as the desire to explore the game's virtual world, find its secrets, and collect in-game items with no significance gameplaywise. Competition and achievement motivations were negatively correlated with hostility, which seems contra-intuitive at first glance, but supports the idea that competition in video games can be used to express negative emotions in a socially appropriate way, thus lowering anger and frustration [4, 9].

#### 4. Discussion

The results of the study did not support most of our hypotheses. Only a few participants from the study showed higher than normative scores in any of the aggression measurements we used in the study. It worth noticing that those normative scores were obtained on samples that were quite similar to our sample agewise [24, 27]. Indeed, some time has passed since those questionnaires were adapted or standardized on Russian samples, suggesting that the norms could have changed. Still, even with this taken into consideration, adult gamers from our sample do not seem to have high aggression (if we assume it can be measured by questionnaires). About ¼ of the sample showed levels of impulsiveness that exceed the normative values provided by the authors of the adaptation [26]. According to the description of the questionnaire, those people might have difficulties controlling their behavior [25]. It partially supports our first hypothesis. Yet, no data supports that higher impulsiveness had any connection with the preferred game type or regular time spent playing video games, which matches some previous findings based on other impulsiveness measurements [11].

More active gamers showed higher levels of physical aggression, trait-level aggression, and communicative aggression than the least active gamers group. It partially supports our fourth hypothesis. There are several possible explanations. First, people with higher trait-level aggression might be more likely to play video games longer (e.g., to release their aggressive tendencies in a socially appropriate way). Second, suppose the general aggression model is correct, playing violent or competitive video games might enhance aggressive tendencies in those who play longer due to longer exposure to video game violence [16]. While we cannot identify how many of our participants preferred violent video games, a significant amount of popular video games contain some forms of virtual violence, and all online games include some form of competition between gamers in direct or indirect form (via ratings, trophies, etc.). Nevertheless, it is still worth noticing that the sample's aggression levels were mainly in the normative range. Thus, further research is needed to support or refute any of those possibilities. Additionally, gaming addiction can also partake in gamers' aggressive tendencies. However, while gaming addiction results in more prolonged regular gaming, more extended gaming cannot be considered a sign of gaming addiction without the presence of addictive behavior symptoms, such as conflicts or salience.

As assumed by the second hypothesis, impulsiveness showed significant positive correlations with all aggression measurements except for hostility. It matches the previous findings and suggests that while impulsive people might be more prone to aggressive or angry behavior, hostility as a cognitive

component of aggression, based on injustice, disadvantage, and dissatisfaction [24], has little to do with impulsiveness and lack of self-control.

No significant differences in gaming motivation were found between gamers who played regularly for a different time; thus, the third hypothesis is also rejected. It means that being more interested in the game is not unequivocally linked with extended periods of gaming.

No gaming motivation scales were positively correlated with impulsiveness or aggression, except for a positive correlation between hostility and immersion. It means that our fifth hypothesis is also rejected. This correlation suggests that people experiencing injustice and dissatisfaction with their needs not being met might be more interested in immersing themselves in virtual environments like video games. Yet, the correlation between hostility and escapism was almost zero, meaning that even if our assumption is correct, this is not done entirely consciously. The escapism scale of Yee's questionnaire includes the direct questions "How often do you play so you can avoid thinking about some of your real-life problems or worries?" and "How important is escaping from the real world to you in the game?" [20, 28], which means that high escapism scores require at least some reflection over own gaming behavior, while immersion as a general scale includes other motives as well.

Interestingly, competition motivation correlated with anger negatively and had no significant correlation with other aggression measurements. We already supposed that it might contribute to the idea of using competitive video games to release negative emotions, such as anger, safely and appropriately, thus lowering its levels. This result can also be explained by correlations between competition and social forms of gaming motivation, including socializing and relationship motivation. It seems that in our sample, advancement and competition motivations were more linked with social motivation than solely proving yourself worthy. It might be so that for adult gamers playing video games even in a competitive way is also a way to communicate more than to oppose each other.

Unlike many other studies, in our young-adult Russian sample (e.g. [19, 20]), men were found to have stronger relationship motivation than women. It might be due to the unbalanced sample with more women being interested in offline games and having lower gaming social motivation. It might also suggest that women from the sample do not use video games as a mean of relationship building. The discovery motivation seems to be associated with lower aggression indefinitely, suggesting that non-aggressive gamers are more interested in non-competitive, non-destructive exploration-oriented gameplay, or those types of gaming activities can lower aggressive tendencies. Male gamers from our sample did not differ from female gamers in any form of aggression except for anger, in which women scored significantly higher. Thus, our sixth hypothesis was only partially supported concerning higher achievement and competition motivations in the male sample.

## 5. Conclusion

The results do not support the idea that video gaming indefinitely increases aggression or impulsivity in young adult video gamers. Questionnaire-wise, aggressive tendencies in our sample were not stronger than normal. Yet, about ¼ of our sample had high levels of impulsiveness. Competition or achievement gaming motivation showed no significant correlation with trait-level aggression or communicative aggression. Instead, competition motivation in video games was associated with lower anger, suggesting that competitive gaming might partake in anger redirection, as suggested by some previous studies. Video gamers who play more than 10 hours per week had higher trait-level aggression and communicative aggression than gamers who play less than 4 hours per week, which is not explained by the sample's gaming motivations or gender specifics. Higher aggression might be an independent motivating factor to play more video games or the result of excessive gaming – anyway, further investigation is needed.

## 6. Limitations

There are several significant limitations in the present study. First, there was no control group of non-gamers. It was an elaborate decision, as in the targeted sample of young adults aged 18-33, it is difficult to find enough male participants with no gaming experience. However, it still limits our possibility to interpret and generalize the result.



Second, the use of Yee's Motivations of Play in MMORPGs Questionnaire for offline games or non-MMORPG online games requires further studies, as it was not initially designed for those types of gamers. However, Lemerrier-Dugarin et al. [19] successfully used this questionnaire for online gamers regardless of their preferred genre. Some gamers' motivation studies also use similar to Yee's models to compare online and offline gamers (e.g. [30]).

Third, we did not ask our participants about the violent content in their preferred games, while most video games and aggression studies specifically deal with violent video games. It significantly limits our ability to draw conclusions and parallels. However, we found several studies linking aggression to non-violent games with competitions (e.g. [17]). We also assume that the depicted violence levels can be quite different even across games of the same genre or the gaming product's age rating. Thus, to identify the preference for violent video games, a whole new part of the survey is needed. It would be done in our future studies.

Other limitations are usual for this type of study: the sample is relatively small and is to a degree "self-selected," and the methods we use do not allow causality-based conclusions. Aggression was only measured with questionnaires; thus, we only obtained information about trait-level aggression and its components but had no information about the real-life behaviors of our participants. However, the latter seems almost impossible in an anonymous online study, as none other sources of information other than self-reports are obtainable with this design.

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# Parental Assessment of Online Gaming Addiction Behavior in Children and Adolescents

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## Abstract

The prevalence of Internet addiction (IA) is 1.5-13.9% in the USA, Europe and Russia; in Asian countries it reaches 7.5-36.9 %. Such a significant difference in the assessment of the scale of the phenomenon makes it possible to raise the question of the reliability of the criteria used. The goal of this study was to compare the results of questioning parents using questionnaires on Internet gaming behavior in children and adolescents, as well as a questionnaire on types of upbringing. The main group consisted of parents of 26 children and adolescents aged 6-17 years, 14 boys and 12 girls, whose parents complained of their excessive use of the Internet. The comparison group consisted of the parents of 31 children and adolescents aged 4-17 years, 21 boys and 10 girls, whose parents had no such complaints. The severity of Internet activity was measured by Test for child Internet addiction and "Determination of dependence on computer games, children's version" questionnaire. The types of upbringing were estimated by "Analysis of family relationships" questionnaire. It was found that the IA severity in the group of children and adolescents whose parents believed that their children were overly addicted with a group of children and adolescents without such complaints did not reveal significant differences. At the same time, differences in the educational position of parents in the compared groups were revealed. It has been shown that those parents who consider their children online gaming activity to be excessive are less able to use prohibitive measures. They are more characterized by an unstable type of upbringing, and they are distinguished by the immaturity of the emotional attitude towards their children, which manifests itself in such features as the expansion of the sphere of parental feelings and their underdevelopment.

## Keywords

Internet addiction, Online gaming activity, Parental assessment, Types of upbringing, Children and adolescents

## 1. Introduction

The prevalence of Internet addiction (IA), according to various publications, is 1.5-13.9% in the USA and Europe, and in Asian countries it reaches 7.5-36.9 % [1-7]. According to Russian studies, the analysis of the prevalence of IA among Moscow adolescents had showed it in 4.3% of the surveyed, and 29.3% are at risk [8]. IA was detected in 12% of 527 surveyed university students in Ufa, Republic of Bashkiria [9]. Monitoring of 16,574 secondary school students showed that 89% of boys and 64% of girls play computer games, while every third boy and every fifth girl are at risk in the IA [10]. A recent study of 1119 schoolchildren aged 15 to 18 years in Kopeysk (Chelyabinsk region) revealed a high risk / pronounced signs of IA in 10.4% of the examined [11]. Such a significant difference in the

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assessment of the scale of the phenomenon makes it possible to raise the question of the reliability of the criteria used.

Various literature sources provide 2 main approaches to assessing the online gaming activity (OGA) of children and adolescents, each of which has its own advantages and limitations. This is a self-assessment based on questionnaires and an analysis of referrals to medical institutions based on complaints from parents (guardians, or other legal representatives). Most of the statistics presented are based on self-surveys of adolescents and young people. However, in the minds of a reflexive adolescent with an insufficiently formed personality boundary, the idea of his own behavior and his self-esteem often diverge. As a result, it is difficult for him to distinguish what is really happening to him or what is truly inherent in him from what others say about him.

If we consider the problem of OGA of children and adolescents from the perspective of parental perception, then we can say that the real scale of the "disaster" and their interpretation are sometimes confused here. Such a factor as the emotional rejection of the child, the rejection of his inherent authentic character traits leads to the fact that the child's playful hobbies irritate the parents, and their dominance in the child's life to the detriment of other activities (study, sports, etc.) gives rise to anxious expectation for the future. As a result, the true scale of OGA may be exaggerated, and a child may be called an "addict", "gamer", etc. for no apparent reason.

