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Syllable Frequencies in Manding: Examples from Periodicals in Bamana and Maninka

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Abstract. We study the rank–frequency distribution of syllables in texts from written press in Bamana and Guinean Maninka, two closely related languages from the Manding group of the Mande family in West Africa. Five issues of widely circulating newspapers are analyzed in each language. The Bamana texts are written in a Roman-based alphabet without marking of tones, while Maninka texts are published in the N'ko alphabet comprising a superficial notation of tones. For the sake of comparisons, the Maninka data are also compiled for syllables with tonal distinctions neglected. The obtained rank–frequency distributions of syllables are fitted using two discrete distributions, Jain–Poisson and positive negative binomial, as well as the continuous Yule distribution. In most cases, a satisfactory fit was achieved, with the determination coefficient $R^2 > 0.95$ and discrepancy coefficient $C < 0.02$. The relation of the Yule distribution and Zipf's law with respect to the number of syllable types is discussed.

Keywords: *Syllables, Bamana, Mandinga*

1. Introduction

Quantitative linguistic studies cover distributions of various language units, from graphemes and phonemes (cf. Tambovtsev & Martindale 2007; Kelih 2013; Koščová et al. 2016) to suprasentence entities (cf. Altmann 2014; Rovenchak & Buk 2018). Syllables are localized on the smaller side of this cline, and the syllabic level remains underrepresented in the literature. Syllables in Dutch were analyzed by Schiller et al. (1996). Statistical studies of Korean by Choi (2000) included analysis of syllable frequencies. Frequencies of syllables, alongside phonemes and moras in Japanese, were in the focus of the research by Tamaoka & Makioka (2004). Syllabic complexity for nine European languages was studied by Adsett & Marchand (2010). For a concise review, see also the Introduction to the recent paper by Radojičić et al. (2019) and references therein.

Strauss et al. (2008) suggested that, similarly to words, rank–frequency distributions of syllables follow Zipfian behavior. Such an observation was confirmed for Serbian (Radojičić et al. 2019). This conclusion, however, might not be the case for languages where open syllables are predominant. The reason is that the number of syllable types in such languages is significantly smaller comparing, e. g., to Slavic or Germanic languages. Consequently, there might be simply not enough syllable types to provide wide plateaus at high ranks.

In the present paper, we analyze texts from written mass-media in two closely related languages from the Mande family in West Africa. Previously, some quantitative studies of one of the languages, Guinean Maninka, were made (Rovenchak 2011; 2015). Several quan-

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titative-linguistics papers include Bamana alongside other languages (see, in particular, Fenk & Fenk-Oczlon 1993; Nettle 1998; Peust 2008).

The paper is organized as follows. In Section 2, the material we analyze in the work is briefly introduced, with the description of languages and sources given. Section 3 contains the information on phonotactics of the languages under study and principles of syllabification. Results are presented in Section 4. Brief discussion is given in Section 5.

2. Material description

The Manding languages are a part of the Mande language family spoken in West Africa, see map in Fig. 1. In the present work, we focus on two of them, Bamana (Bambara, Bamanankan) and Guinean Maninka. Bamana is the main language of Mali spoken by some 14 million people (of these, about 4 million are L1 speakers). Maninka is spoken in Guinea, Mali, Senegal, Liberia, Sierra Leone. Its Guinean variety is the mother tongue for some 5 million people, and further 3 or 4 million use it as L2. Bamana and Guinean Maninka are closely related (about 98% of common vocabulary in M. Swadesh's 100-word list), but their written varieties diverge further apart.

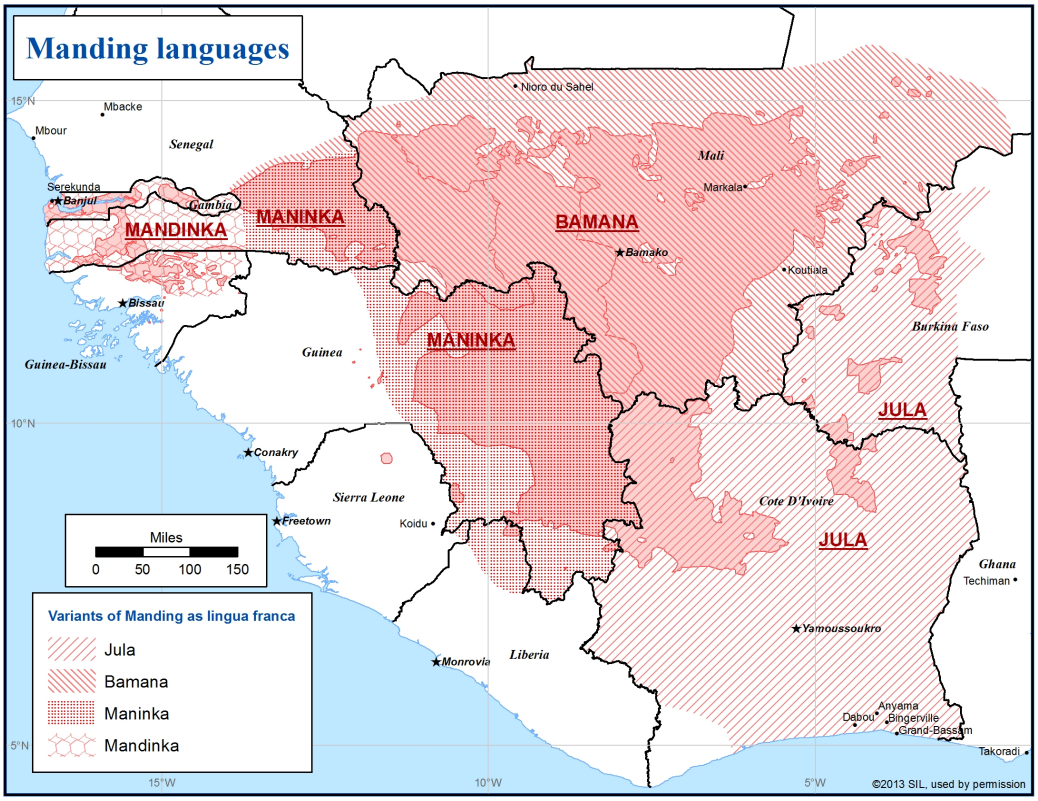

Figure 1. Geographical distribution of Manding languages (Vydrin et al. 2001) ©2004 SIL International ®. Used by permission, redistribution not permitted.