The literature has repeatedly pointed out that it is the parental interpretation of the pupils' Internet gaming activity that is a decisive factor in assessing their severity and consequences, and attributing this phenomenon either to behavioral deviation or to an established addictive disorder [12]. Dysfunctional family relationships, family conflicts, cold, dismissive, indifferent and restrictive parenting styles, and low family cohesion contribute to the negative perception of the child's online play activity. Moreover, these traits can increase the risk of developing IA [13-20]. On the other hand, a number of sources say that if a child is closely attached to the mother, then she is less likely to interpret his OGA as an addiction [21-22].

In turn, an authoritative parenting style is a protective factor against IA. Thus, the parent must be caring, protect his child, but respect his autonomy. [23].

There are many different classifications of games, the most popular are the following: by genre [24-25], a narrative game or not [26], according to the main action - activity, search, imitation, logic [27].

The goal of this study was to compare the results of questioning parents using questionnaires on Internet gaming behavior in children and adolescents, as well as a questionnaire on types of upbringing. We compared the responses of parents who complained about excessive online activity of their children with those of parents who did not have such complaints. Thus, it was planned to find out to what extent the complaints made by parents about the excessive use of the Internet by their children really reflect the presence of dependent computer behavior, and not a consequence of rejection of the child's behavior style, a particular manifestation of which is a high enthusiasm for online games and absorption in them. We assumed that the use of rating scales, in contrast to spontaneously presented complaints, more objectively reflects the real state of affairs, since it is more based on test choices, is the result of rational understanding and logical analysis of the situation associated with the child's hobby.

## 2. Subjects and Methods

The main group consisted of parents of 26 children and adolescents aged 6-17 years, 14 boys and 12 girls ( $\chi^2=0.154$ ;  $p=0.695$ ). Statistical data on age and gender are presented in Table 1. The inclusion criteria were: (1) parents complained of excessive use of the Internet, which led to their self-seeking help from a psychotherapist of the Children's Advisory Center of St. Petersburg State Pediatric Medical University; (2) availability of informed consent to fill out the questionnaires, (3) understanding the meaning of the questionnaire questions; (4) the absence in the course of preliminary screening, carried out on the basis of the research diagnostic criteria of ICD-10, diagnoses from headings F 00-89. Since at the time the parents filled out the questionnaires, the examination and follow-up continued, the diagnoses F90.0 Disturbance of activity and attention, F90.1 Hyperkinetic conduct disorder, F91.0 Conduct disorder confined to the family context, F91.3 Oppositional defiant disorder. The exclusion criteria were (1) the presence of other mental disorders from headings F 00-89 accompanying the main complaints, as well as a conscious request from the parents to search for a mental illness in the pupil –

a delegated falsified disorder (F68.12 – Munchausen syndrome by proxy); (2) refusal to continue the study.

Initially, 36 people were supposed to be surveyed. However, on the basis of concomitant symptoms F 00-89, 6 respondents (16.7%) were not included in the study. Based on the exclusion criterion, 4 respondents (11.1%) completed the survey ahead of schedule, whose questionnaire questions seemed “offensive” and “suspicious”.

The comparison group consisted of the parents of 31 children and adolescents aged 4-17 years, 21 boys and 10 girls whose parents did not complain of excessive OGA. The comparison group is comparable in age, sex and the number of complete/incomplete families with the main group (Table 1).

Research methods. To assess the severity of Internet activity we used tests and methodologies elaborated and validated in Russian Federation:

1) "Test for child Internet addiction" (TCIA) [28]. Consists of 20 questions, graded 1-5 points. According to the author's approbation, a total score of up to 50 indicates a minimal risk of developing IA, 50-79 points - about a high risk of IA, 80 points and above - about clinically expressed IA.

2) Questionnaire "Determination of dependence on computer games, children's version" (DDCG) [29] Consists of 17 questions, each of which is assessed yes / no. If the total score exceeds 3, then this is regarded as addictive play behavior.

3) Questionnaire "Analysis of family relationships" (AFR) [30]. The questionnaire consists of 130 items, each of which is assessed yes/no. Children's (for 3-10 years old) and adolescent (11-21 years old) variants of the questionnaire are similar in the number of questions and their content, the differences concern age-determined nuances of the wording. As a result, 20 main characteristics (scales) of the parent's upbringing position in relation to the child/adolescent are assessed.

All three presented questionnaires were completed by mothers. Currently existing methods for children and adolescents in the Russian Federation provide an opportunity to evaluate online activity and game dependent behavior separately.

Clarification of complaints was conducted with parents in the format of a clinical interview. The parent was offered a free style of presenting complaints. To structure the interview, the researcher proposed three main open-ended questions: "What is happening to the child?", "What is the reason for these difficulties?", "How does he / she react to your advice/comments?"

In this work, the taxonomy developed by Kutaliev was used. This author proposed to divide games into the following genre groups: action (shooters, martial arts, arcades, etc.), simulations, adventures, strategies, puzzles, role-playing and mixed games [25].

Statistical processing was carried out using the  $\chi^2$  goodness-of-fit test, the Mann-Whitney nonparametric U test, for the parametric data of the Student's t-test. To check the normal distribution, the indicators of skewness and kurtosis and their standard errors were used. Significance level –  $p \leq 0.05$ .

### 3. Results and Discussion

Among the online games used by children and adolescents, the leading genre groups were the following: action (23 people), strategy (7 people), puzzles (2 people). The obtained data regarding genre groups can be correlated with the previous publications. According to various sources, shooters (a subgenre of the genre group - action) are preferred by 19.8 - 96% of all players [31-32]. Strategy is a less popular genre, although there are works in which players report this genre group as one of the leading [33]. The division of players according to genre is an important predictor. There are publications that report that among all players, those who resort to shooters are more likely to become pathological gamers [34], or separately to MMORPG (role-playing games) [35].

Parents complained about the inability to control both the content and the temporal characteristics (duration, time of day) of their children OGA. The content of the games appeared to be "stupid", "empty", "unintellectual", "shocking". At the same time, in the words of some parents, the latent delight and joy sounded like a dissonance that the child knows how to use such complex technologies. That is, an internally contradictory attitude towards the hobby of children was often revealed. Parents' attempts to control the time and duration of children's play behavior ended in open confrontation, in which the child usually won. The imperative to "immediately stop playing" on a computer or tablet usually leads

to a violent affective reaction on the part of the child that goes beyond what is permitted – rudeness, boorishness towards parents and even foul language.

The peculiarity of complaints made by parents about excessive use of the Internet was their close intertwining with manifestations of behavioral deviations. Along with complaints about the online activity of children, parents pointed to a number of concomitant behavioral disorders, such as restlessness, excessive mobility, inability to concentrate for a long time when doing school and homework, disobedience, protest behavior, provocation of quarrels and conflicts with parents, siblings and peers. It was noted that it was impossible to force the child to carry out daily duties, the experience of discomfort in the school environment and among peers, refusal to attend school, and tension in communication with teachers. Children and adolescents usually did not tolerate criticism in their address, in response to any comment, screams and scandals were observed. There was an increased sensitivity to any negative assessment of their actions. When analyzing the family situation, it was revealed that the parents, in principle, could not influence the child, prohibitions and punishments were ineffective.

Since at the time of the survey, no patient had undergone a final examination and the follow-up time was not necessary for the diagnosis, information on the diagnosis profile was not provided. Hypothetically, children were supposed to have F90.0 Disturbance of activity and attention, F90.1 Hyperkinetic conduct disorder, F91.0 Conduct disorder confined to the family context, F91.3 Oppositional defiant disorder. The peculiarity of the studied sample consisted in the fact that none of the patients had manifestations of antisocial, aggressive, illegal (delinquent) behavior, including in the peer group – diagnoses F91.1 Unsocialized conduct disorder and F91.2 Socialized Conduct Disorder.

**Table 1**

Characteristics of age, gender, family, Internet-addicted and gambling-addicted behavior in the main group and the comparison group

Characteristics Total	Total (N=57)	Main group (N=26)	Comparison group (N = 31)	Differences
Age M (sd)	11.58 (4.23)	12.13 (3.71)	11.00 (4.62)	t=1.028
min-max, years	4-17	6-17	4-17	p=0.318
Gender				
female	22 (38,6%)	12 (46.1%)	10 (32.3%)	$\chi^2=1.152$
male	35 (61.4%)	14 (53.8%)	21 (67.7%)	p=0.283
Family				
Full	34 (59.6%)	17 (65.4%)	17 (54.8%)	$\chi^2=0.653$
Incomplete	23 (40.4%)	9 (34.6%)	14 (45.2%)	p=0.519
Total score TCIA. Me [Q1; Q3], min-max, points	34.00 [24.00; 43.00] 0-72	28.00 [21.75; 43.00] 0-70	34.00 [25.00; 49.00] 20-72	p=0.348 U Mann-Whitney
Total score DDCG, Me [Q1; Q3], min-max, points	2.00 [1.00; 5.00] 0-16	2.50 [1.00; 5.00] 0-10	2.00 [1.00; 5.00] 0-16	p=0.809 U Mann-Whitney

Table 1 shows that the main group and the comparison group did not differ in the median values of the Internet addiction scales (p=0.348 according to U Mann-Whitney criteria) and dependence on games (p=0.809 according to U Mann-Whitney criteria). That means that children and adolescents whose parents complained about excessive use of online games did not differ in objective signs of the severity of addictive behavior from their peers whose parents did not present such complaints. Moreover, both in the main group and in the comparison group, the scale indices were within the reference values (for TCIA it is less than 50 points, for DDCG – 3 or less points), which indicates not only the absence of clinical signs of IA, but about the absence of the risk of its formation. Thus, an objective scale-rating assessment of the true scale of online activity of patients suggests that parental complaints about excessive use of Internet games in our case were the result of erroneous interpretation.

**Table 2**

Types of upbringing according to the "Analysis of family relationships" questionnaire in the main group and the comparison group

Types of upbringing Me [Q1; Q3], min- max, points	Total (n=57)	Main group (n=26)	Comparison group (n=31)	Differences up to U Mann-Whitney
Hyperprotection	4.00 [2.00; 5.75] 0-10	4.00 [2.00; 6.00] 0-10	4.0 [1.75; 4.25] 0- 8	p=0.445
Hypoprotection	2.00 [1.00; 3.00] 0-9	2.00 [1.00; 3.00] 1-7	2.50 [1.00; 4.00] 0-9	p=0.880
Indulgence	2.00 [3.00; 4.00] 0-9	3.00 [2.00; 5.00] 0-9	3.00 [2.00; 4.00] 1-6	p=0.329
Ignoring the needs of the child	0.00 [0.00; 1.00] 0-4	0.00 [0.00; 1.00] 0-3	0.00 [0.00; 1.00] 0-3	p=0.449
Excessive requirements-duties	1.00 [0.00; 2.00] 0-5	1.00 [0.00; 2.00] 0-5	1.00 [0.00; 2.00] 0-4	p=0.649
Lack of requirements- responsibilities	2.00 [1.00; 3.00] 0-5	2.00 [1.00; 3.00] 0-5	2.00 [1.00; 3.00] 0-5	p=0.826
<b>Excessive requirements- prohibitions</b>	<b>1.00 [1.00; 2.75] 0-5</b>	<b>1.00 [0.00; 2.00] 0-5</b>	<b>2.00 [1.00; 3.00] 0-5</b>	<b>p=0.013</b>
Lack of prohibition requirements	2.00 [1.00; 2.75] 0-4	1.00 [2.00; 3.00] 0-4	1.00 [1.00; 2.00] 0-4	p=0.285
Excessive sanctions	1.00 [0.00; 1.00] 0-4	1.00 [0.00; 1.00] 0-4	0.00 [0.00; 1.00] 0-3	p=0.164
Minimum sanctions	3.00 [2.00; 4.00] 0-5	3.00 [2.00; 4.00] 0-5	2.50 [1.75; 4.00] 0-5	p=0.687
<b>Unstable parenting style</b>	<b>1.00 [0.00; 3.00] 0-5</b>	<b>1.00 [0.75; 3.00] 0-4</b>	<b>0.00 [0.00; 2.00] 0-5</b>	<b>p=0.027</b>
<b>Expansion of the sphere of parental feelings</b>	<b>1.00 [0.00; 2.00] 0-7</b>	<b>2.00 [1.00; 3.00] 0-7</b>	<b>0.00 [0.00; 1.00] 0-6</b>	<b>p=0.002</b>
Preference in a child / adolescent for children's qualities	0.00 [0.00; 1.00] 0-3	0.00 [0.00; 1.00] 0-3	0.50 [0.00; 1.00] 0-3	p=0.573
Educational uncertainty of parents	2.00 [0.25; 3.00] 0-5	2.00 [1.00; 4.00] 0-5	1.00 [0.00; 2.25] 0-5	p=0.065
Phobia of loss of a child	0.50 [0.00; 1.00] 0-4	1.00 [0.00; 2.00] 0-4	0.00 [0.00; 1.00] 0-4	p=0.222
<b>Underdevelopment of parental feelings</b>	<b>1.00 [0.00; 2.00] 0-8</b>	<b>1.00 [0.00; 2.00] 0-8</b>	<b>0.00 [0.00; 1.25] 0-4</b>	<b>p=0.031</b>
Projection onto the child of one's own undesirable qualities	1.00 [0.00; 2.00] 0-5	1.00 [0.00; 2.00] 0-5	1.00 [0.00; 3.00] 0-4	p=0.381
Making the conflict between spouses in the sphere of upbringing	0.00 [0.00; 1.00] 0-5	0.00 [0.00; 1.00] 0-4	0.00 [0.00; 1.25] 0-5	p=0.542
<b>Preference for female qualities in a child</b>	<b>1.00 [0.00; 2.00] 0-4</b>	<b>1.50 [0.75; 4.00] 0-4</b>	<b>0.00 [0.00; 2.00] 0-4</b>	<b>p=0.007</b>
Preferences in the child of male qualities	0.00 [0.00; 1.00] 0-4	0.00 [0.00; 1.25] 0-4	0.00 [0.00; 0.25] 0-3	p=0.076



Hypothetically this situation may be associated with a misunderstanding by parents of their children and, as a consequence, the interpretation of reactions of protest, stubbornness, emancipation for manifestations of addictive behavior, at the next stage, the results of studying the educational position in 2 compared groups were analyzed (Table 2).

It was revealed that in the main group the values of the scale "Excessive demands-prohibitions" ( $p=0.013$ ) and higher than the values of the scales "Unstable style of upbringing" ( $p=0.027$ ), "Expansion of the sphere of parental feelings" ( $p=0.002$ ), "Underdevelopment of parental feelings" ( $p=0.031$ ) and "Preference for female qualities in a child" ( $p=0.007$ ). This shows that, compared to the reference sample, parents whose children's online gambling activity appeared to be excessive had a reduced use of prohibitive measures against their children. In general, this indicates to an insufficient formation of educational competence, a property that plays a key role in the formation of behavioral deviations in children [36].

In addition, in the main group, there was a high severity of characteristics reflecting the immaturity of the emotional component of the attitude of parents to children. This is, first of all, the expansion of the sphere of parental feelings - a property that indicates the instability and blurring of child-parental boundaries with a high desire on the part of the parents to "emotionally invest" in the child. Also significant is such a characteristic as the underdevelopment of parental feelings associated with insufficient knowledge of the inherent in the pupil of the authentic characterological properties and the desire to control his external behavior. In the context of our research, this may be an attempt to control the child's hobbies for Internet games through ineffective measures.

Such an educational characteristic as "Preference for female qualities in a child" is associated with a subconscious desire to have a calm, docile pupil, which indirectly indicates the presence of protest behavioral reactions in the studied contingent. Of great importance (to explain the results obtained) is the prevalence in the main group of an unstable style of upbringing, the role of which in the origin of dysfunctional parent-child relations has been repeatedly emphasized [37].

Probably, the feeling of anxiety, usually associated with low educational competence, was a direct source of exaggeration of the problem of Internet use. Not possessing effective ways of influencing children necessary to achieve results, in this case the desire for them to play less and learn more, parents justified their own educational incompetence by adding symptoms of addiction in children. This position of the parents is unconscious; it does not pursue the goal of stigmatizing the child. The criteria for delegated falsified disorder are excluded in this case.

#### 4. Conclusion

Thus, a comparison of the OGA severity of the group of children and adolescents whose parents believed that their children were overly addicted to online games with a group of children and adolescents where no such complaints were noted did not reveal significant differences. At the same time, in both groups, the indicators corresponded to the reference values both according to the methodology that assesses Internet activity and according to the questionnaire measuring the involvement in computer games. At the same time, differences in the educational position of parents in the compared groups were revealed. It has been shown that those parents who consider their children OGA to be excessive are less able to use prohibitive measures. They are more characterized by an unstable type of upbringing, and they are distinguished by the immaturity of the emotional attitude towards their children, which manifests itself in such features as the expansion of the sphere of parental feelings and their underdevelopment.

In general, the study conducted indicates the possibility of overdiagnosis of IA when collecting an objective anamnesis on the part of the parents. This echoes the findings of the Przybylski et al. [38] meta-analysis that the evidence linking Internet gaming disorder to game engagement was strong, but links to physical, social, and mental health outcomes were decidedly mixed, as well as the opinion of Markey and Ferguson [39] that for almost all kids and young adults, video games will be a normal part of their development. The overwhelming majority of people appear to be able to play video games while still balancing a productive work schedule and active social life.

Research limitations. The factors limiting the results obtained include: (1) a wide age range of the surveyed contingent, including both preschool children and adolescents, (2) involving only mothers in

the study, (3) using 2 scales to study the severity of online gaming behavior, separately to assess Internet activity, separately for the level of involvement in games.

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# Digital Volunteering in Representations in Youth

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## Abstract

Youth is the age period of active search for own position in society on the bases of wide opportunities of separated choices and social role testing. The volunteering activity as the form of helping behavior in the period of self-determination can be the source of self-knowledge and self-realization that can compensate the risks of complicated social and professional choices. The popularity of volunteering activity grows in modern Russian society, particularly in youth. The digital volunteering became a new form of helping behavior that can be useful and demanded by young people. The goal of our study was to investigate the digital volunteering representation in youth. The data included 202 young people aged from 14 to 23 years. The analyses allowed to define representations about forms and content of digital volunteering, its advantages and disadvantages. The role of motivation for volunteering in attitude to that activity are discussed.

## Keywords

Digital volunteering, internet, helping behavior, motivation, youth

## 1. Introduction

The processes of self-determination and self-realization of modern Russian youth occurs in period of big opportunities and risks: the high level of social uncertainty and inconsistency of system of social norms and values, huge information flow in global informational space. Modern Russian society has high level of transitivity: on the one hand we observe huge unpredictability of social processes, their instability and sharp changes in combination of uncertainty of direction and content of potential changes; on the other hand, new forms of social connections and relations develops and it provides the plurality of space for life choices [1; 2; 3; 4].

The period of youth is considered as a period of active entrance to adulthood in the position of full partnership with social world, as a time for transition from developing model of priority appropriation of social-cultural experience to developing model focused on creative and productive being [5]. The age-psychological specificity of youth appears in active search for own position in society on the bases of wide opportunities of separated choices and social role testing [6; 7; 8]. The volunteering activity in the period of self-determination can be the source of self-knowledge and self-realization that can compensate the risks of complicated social and professional choices.

The volunteering activity becomes more popular and common in modern Russian society. Complicated social-economic conditions of existence of some social groups in Russian Federation, nature and technological catastrophes, arousing attention to ecological questions creates conditions and space for self-realization in sphere of altruistic help to people in need. Active development of institute of non-profit organizations, appearance of legal status of volunteering according to the Federal Law about the volunteering activity signed in 2018 provides the increasing interest to heling behavior in society, particularly in youth. We can observe the developing interest to volunteering activity in youth community.

The role of participation in volunteering activity for somatic and psychological well-being is the subject of numerous investigations in psychology, sociology and other social sciences. The

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longitudinal study showed that volunteering activity correlates with good level of somatic health, moreover volunteering involvement influence on increasing level of somatic health [9;10]. There are evidences for correlation between volunteering activity and life satisfaction, self-esteem, happiness feelings, lower chance for depression and distress emotions, higher level of moral development [11; 12; 13; 14; 15; 16; 17]. The hypothesis of cumulative effect that volunteering activity of people with the desires, abilities, personal features, values and meanings adequate for helping behavior influences on common level of psychological and physical health was proved [18]. The theory of reasoned actions propose to analyze the determination of behavior from the perspective of two main factors: attitudes and subjective social norms [19]. The volunteers often have the attitudes to help with the supporting social atmosphere for norms of prosocial behavior. The results showed the importance of attitudes and norms factors for participation in volunteering activity of non-government organizations [20]. The addition of third factor: perceived behavioral control from the model of planned behavior help to estimate the probability to success in activity, for example volunteering actions [21,22]. The high value of components of planned behavior predicts the high sustain of volunteering behavior [23]

The development of volunteering activity leads to appearance of new forms of volunteering: the digital volunteering became a new form of helping behavior. There are some synonymic terms that are used in literature: digital volunteering, virtual volunteering, online volunteering, cyber volunteering, e-volunteering [24]. There are different definitions of digital volunteering that in most general forms is regarded as any form of volunteering that can be realized in internet [25]. The question of digital volunteering essence is very interesting and can be discussed from different perspectives. On the one hand, digital volunteering can be regarded as a form of civil position that can be easily changed for typical and traditional form of real-life volunteering activity. In that case computer and internet can be considered simply as a tool that can be the only resource in some life situations (for example in pandemic conditions with restrictions for life contact and movement). And in life situation with no restrictions internet and computer ceased to be important tool and person can easily realize life form of helping behavior. On the other hand, digital volunteering can be observed as an independent reality. According to A.Toffler ideas the specificity of communication processes and not the information itself becomes meaning foundation for development of new types of activity, in particular volunteering [26]. Thereby we can classify volunteers that help in real life situations, online volunteers and mixed form of volunteering when person can combine both forms depending on circumstances [27]. Different advantages and disadvantages outcomes of internet and volunteering are discussed in society [28].

The concrete form of helping behavior – helping behavior through internet – can be attractive for wider circle of participations, primarily for youth audience. Informational socialization in youth leads to development of new forms of identity, in particular virtual identity that seeks its realization, especially in forms of internet activity [29]. The development of identity in social approved and social useful forms of volunteering in internet space can increase self-esteem and support your identity, including virtual identity. The role identity of volunteering predicts the involvement in that prosocial behavior [30].

We analyzed main directions of digital volunteering. We suppose that several trends in digital helping behavior can be depicted. The first one is the notification and mobilization of people for giving different forms of help in "yere and now" situations with the internet resources (in particular in crisis and emergence situations with low forecasting of potential changes). The second form is the organization of meeting and discussion spaces to attract the attention of society to keen social problems that must be solved in short- or middle- time perspective, including political activity. The third forms of digital volunteering is the information analyses, including big data, with public conclusions for potential realization of practical volunteering in future, including technical support of coordination process of activity of different volunteering in internet space [31]. In this way digital volunteering propose different forms of activities connected with interaction with people, analytic and searching activity, technical questions. The requirements to technical skills to interact in digital volunteering are quite simple – the basic computer skills are often enough for participation. The simplicity and variety of concrete roles in digital volunteering allows participation of people with different disabilities [32].

The analyses allow to depict main advantages of digital volunteering comparing to classic forms of helping behavior. The digital volunteering can be anonymous and it is simple in regulation of

participation intensity of helping [33]. There are comfortable conditions to choose the concrete form and level of participation [34]. The level of social inequality decreases and it opens the wide opportunities for self-realization with different level of motivation, health, and resources [35]. The specific explosion of digital volunteering is happening [36]. The goal of volunteering are defined by actual social changes in world. For example, period of epidemic restrictions in 2020 that changed the possibilities for professional activity and self-realization increased the intensity of distant forms of interaction and necessity to learn new technologies. digital volunteering becomes more and more popular.

The volunteering activity is realized on free basis without material encouragement. The motivation basis for volunteering participation is the goal of particular research. The analyses of volunteers motivation showed that the level of freedom in situation of decision making about participation in volunteering activity influence on future desire to be the member of helping community for youth audience. The compulsion and pressure to participate decreases the desire and willingness for volunteering in future. The feel of free choice of volunteering increases the desire to repeat those forms of life activity [37; 38]. The prosocial form of volunteering can have different motivational basis in its foundation. The externally observed and socially approved helping behavior can be egoistic in some situations. There are different classifications of motives for volunteering activity. The foundation of volunteering activity can be altruism, empathy, feeling of subject significance, need to be useful for others, affiliation feeling and desire for new contacts [39]. Nowadays more wide space of motives is observed for volunteering activity. Accepting the special role of altruism there can be personal motives of volunteers focused on yourself: self-realization, personal grow, expansion of social contacts, compensative motives such as self-esteem compensation, decreasing the feeling of loneliness, desire for practical experience [40]. Some authors define dualism of actuality of altruistic and egoistic motives at the same time [41]. There are classifications that defines personal, social and pragmatic motives linked with indirect economical effect and benefit [42; 43]. Some authors propose the idea that “pure” altruism doesn’t exist and will be connected with professional carrier expectations, love to games, high level of life activity, social relations [44; 45; 46]. There are models that pretend to unit different groups of motivations – for example, model ABCE (Affiliation, Beliefs and Attitudes, Career, Egoism) [47]. The functional motivation model in research of volunteering activity defines six motivational functions: belief function, source of competencies function, social function, resource for career possibility’s function, defensive compensation function, source for development function [48; 49]. The belief function is connected with the possibility to express significant prosocial beliefs and values linked with altruistic and humanistic attitudes. Source of competencies function is realized in ability to develop and support skills and qualities necessary in the field of helping behavior. Social function presents the possibility to develop social relations, find new contact and enter new social groups and communities that are interesting personally for volunteers. Resource for career possibility’s function resource for career possibilities function is regarded as search for possibilities for potential work or employer acquaintance. Defensive compensation function helps to decrease the level of own negative feelings, including Ego representation due to participation in volunteering activity. As the source for development function the authors define positive influence on self-esteem, self-perception and self-respect by helping behavior [50]. The proposed model of Volunteer Function motivations allows to describe main groups of motivations in helping behavior. The investigation of different social volunteering groups shows that consistent and frequent participation in volunteering activity are more often correlates with Belief, Source of competencies functions [51; 52].

## 2. The Goal of the Study and Methods

The goal of our study was to investigated the digital volunteering representation in youth. We investigated the perceiving forms of digital volunteering activity, its advantages and disadvantages. We also study the peculiarities of motivation for volunteering activity. Motivation defines the behavior and representation and attitudes to world and happening events. The volunteering motivation influence in representation of digital volunteering activity. The hypothesis of the study was the idea that volunteering motivation correlates with different digital volunteering representations: more vivid

volunteering motivation in youth correlates with more clear representations about forms, advantages and disadvantages of volunteering activity.

The data consisted of 202 young people from schools, institutes and universities in Moscow, Russia. The analyzed group aged from 14 to 23 years old ( $M=16.7$ ,  $SD=2.3$ ) with 54% of men and 46% of women.

Two questionnaires were used in our investigation. The first one was the Volunteer Functions Inventory based on functional motivation theory. The questionnaire was proposed by Clary and colleagues in 1998 and is aimed to estimate the reasons for participation in volunteering activity. It contains the following motivational functions: defensive compensation function, belief function, resource for career possibility's function, social function, source of competencies function, source for development function [53]. Translated forms of VFI are used in research in different countries [54; 55] The investigators note good psychometric characteristics of the questionnaire [56], the possibility to use with different age groups [57]. The VFI was used in Russian investigation for the first time. The translation of VFI was done by several independent experts, after the coordinated translation version the reversed translation was done with subsequent comparison of original version and last version with double translation. The analysis of internal validity of VFI components showed satisfying results: the Alpha-Cronbach coefficient varies from 0.78 to 0.88 that is higher than the required threshold 0.75.

The second questionnaire was present by groups of open questions that were focused to define the representation about the content of digital volunteering activity. It contains 10 open questions divided into 3 groups: the understanding of content of digital volunteering, the experience of own participation in volunteering activity, the description of advantages and disadvantages of digital volunteering. The content analysis helped to define main groups of answers on these spheres.

### 3. The Results

The analyses of representations about possibilities and forms of digital volunteering shows the following. Firstly, we investigated the informational orientation about the possibilities of digital volunteering and knowledge about digital volunteering forms. The group of open questions was used with the common idea – what is the digital volunteering? The content analysis allowed to define 54 different questions that we united in more general categories. The results are presented in Table 1.

**Table 1**

Representations about digital volunteering in youth

Representations about digital volunteering	% from the answers
digital volunteering – use of internet to realize different forms of activity by yourself and your colleagues: webinars, education through internet, psychological help.	44.4
Common definition of digital volunteering as altruistic distant help	22.2
digital volunteering as the help in orientation in internet space, development of computer skills	18.5
digital volunteering as the source for information about different forms of help, supporting projects and financial support	9.3
no idea about digital volunteering	5.6

The analysis of distribution of open questions showed that up to half on our subjects perceive digital volunteering as the altruistic helping behavior with the use of internet and other different audio and video resources of communication used for meaningful activity. Young men named such forms of digital volunteering as conducting free webinars, educational activity, psychological help through Zoom, Skype and other audio and video resources. About 20% of subjects explaining the content of

digital volunteering mentioned old people as the main group that needed help in educational context, getting acquainted and developing computer skills. At the same time a big group of subjects has problems in content understanding of goals of digital volunteering: 27,8% gave very common definition or refused to name the aim of digital helping behavior. The content analysis of informational orientation about the possibilities of digital volunteering showed that in spite of specific social experience of communication limits and vivid need for help for some social and age groups the youth representations are often diffused. The vivid understanding of digital volunteering content is typical not for all subjects.

We analyzed the peculiarities of volunteering motivation of our subjects. The Table 2 present the average means of distribution of preference in volunteering motivation.

**Table 2**

The mean distribution of motivation functions to volunteering.

Function	Mean	Standard deviation
Defensive compensation function	3.48	1.44
Belief function	5.44	1.22
Resource for career possibility's function	3.85	1.36
Social function	4.02	1.39
Source of competencies function	5.15	1.35
Source for development function	4.44	1.42

The belief and source of competencies functions are the most important motivation resources to volunteering for youth. The less important are defensive compensation and social functions. The correlation analysis between different motivation functions showed the significant correlations between all functions (correlation coefficient Spearman with values from 0.344 to 0.769,  $p < 0.001$  for all pairs of functions). Significant correlations of all components demonstrate the internal unity of the construct but at the same time shows the lack of motivation function differentiation for subjects.

The cluster analyses (method K-means) on the basis of VFI results we defined 3 groups of subjects. Table 3 present the centers of clusters. We found that there are significant differences for all scales of VFI for subjects from different clusters (Kruskal-Wallis criteria for independent groups,  $p < 0.001$ ).

**Table 3**

The clusters centers (types) of motivation to volunteering.

Function	1 type	2 type	3 type
Defensive compensation function	5.0	3.4	1.8
Belief function	6.5	5.4	4.2
Resource for career possibility's function	4.9	3.8	2.5
Social function	5.3	4.0	2.3
Source of competencies function	6.4	5.2	3.4
Source for development function	5.9	4.4	2.6
% of subjects	28.7	49.5	21.8



1 type (28.7%). Subjects in that group estimate highly all motivational functions of volunteering. We can name that group as group of “active volunteering”.

2 type (49.5%). Subjects from that group have very smooth profile for volunteering functions most esteems are average. At the same time volunteering as resource for career possibilities and source for development is evaluated not lower that by subjects from 1 type group. We can name that group as “pragmatic volunteering”.

3 type (21.8%). All functions are evaluated lower than in both previous groups. We can name that group “passive volunteering”.

We defined the level of experience in real volunteering activity of our subjects with different types of motivation to volunteering. 74.5% of data have the experience in volunteering activity, and, 25.5% no. But last year – the pandemic year – was not active for them -only 36.2% took part in altruistic helping behavior and 63.8% didn't. We analyzed the correlation between real volunteering experience and types of motivation to volunteering. The results are present in Table 4.

**Table 4**

Distribution of subjects with and without volunteering experience in groups with different types of motivation to volunteering

	volunteering experience		volunteering experience for last year	
	yes	no	yes	no
1 type	90.0%	10.0%	30.0%	70.0%
2 type	83.3%	16.7%	50.0%	50.0%
3 type	46.2%	53.8%	15.4%	84.6%
Total	74.5%	25.5%	36.2%	63.8%

We can observe that subjects from group “passive volunteering” have the lowest volunteering experience comparing with both groups – “active volunteering” and “pragmatic volunteering”. The analyses of volunteering experience in last year shows that “pragmatic volunteering” were most active in life. The main conclusion is the fact that active volunteering” and “pragmatic volunteering” groups are more involved in real volunteering activity and they have the understanding of motivation to participate in helping behavior.

Let's estimate the specify of representations about digital volunteering among different groups with different types of motivation to volunteering. The Table 5 present the results.

The analysis shows that representation about digital volunteering as activity intended to realize different forms of activity by yourself and your colleagues: webinars, education through internet, psychological help) is more typical for “active volunteering” and “pragmatic volunteering” groups. Common definition of digital volunteering as altruistic distant help is typical for “passive volunteering” group.

The orientation in concrete volunteering organizations in internet is rather low: 68.1% of subjects didn't name any of them, 21.3% called only 1-2 internet addresses, 10.6% – 3-4 sites. The most popular volunteering organizations among youth are groups that realize helping behavior for keen social human problems (namely, Lisa Alert, Help fund by Habensky, Rejected were named by 39.3% of subjects) and animals problems (namely, Greenpeace, Peta, White tooth were named by 35.3% of subjects). Specialized site with opportunities to search for volunteering place were named by 25% of subjects.

The analysis of advantages and disadvantages of digital volunteering was done. Table 6 present the described advantages of digital volunteering. The subjects often named more than one category, as the result the summering percent of answers is more than 100%.

The analysis of answers shows that young people are orientated in advantages of digital volunteering and are focused of wider opportunities in mobility of help and chances to help different people that can be far away (examples: “Can help everyone nevertheless how far the person is”, “Can help people all over the world”, “Higher mobility and availability to all people with internet”) and significant time economy (examples: “save volunteering time and increase multitasking”, “ You need

less time for search”, “Digital volunteering needs less time and can be realized in time when the volunteer want”). The subjects also mentioned that digital volunteering becomes more available as for those who need help and for helpers themselves (“some people can’t be real life volunteers due to health restrictions and mobility limits, due to lack of special education and deficit of special skills (if you work with old people or small children),” the digital volunteering gives them the chance to realize their goals”). The results of analysis of distribution on named advantages of digital volunteering for groups with different types of motivation to volunteering are presented in Table 7.

**Table 5**

Distribution of representations about digital volunteering among different groups with different types of motivation to volunteering.

Representations about digital volunteering	1 type		2 type		3 type	
	yes	no	yes	no	yes	no
digital volunteering – use of internet to realize different forms of activity by yourself and your colleagues: webinars, education through internet, psychological help)	70.0%	30.0%	54.2%	45.8%	30.8%	69.2%
Common definition of digital volunteering as altruistic distant help	20.0%	80.0%	29.2%	70.8%	46.2%	53.8%
digital volunteering as the help in orientation in internet space, development of computer skills	20.0%	80.0%	16.7%	83.3%	23.1%	76.9%
digital volunteering as the source for information about different forms of help, supporting projects and financial support	10.0%	90.0%	8.3%	91.7%	15.4%	84.6%
No idea about digital volunteering	0.0%	100.0%	8.3%	91.7%	7.7%	92.3%

**Table 6**

Advantages of digital volunteering in youth

Arguments for advantages of digital volunteering	% of subjects named that argument
The spread of opportunities and increasing mobility.	38.3
Time economy	38.3
The opportunity for bigger volume to help/ higher possibility for help in specific conditions	50.1

The distribution shows that argument “The spread of opportunities and increasing mobility”, “Time economy” are more typical for group of “active volunteering” than for other motivational groups.

The analysis of disadvantages of digital volunteering in youth allowed to define 4 categories of typical answers. The subjects often named more than one category, as the result the summing percent of answers is more than 100%. Most popular categories are the absence of live communication and interaction that you get in real life, the significant constriction of types of volunteering activity, non-material product/result and difficulties in realization of volunteering activity due to the lack of technical means. The results are present in Table 8.

**Table 7**

The distribution of advantages of digital volunteering for groups with different types of motivation to volunteering

Advantages	1 type		2 type		3 type	
	yes	no	yes	no	yes	no
The spread of opportunities and increasing mobility	50.0%	50.0%	37.5%	62.5%	30.8%	69.2%
Time economy	50.0%	50.0%	41.7%	58.3%	23.1	76.9%
The opportunity for bigger volume to help/ higher possibility for help in specific conditions	40.0%	60.0%	54.2%	45.8%	53.8%	46.2%

**Table 8**

Disadvantages of digital volunteering in youth

Arguments for disadvantages of digital volunteering	% of subjects named that argument
The absence of live communication and interaction.	46.4
The constriction of types of volunteering activity	25.0
Nonmaterial product/result	7.1
The lack of technical means	7.1
Other	14.3

The analysis of answers about disadvantages of digital volunteering shows that youth auditoria feel lack of live communication and interaction in helping behavior, the absence of contact between volunteer and needy – up to half of responds describe the problem as “no personal communication, “tactile” support, that often is even more important than any other”, “contact is weaker than in situation of live communication when you have more opportunities to realize it”, “ in virtual communication you can forge the emotions”. Some subjects mentioned the constriction of types of volunteering activity in digital space (examples: “the variety of types of volunteering activity tapers”, “Some volunteering can be realized as a physical help for needy (to take a work with dogs from shelter, help people in hospice, feed the people). “Internet doesn’t give you that opportunity”, “Digital volunteering can realize psychological support but not physical help”). The nonmaterial result of digital volunteering also can be regarded as disadvantage (examples: “no feeling that your do something significant and vivid”, “don’t see people you help”) and technical problems (“the internet delays”, “dependence from the technical devices – no signal, no devices – no chance to help”, “the quality of help can vary from technical devices”, “not all people have technical devices”).

**Table 9**

The distribution of disadvantages of digital volunteering for groups with different types of motivation to volunteering

Disadvantages	1 type		2 type		3 type	
	yes	no	yes	no	yes	no
The absence of live communication and interaction.	60.0%	40.0%	62.5%	37.5%	38.5%	61.5%
The constriction of types of volunteering activity	30.0%	70.0%	33.3%	66.7%	30.8%	69.2%
Nonmaterial product/result	10.0%	90.0%	8.3%	91.7%	0.0%	100.0%
The lack of technical means	0.0%	100.0%	12.5%	87.5%	7.7%	92.3%
Other	10.0%	90.0%	12.5%	87.5%	23.1%	76.9%

The distribution on disadvantages of digital volunteering for groups with different types of motivation to volunteering are presented in Table 9.

The absence of live communication and interaction as the disadvantage is more important for subjects from groups of “active volunteers” and “pragmatic volunteers”. That can be connected with specific motivation of volunteers from these groups – career possibilities, importance for social and development motivation.

#### **4. The Discussion**

Our results showed that the informational orientation in possibilities of digital volunteering in Russian youth is rather low – more than a quarter of subjects showed very vague perception of digital volunteering forms and practices. In spite of high involvement of modern youth audience in internet the opportunities for prosocial activities are not vivid for them. High level of advertising of digital volunteering in internet doesn't have the real recoil. The “digital natives” or so called “generation Y” have higher competence in internet use [58]. They are presumably more ready for internet prosocial behavior but in reality the engagement in volunteering behavior is more complicated. We also found out that the orientation in concrete volunteering organizations in internet is low – 68% of subjects didn't named any internet addresses in spite of the fact that many of them has the experience of volunteering activity. The analysis of real practice in other research defines the preferred forms of volunteering activity. The engagement in volunteering activity is higher for offline volunteers and mixed group combining offline and online volunteering activities. The pure digital volunteering is less popular for all age groups, including age group from 15 to 34 years old [59]. Our sample has a good level of experience in volunteering activity (74.5%) but the representation about real forms of digital volunteering were not so vivid. The analysis of volunteering motivations showed correlation with deepness of representations about digital volunteering. “Active volunteering” and “pragmatic volunteering” groups have more concrete and detailed understanding of forms and content of digital volunteering.

The understanding of advantages and disadvantages of digital volunteering also shows some interesting findings. For analysis of advantages the answers can be divided into two groups: advantage focuses for those who need help and advantages for volunteers themselves. At least 83,8% of subjects mention the possibility to choose comfortable time and place for help, that seems to be more secure for personal time and resource organization. Only 16,2% of subjects are focused only on advantages for people that need help with advantage focus on availability to help those who are far away, alone and have some activity limits. No differences for different motivation groups were found. The analysis of disadvantages of digital volunteering defined the absence of live communication and interaction as the most important one. That fact correlates with the preference of offline or mixed forms of volunteering among people: live communication and “eyes to eyes” interaction is preferred for helping behavior due to obvious reinforcement of the volunteer. Possibly the perceived behavioral control in real-life cooperation leads to high confidence in effectivity of volunteering behavior [60].

#### **5. The Conclusions**

The goal of our study was to investigate the digital volunteering representation in youth. We supposed that volunteering motivation correlates with different digital volunteering representations: more vivid volunteering motivation in youth correlates with more clear representations about forms, advantages and disadvantages of volunteering activity. The realized investigation helps to define representations of digital volunteering in youth. The representations of digital volunteering in youth are rather vague- some common characteristics of digital helping activity are named with a not high level of orientation about volunteering structures in internet. The experience of real practice in volunteering has some link with deepness of knowledge and understanding of digital volunteering activity. The main advantages and disadvantages of digital volunteering are defined. There is some contradiction in representations of advantages and disadvantages of digital volunteering – in some forms online helping behavior wide the possibilities to help, but at the same time dependence from internet and technical devices, limitation of help forms due to distant communication are named.

During the investigation we defined different motivation functions of volunteering activity. Three types of volunteering motivation were depicted: "active volunteering", "passive volunteering", "pragmatic volunteering". We analyzed the links between different types of volunteering motivation and representation about digital volunteering. The groups of "active volunteering" and "pragmatic volunteering" have more clear representations about forms, advantages and disadvantages of volunteering activity that subjects from "passive volunteering" in most situations. The reflection of volunteer motivation can make the understanding of altruist helping behavior more vivid and clear.

The theoretical significance of the present study is defined by the described picture of digital volunteering representation in modern Russia. There is a lack of investigation on that theme in Russia. The varied levels of informational orientation about digital volunteering were described. The revealed results can be used in the practice of volunteering involvement processes. The modern Russian volunteering groups are looking forward to attract active youth in prosocial activity. Comprehension of stimulus and values of that participation for new possible participants, their perception and knowledge for digital volunteering can be useful in organization of effective people engagement programs.

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# Measurement of Presence by a Presence Counter Based on Breaks in Presence

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## Abstract

The paper is concerned with methods of measuring presence. The physiological and behaviour methods are situation-specific whereas subjective method is used after virtual session. In this paper we focus on the method that evaluates the presence counter based on breaks in presence (BiP). The advantage of this method is its implementation during the virtual session, during the virtual experience.

Within the experiment, 22 participants walked around the virtual Asian park and searched for virtual vases. They gave signals when BiPs occurred. The presence counter can be calculated based on this data. To validate this approach the participant were asked to answer ITC-Sense of Presence Inventory (ITC-SOPI) after the virtual session.

Our approach of computing the presence counter involves the Markov chain that is a simplest model of stochastic process.

Presence counter based on BiP and the Markov chain was proposed by Slater and Steed. They consider the discrete time model. In the paper we revisit this approach and, additionally, develop the continuous time Markov chain based method of presence counter. The calculation of the correlation between the presence counters based on BiP and results of ITC-SOPI shows that the counters relied on the continuous time Markov chain are most sensitive. This paper shows that a BiP-based presence counter can be used as an effective presence measure.

## Keywords

Virtual reality, presence, mediated presence, presence measurement, breaks in presence, Markov chains, presence counter

## 1. Introduction

The virtual reality is a special technology that makes it possible to create an interactive three-dimensional environment. The presence is the main phenomenon in the study of virtual reality. "...The phenomenon of Presence is that an individual experiences the illusion of being present in the same reality with objects or subjects that are not in the directly observable reality of the individual. It is necessary to make a reservation at once that in this context we are not talking about the situation of full consciousness of the individual that the reality he feels is in fact artificially created or caused to exist in another way" [1, p.38].

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The authors of [2] call the experience of presence in the virtual world mediated presence. In their opinion, the mediated presence is a sense of presence in the external world, in the realization of which technology plays an important role. When a person experiences a strong mediated presence, his/her experience shows that the technology has become a part of themselves, and the mediated reality has become a part of the Other. In the context of this work, the presence will be understood as an mediated presence.

The presence as a phenomenon can be recorded and measured. The question of selecting measurement methods is extremely important. The subjective methods, primarily questionnaires and inventories, can be used. The behavioral and physiological measurement methods can also be used. Note that the subjective methods depend on the subjective opinion of the subjects and they do not measure presence at the moment of experience. On other hand, they are universal. The behavioral and physiological methods depend on events that trigger behavioral and physiological responses. Slater proposed a method based on breaks in presence (BiP) [3]. Most participants in virtual environments do not experience being present all the time while interacting with VR. They can hear sounds from the real world and feel the touch of objects from the real world. These sensations can cause the consciousness moves from the virtual environment to the real one. However, if a person reports a transition from the virtual environment to the real one, it means that they have just felt themselves in the virtual environment. In this way, messages about breaks in presence help to measure the presence. This method allows us to know that a participant experiences the presence at the moment when he experiences it. Slater measured the presence based on the CAVE technique and the movement around the chess table with 3D chess. The movement was carried out by walking. Slater used a mathematical model of discrete time Markov chains.

The main question of this study is whether it is possible to measure the presence by the BiP method using Markov chains in the HMD technology and moving by walking for small distances and teleporting for significant distances? Will the BiP-based presence counter measure the experience that is usually regarded to as presence? What methodological features should be taken into account? To address these question we extend Slater's approach to continuous time Markov chain. Moreover the validity of the BiP-based presence counter was evaluated by correlation with the ITC-Sense of Presence Inventory (ITC-SOPI) [4].

Notice that in this paper, we did not set out to link the presence with any individual characteristics of the participants, we were only focused on the validity of the presence counter.

## 2. Background

A large number of publications have been devoted to the presence, since the 90s. From relatively old reviews, for the purposes of this paper, it is interesting [5].

Now, a number of reviews of more recent works related to the concept of presence have been published. The paper [6] provides a theoretical overview, and the paper [7] discusses methods for measuring presence, and suggests, according to the authors, unused methods. The paper [8] discusses about immersion, social presence and co-presence as the ability to be somewhere together, to perceive and be perceived by other people, to interact with people. The paper [8] also raises the question of realism and veracity.

Close to this is the discussion of perceptual and social realism as important aspects of the presence [9]. Perceptual realism occurs when the environment supports the action in it, when the response of the environment is perceived as plausible and adequate. Social realism refers to a more general concept: when an event that occurred in the environment is plausible, when it can happen in the real world. There can be high perceptual and low social realism in a virtual environment.

These concepts echo Slater's earlier ideas of place illusion and plausibility [10].

The paper [11] mentions three main approaches to the study of the presence: the mediated-objective school of thought approach, mediated-subjective school of thought approach and inner presence school of thought approach. The first two schools describe the presence as an essential element in mediated experience. The third describes the presence as a phenomenon that does not require median systems (virtual reality technologies, etc.).

The schools of the mediated presence define presence as the perceptual illusion of immediacy. [11] criticizes this approach, although points out that schools of mediated presence provide good definitions of a number of concepts, such as immersion and involvement. According to [11], the mediated presence approach does not answer important questions: why do we feel the presence, what is its role? Trberti and Riva, the researchers of inner presence school raise the similar questions [12]. They also talk about the schools of mediated presence, which, according to them, do not answer questions about the evolutionary cause of the presence, about its causes and purpose.

Representatives of the third school in their works define the phenomenon of presence as a conscious sense of being in the external world, as a phenomenon that controls the division into the inner and the outer [13], [14], [15], [16], [17], [18], [19], [20], [12]. They suggest treating the presence as a presence in any environment, not necessarily created by virtual reality technology. They see the presence as a central part of conscious mental life [20]. The sense of presence, according to these researchers [12], allows you to constantly adapt your own activities to the external environment. This approach is also related to the concepts of intentions and actions: the more the environment allows you to implement intentions, turn them into actions, the stronger the experience of presence.

There are other works in which presence is considered more broadly than presence in a virtual environment. For example, [21] assumes that the presence is associated with the successful implementation of intentions, so that a person feels like a successful author of their own actions. In [? ], the presence is considered as a personal state that occurs in both real and virtual environments, and mediation is not only a technique for creating virtual reality, but in general, any situation where actions are implemented indirectly, so presence is analyzed by the example of driving a car to demonstrate the flexibility of this approach.

Another interesting work [22] is devoted to the relationship between the presence and the perception of own movement in a virtual environment. In contrast to the researchers of the school of inner presence, who suggest that the virtual environment creates limitless possibilities unlimited opportunities [22] indicate that virtual environments, on the contrary, are limited in comparison with reality, in particular, it is very difficult to move. In [22] the presence and illusory self-movement in a virtual environment are linked. The experimental material shows that the presence is related to how one's own motion is perceived in a virtual environment.

We should also mention the works [23], [24], [25], devoted to the relationship of metacognitive processes and the presence. Metacognitive processes, such as monitoring and error correction, prevent cybersickness, but can also prevent the appearance of the presence, since these cognitive processes lead to the fact that a person pays attention to the low naturalness of virtual scenarios [24]. Purposeful study of different classes of psychological factors of the sense of presence will lead not only to progress in the construction of a general psychological theory of the sense of presence, but also will allow us to find effective solutions to fundamental and applied problems using virtual reality technologies [24].

The presence, regardless of the definition of which school the researcher uses, is a subjective experience in which a person interacts in one way or another with the reality surrounding him (for representatives of schools of mediated presence – virtual).

The presence measure is necessary in order to establish whether presence actually increases interaction with the virtual environment system, and to better understand the factors that may drive this phenomenon [26]. The question of a valid measure of presence was pointed in [26]. The measuring of the presence in the framework of the subjective, the behavioral and the physiological methods was considered since [27], [28].

The subjective method uses questions such as "how real did the virtual environment seem to you?", "was the virtual environment really the place you were in – or just a series of images shown to you?", [27], [28], [26], [29].

The behavioural method tracks the user's behaviour, for example, whether the user shield himself/herself when an object is thrown at his head, [27], [28], [26], [29].

The physiological methods record changes in the heart rate, skin temperature, GSR, respiratory rate, etc. The experimenter looks at whether a person is stressed in a stress situation in the virtual environment [27], [28], [26], [29].

In 2000 Slater, together with his colleagues, proposed an approach to measuring presence [3]. According to Slater, traditional methods of measuring presence have certain disadvantages. In particular, the responses to the questionnaire can ensure that only conscious and voluntary responses are integrated over time. Behavioural measures, such as responding to the sudden appearance of an object, require events in the environment. The physiological measurements offer, according to Slater, a promising way forward. However, the physiological methods are used in cases where the environment causes anxiety (for example, go to a pit). That is why they are only suitable for a very small number of applications. What the physiological response is appropriate for observing a virtual chair, a room, or a deck of a ship? Relying on the physiological responses to specific events or objects in a virtual environment does not offer a general solution [30].

The main idea of the approach proposed by Slater and his co-authors can be described as follows. A person who is in the virtual reality environment switches between being present in the virtual environment and being present in the real environment [30].

Initially, Slater and Steed intended to use the mathematical model of Markov chains to calculate presence based on BiP. Later [31], the Slater team rejected this method as too complex. Natural noises were the cause of BiP in operation [3]. The noises were modeled by experimenters in later works [31].

Let us briefly describe the approach of [3] that provides the main idea of the method used in this paper. In the immersive virtual environment, the participant receives a continuous stream of

sensory data. This data is mostly visual, coming from a virtual environment. But also often this data is auditory from the real world or real haptic and kinesthetic data (for example, the weight of the HMD). Sometimes, the sensor data of the virtual environment shows disturbances. Or a close-up of an object shows its texture mapping. Additionally data from the real world can intrude: the phone rings, there is a sudden movement of air when the door opens, the temperature changes, the cable is wrapped around the leg. Sometimes, the participants' internal mental processes make them realize that they are actually in the virtual environment when the participant in the laboratory or exhibition hall, and not in the illusory place presented to them by the virtual environment [3].

In other words, two alternative gestalts are available to each person at any time. The first gestalt is "I am in the place depicted by the VE system" Bellow, we following [3] denote it by "V". The second gestalt is "I'm in the lab in the computer science building, wearing a HMD". This state is denoted by "R". At every moment, the individual can occupy only one state. Being in the virtual presence in the virtual environment can be considered as the degree of preference of the state V [3].

However, during the experience of being in the virtual environment, as expected, the individual usually experiences transitions between state V and state R. These time instants when the individual switches from one interpretation to another, in particular, from V to R, are studied. It is not possible to ask participants to report transitions from R to V because this will require them to immediately exit the presence state. However, according to the authors [3] the experimenter can ask participants to report transitions from V to R. Since the transition from V to R implies the feeling of the presence, we can use this information to evaluate the being of presence.

On the other hand, the information of transition from R to V is unavailable. Thus, Slater proposed to consider two cases: low and high presence. The low presence case implies that the state "R" is basic, when the high presence case means that primary individual occupies the state "V".

In their work, Slater and Steed provide the mathematical calculations that allow using the technique of Markov chains to derive the formula for counting the experienced presence depending on the reported BiPs. As a consequence of this formula, the probability that the participant experienced the presence is computed. The value of this probability serves as a presence counter. This formula is modified for conditions involving high presence and for conditions involving low presence [3].

Slater and Steed used the discrete time Markov chain assuming the time unit equal to 10 seconds. Participants reported BiP orally.

In this framework, the low presence condition means that the transition from R to V occurs just before BiP. Whilst, the high presence is modeled by immediate recovering of V after BiP.

To distinguish the low and high presence cases Slater and Steed used discriminator question.

### **3. Methods**

#### **3.1. Participants**

The study involved 22 people, including 11 women and 11 men. With the exception of two people (men and women), all participants had or pursued the university degree.



**Figure 1:** General view of a virtual scene.

### 3.2. Equipment: hardware and software

The environment uses the vr HTC Vive headset. It connects with the computer via cables. Apart from a VR headset, the Vive system is equipped with special hand-operated controllers and with two infrared cameras for tracking a person in the environment. In order to implement both systems, the Unity 3D development environment was used, along with the C# programming language, a SteamVR plugin etc.

The most elaborated and suitable for the experiment set of visual resources was chosen at the design stage in order to create the effect of presence and immersion into the virtual environment.

Visually, the scene is a reconstruction of a classical Far-Eastern mountain monastery (see Figure 1).

### 3.3. Procedure

The participants were asked to provide their name, offered to wear HMD, and, having seen the virtual environment with them, follow the opened area, which is an Asian-style park. The movement was carried out by means of physical movement in a limited space and by means of successive teleportations over long distances. In the park, the participants had to fix specially selected objects along the way – low rounded vases (see Figure 2). The objects were chosen according to the principle of average notability and, at the same time, naturalness for any location of the created scene. The task was to give meaning to the walk in the park, make it purposeful and encourage the participants to move around the space of the park.

The stay in the environment was limited by 7 minutes. After the first five minutes, the participants could leave the environment at any time they wanted. The participants were instructed to say the word "here" loudly every time they felt BiP. During the experiment, an





**Figure 2:** Detecting a vase and indicating it with a laser pointer .

audio recording was conducted. The time at which the subjects uttered the word "here" was recorded on an audio recording.

During the experiment, the number of vases found was also recorded. The participant could see them on the counter on his hand (see Figure 2). A large or small number of vases found were not rewarded or punished in any way.

As in the original paper by Slater and Steed the discriminator question about the experience of the presence was asked after the experiment. The participants were asked where they felt during the session. Also, the reasons for pronouncing the signal "here" were specified. If the participant never said "here!", then the question "why?" was asked. Did the participant always feel like they were here, in a real room? Did the participant feel like they were in an Asian park all the time?

The Russian version of the ITC-Sense of Presence Inventory (ITC-SOPI) was offered after the experiment. It is described in the paper [4]. This inventory is based on four factors:

- Sense of Physical Space;
- Engagement;
- Ecological Validity;
- Negative Effects.

These four factors cannot be combined into a single measure of presence. According to [4], the main determinants of the Sense of Physical Space factor are the variables of the media form, i.g., the properties of the virtual environment. The questions on this scale relate to the participants' experiences about the reality of what is happening, the ability to touch the elements of the environment, to interact with them, ect. The second factor that is considered is Engagement. One of the points of this factor directly examines how attractive respondents find

the content. Other questions that make up this scale relate to excitement and emotionality. The answers depend on the media content, but are also amplified by the media form.

The questions that include the third factor, Ecological Validity, concern the plausibility and realism of the content, as well as the naturalness of the environment. The amount, degree, and sequence of sensory stimulation, according to the authors, improves perceived naturalness and, in turn, increases scores on this scale. The high immersiveness of the media form (i.e., how it allows the participants to experience immersion), gives an increase of Ecological Validity. The higher immersiveness is the less the impact of the content on the perception of authenticity is. The difference in photorealism also leads to differences in the scale of Ecological Validity.

The questions related to the fourth factor, negative effects, are less related to the first three factors than to each other. In [4] Negative Effects were not strongly correlated (positively or negatively) with Engagement or Ecological Validity. However, they had a low but significant positive correlation with the Sense of Physical Space. Some negative effects, such as headache, eye strain, fatigue may be associated with the media form. Further, content can affect on the Negative effects: if it is perceived as boring, the participants may give appropriate ratings of fatigue or even headache [4].

### 3.4. Presence counter based on BiP

The presence counter was calculated based on the probability formula of experiencing presence, which was derived using Markov chains. The formulas given in [3] were applied. Time was discrete in the work [3]. The length of the time interval was 10 seconds. Also, the presence counter at the interval length of 5 seconds was calculated to increase the sensitivity of the method. In addition, formulas for continuous time were derived.

As in paper [3] we study the stationary distribution. Notice that [32] the stationary distribution exists and moreover the Markov chain converges to it exponentially. The approach proposed in (Slater, Steed, 2000) implies that we are to solve the inverse problem: we compute the stationary distribution using the information on breaks in presence, and then we are to find the matrix of transition probabilities that provides the measure of presence. Following [3] we consider two cases. First is the low presence case. Roughly speaking, it means that the participant leaves the state of presence once he/she reaches it. The second case we examine is the high presence situation. It implies that the state no-presence is leaved once the participant reaches it.

$p_L(b)$  is the probability of presence, corresponding to the stationary distribution, for conditions of low presence at discrete time [3]:

$$p_L(b) = \frac{b - k}{n - 1}$$

where

$b$  is the number of BiPs,

$n$  is the number of time intervals.

$k$  is the number of "close BiPs", that is, BiPs in adjacent time intervals.

$p_H(b)$  is the probability of presence for high presence conditions at discrete time [3]:



$$p_H(b) = \frac{n-1-b}{n-1}$$

where

$b$  is the number of BiPs,

$n$  is the number of time intervals.

Furthermore, we extend the approach of [3] assuming the continuous time. In this case, the dynamics of probabilities is determined by so called Kolmogorov equation that is an ordinary differential equation [32]. As above, we consider the inverse problem. We compute the matrix of transition rates by using the stationary distribution computed by BiPs. We also follow [3] and examine two cases: low presence and high-presence. However, the continuous time setting, implies that we are to introduce the relaxation time that is an external parameter. For the low presence case, it is assumed that the participant occupies the presence state once it is reached for the averaged time interval of the length  $\mu^{-1}$ . The case of high presence is opposite. Here we assume that the participant will reach the presence state once he/she leaves it for the time interval of the averaged length equal to  $\mu^{-1}$ . To adjust the continuous and discrete time models, one is to let  $\mu^{-1}$  equal to the time unit for the original discrete time model proposed in [3].

$p_L V$  is the probability of presence for low-presence conditions at continuous time:

$$p_L V = \frac{b}{T * \mu}$$

where

$b$  is the the number of BiPs,

$T$  is the total time of the virtual reality session,

$\mu = 0.1$  with a relaxation time taken equal to 10 seconds.

$\mu = 0.05$  with a relaxation time taken equal to 5 seconds.

$p_H V$  is the probability of presence for conditions of high presence at continuous time:

$$p_H V = \frac{\mu}{\mu + \frac{b-k}{T}}$$

where

$b$  is the the number of BiPs,

$T$  is the total time of the virtual reality session,

$\mu = 0.1$  with a relaxation time taken equal to 10 seconds.

$\mu = 0.05$  with a relaxation time taken equal to 5 seconds.

### 3.5. Mathematical and statistical methods

In this paper, the mathematical model of Markov chains is used.

In this paper, we use the Pearson correlation coefficient for

- calculation of the relationship between the scales of the ITC-SOPI questionnaire based on the responses of the subjects to the Russian version of the ITC-SOPI;

- calculation of the relationship between the ITC-SOPI scales and different variants of calculating the probability of presence based on BiP;
- calculation of the relationship between the presence measures and the effectiveness of the search for vases, which is expressed in the number of vases found.

#### 4. Results and discussions

The results of the ITC-SOPI questionnaire were calculated for all participants of the experiment. A BiP-based presence counter was calculated for each participant. The probability of presence is calculated when calculating the presence counter. If the participant gave a definite answer that he/she felt a presence most the time, then the formula for high presence condition was applied. If the participant gave a definite answer that he/she felt no presence or felt little presence, then the formula for low presence condition was applied. If the participant did not give a definite answer, then both formulas were applied.

Presence counter was calculated for the group of participants in the experiment 8 times according to the following principles:

The presence counter was calculated under the following frameworks

- Time interval/relaxation time is equal 5 sec or 10 sec;
- Discrete or continuous time Markov chain is used;
- The high or low presence assumption was applied to the undecided participants

And always the high presence assumption was applied to the participants reported a high presence. Always the low presence assumption was applied to the participants reported low presence or no presence.

This gives the 8 ways of calculation of presence counter

It is necessary to compare the presence counter with the results of the ITC-SOPI to determine the validity of the presence counter.

The ITC-SOPI results were also calculated. The Pearson's correlation analysis was performed between the scales of the questionnaire. See Table 1.

Table 1: Correlations between the ITC-SOPI scales,  $r_{crit} = 0.42$  ( $p \leq 0.05$ ) for the first level of significance,  $r_{crit} = 0.54$  ( $p \leq 0.01$ ) for the second level of significance

	Sense of Physical Space	Engagement	Ecological Validity	Negative Effects
Sense of Physical Space	–	–	–	–
Engagement	0.70	–	–	–
Ecological Validity	0.77	0.61	–	–
Negative Effects	-0.02	-0.04	0.13	–

Table 1 shows that the first three factors of ITC-SOPI significantly correlate with each other for the second level of significance. This corresponds to the results described in [4].

The Pearson's correlation analysis was conducted between the results of the inventory and the probabilities of experiencing presence, see Table 2.

Table 2: Correlations between the results of the questionnaire and the probability of presence based BiP,  $r_{crit} = 0.42$  ( $p \leq 0.05$ ) for the first level of significance,  $r_{crit} = 0.54$  ( $p \leq 0.01$ ) for the second level of significance

Probabilities of presence	Sense of Physical Space	Engagement	Ecological Validity	Negative Effects
The length of the time interval/relaxation time is 10 seconds				
$p_L(b)$ for uncertain and low presence; $p_H(b)$ for high presence	0.509	0.318	0.511	0.063
$p_H(b)$ for uncertain and high presence; $p_L(b)$ for low presence	0.487	0.392	0.482	0.333
$p_{LV}$ for uncertain and low presence; $p_{HV}$ for high presence	0.554	0.336	0.541	0.043
$p_{HV}$ for uncertain and high presence; $p_{LV}$ for low presence	0.551	0.416	0.520	0.241
The length of the time interval/relaxation time is 5 seconds				
$p_L(b)$ for uncertain and low presence; $p_H(b)$ for high presence	0.577	0.350	0.541	-0.015
$p_H(b)$ for uncertain and high presence; $p_L(b)$ for low presence	0.349	0.348	0.403	0.355

$p_{LV}$ for uncertain and low presence; $p_{HV}$ for high presence	0.657	0.378	0.592	-0.051
$p_{HV}$ for uncertain and high presence; $p_{LV}$ for low presence	0.538	0.428	0.523	0.355

Table 2 shows that the probabilities of presence significantly and positively correlates with the two scales of the questionnaire. These scales are Spatial Presence and Ecological Validity. The highest correlation values, significant for the second level of significance, were obtained when comparing the first and third ITC-SOPI scales with the probabilities of presence, calculated using a formula designed for low presence condition for the participants who did not give a clear answer or gave an answer about low presence, and using a high presence formula for the participants who gave a certain answer about high presence, for continuous time with a relaxation time taken equal to 5 seconds. This shows that this formula allows to create the most sensitive presence counter. However, when calculating the probabilities of presence using a formula designed for high presence conditions for the participants who did not give a clear answer and for the participants who reported high presence, and using a low presence formula for the participants who reported low presence or did not experience it, for continuous time with a relaxation time taken equal to 5 seconds, a correlation of the probability of presence with the Engagement scale was obtained.

Since, see Table 1, the first three ITC-SOPI scales correlate with each other, this result seems to be natural.

The relationship between the presence counter, which represents the probability of presence, and the "Sense of Physical Space" scale seems obvious. The presence counter is based on BiP and the participants were instructed to report BiP every time they felt like they were in a real room, not in an Asian park. Therefore, it is obvious that the presence counter should correlate with the scale associated with the participants' experiences about the reality of what is happening, the ability to touch the elements of the environment, to interact with them.

The focus on the environment, as measured by the second scale, "Engagement", can also affect whether a participant feels like they are in a virtual environment or in a real room. However, this issue needs further clarification.

Apparently, the naturalness and plausibility of the environment, as measured by the "Ecological Validity" scale, also influenced how the participant felt in the virtual environment.

It should be understood that the application of the formula of high presence conditions for undecided participants does not in itself give more valid results. The greater validity of the results, in which the probability of presence in undecided participants is calculated using the low-presence condition formula, is due to the fact that this formula seems to reflect the presence they experienced more than the high-presence condition formula. The correlation between the

two indicators suggests that one will change in the same way as the second. In our case, the probability of presence calculated using BiP is expected to increase or decrease in the same way as the ITC-SOPI scales. The method of calculating the probability of presence has this property to the greatest extent, when the formula of high presence conditions is used for those participants who indicated a high presence, and the formula of low presence conditions is used for those who indicated a low presence or no presence and for those who were undecided. But of course we get the significant correlation between ITC-SOPI scale “Engagement” and the presence counter using the formula of high presence conditions for those participants who indicated a high presence and for those who were undecided, and the formula of low presence conditions for those who indicated a low presence or no presence.

To clarify the optimal formula, additional studies will be required on an extended sample group and with a more strict discriminant question.

The number of vases found by the participants was also calculated, but it was not related to either the results of the presence counter or the results of the ITC-SOPI, see Table 3.

Table 3: Results of calculating the correlation between the number of vases found and marked by the subject during the experiment and the presence indicators,  $r_{crit} = 0.42$  ( $p \leq 0.05$ ) for the first level of significance,  $r_{crit} = 0.54$  ( $p \leq 0.01$ ) for the second level of significance

Presence indicators	Correlation between the number of found vases and the presence indicator
The length of the time interval/relaxation time is 10 seconds	
$p_L(b)$ for uncertain and low presence; $p_H(b)$ for high presence	0.143
$p_H(b)$ for uncertain and high presence; $p_L(b)$ for low presence	-0.271
$p_LV$ for uncertain and low presence; $p_HV$ for high presence	0.163
$p_HV$ for uncertain and high presence; $p_LV$ for low presence	-0.248
The length of the time interval/relaxation time is 5 seconds	
$p_L(b)$ for uncertain and low presence; $p_H(b)$ for high presence	0.124
$p_H(b)$ for uncertain and high presence; $p_L(b)$ for low presence	-0.285
$p_LV$ for uncertain and low presence; $p_HV$ for high presence	0.168
$p_HV$ for uncertain and high presence; $p_LV$ for low presence	-0.245
Results of ITC-SOPI	
Sense of Physical Space	0.242
Engagement	0.002
Ecological Validity	0.164

Negative Effects	-0.214
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The effectiveness of vases search is not related to the presence, as shown in table 3. It can be assumed that the presence does not affect the performance task related with the objects search and the objects search does not affect the presence.

## 5. Conclusion

In this study, we considered the measuring presence of the using primarily information available during the session of interacting with the virtual reality that does not require an emotionally rich content of the environment. Such a measure is a presence counter based on the calculation of the probability of presence using the Markov chain model. During the session, the participant reports the BiP, while continuing to perform the task. In this experiment, we used an environment that was an Asian park, where the participants could move around using teleportation and find vases. The experiment showed that the number of vases found during the session is not related to the presence measured during the experiment.

The paper shows that the presence counter based on BiP is a valid measure of presence for HMD technology and environment containing moving by walking for small distances and teleportation for significant ones. The presence counter provides the same measure of presence as the ITC-SOPI, which showed the high level of internal consistency in the Russian-language sample group. The formula based on continuous time seems to be more productive, especially since time is actually a continuous quantity, not a discrete one. The obtained results can be improved when we perform the study with largest group and clarify the discriminator question.

Thus, the results show that calculating the probabilities of presence using a formula designed for high presence conditions for continuous time Markov chain with the relaxation time taken equal to 5 seconds is optimal and allows to create the most sensitive presence counter. However, the experimental procedure allows for uncertainty in the subjects' responses to the discriminator question whether they felt a presence. Therefore, it was necessary to use both the formula for high-presence conditions and the formula for low-presence conditions for undecided participants. It will be profitable to find a more strict discriminator question that does not give uncertainty. Moreover future works include the improvement of instructions. The fact that the presence counter calculated on the basis of BiP has a significant correlation with the three of ITC-SOPI scales, that is, not only with "Sense of Physical Space", but also with "Ecological Validity" and with "Engagement", looks very interesting. Obviously, the presence counter measures how much the participant feels in the virtual environment and also how much they perceive the environment as plausible and natural. The presence counter also measures how much the participant is involved in the events of the environment.

Future research should also include virtual experiences related to different environments, participants' capabilities, and tasks. When the procedure for applying the presence counter is clarified, it will be possible to raise the question of the relationship between the presence deducted using the BiP-based presence counter and various individual characteristics of participants, such as gender of respondents, age, degree of familiarity with virtual reality, attitudes associated with participation in the experiment and so on.

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