The material is taken from the Bamana and Maninka corpora (Vydrin 2013; Vydrin et al. 2016; Vydrin et al. 2011–2019a, b). Bamana texts are from *Kibaru* 'News', a monthly newspaper published since 1972, see Figure 2.

Kibaru

Feburuyekalo san 2019
San 46nan - Boko 565
Songo = dɔrɔmɛ 35

Kunnafonisebɛn bɔta kalo o kalo - BP : 24 - Telefɔni : 20.21.21.04 Kibaru bugufiyɛ Bosola Bamako

Jamanakuntigi ka taama Alimanjamana na ani Adisabeba, Afiriki kelenyatonba ka laje kɛnɛ kan ɲ5 nan

Jamana jiri ɲɛnamaba saba bɛ ka tunun dɔɔnin-dɔɔnin : si, nɛrɛ ani balansan ɲ2 nan

Mali Samatasɛgɛ mankanw ye kabako lamaga Nizɛri jamana kan ɲ8 nan

Ebola banakise tɛ Mali la ɲ7nan

Musomanninw ka nɛgɛkɔrɔsigi kɛlɛli kɛra diyagoya ye dinɛ kɔnɔ ɲ5 nan

Fasokanw ye kɛrɛfɛdɔn kɛlɛli ni siginɔgɔnya sinsinnan sira ɲuman ye ɲ8 nan

KIBARU bakurubasanni (Kalo 12 songo) : Mali kɔnɔ – Dɔrɔmɛ 400 - Afiriki Kɔnɔ – Dɔrɔmɛ 800 - Jamana wɛrɛ – Dɔrɔmɛ 1.400

ɲɛ2 KIBARU boko 565 Feburuyekalo 2019

Jamana jiri ɲɛnamaba saba bɛ ka tunun dɔɔnin-dɔɔnin : si, nɛrɛ ani balansan

Si, nɛrɛ ani balansan ye siniɲɔrɔbaw ya an ka jamana kɔnɔ. U dɔnnen don, ka da u nata kan baloko, tuma ani kunja lekɔnan na. U bɛ sɔrɔ jamana yɔrɔ caman na. Falenyɛrɛmajirw dɔn. Kungo bɛ sogow labaa ka dɔgɔ min, a ka damadenw fana lahine ten. Tiɲɛ don, Mali ye Sahelijamana ye nka kungo tulenw bɛ kɔnɔ yɔrɔ caman, sanga a wɔrɔduguyanfan fɛ, kɛrɛnkɛrɛnnenya la Kayi marabolo yɔrɔ minnu ri Lajine bɛ danbo Kilayantan fɛ, ani Kulukɔrɔ marabolo yɔrɔ minnu ri Lajine bɛ danbo, n'a fɔ manninkalayɛnfan fɛ ani Sikaso marabolo, ka surunya Kɔnɔwari jamana na. A kɔrɔsila k'a fɔ ko kungo bɛ ka nagasi Mali kɔnɔ kosɔbɛ, k'a sababu ka jiriɲɛgɛba ye dɔgɔkɔ, sɔjɔjiriko ani kɛrɛyasɔ kama walasa ka sɔ kuraw jo. O kungotiɲɛsɛ in senfe, digi kelen bɛ jiri mɔfɔmaba minnu na, n'u bɛ jiri ka silatunun siɲɔyɔrɔ ri dagɔyɔrɔ kɔnɔ, o ye si, nɛrɛ ani balansan ye.

Lasina Kɔnɔ ye cikstugudatigi ye, a sigilen bɛ yɔrɔ min na o tɛ kɛlɛ «kulibaflɔnɔ», o bɛ kanala fɛ, jiriladonna don, jiridɔnkɔtigi don. Ale hamien don kosɔbɛ n'a ka siluw ye. A kɛrɛfila siju banna ɲɔgɔ la, kɛsɔrɔ si ye jiri lakananen ye an ka jamana kɔnɔ min ɲɔgɔn don ji ni kungo lakaniɲɔgɔw ka saniyaw fɛ. Mɔgɔw bɛ k'u ɲɔgɔ k'u kɛlɛ ka bin. Tiɲɛrɛlila sɔrɔ min na fana ɔ'u jeni k'u faga, o la, u laban bɛ kɛ dɔgɔ ye. Kɔnɔkɔ y'a dafɔn si nata la. A y'a jira ko ale bɛ nata sɔrɔ sitɛnw na, mɔgɔw bɛ na a san, k'u ka kulu dunɲɛ ye. O silulu kelen in ye fura tana ye an fɛ yan, a bɛ ke ka denmisɛnnin banabagatɔ caman furuke, hali bɛlikɔw ni mɔgɔkɔrɔbaw.

A y'a jira k'a bɛ ke muntulu fana ye laada sira kan musɔ caman fɛ, a bɛ ke hali pomadi ye k'a fɛɛrɛ jamana kɔkan, sangɔ nansarila. A y'a jira ko ni fura ma sɔrɔ si halakili la, don dɔ la, an denw bɛnɛ an ninnina kɔ si tun ye mun jiri suguya ye, bawɔ o y'a sɔrɔ a bannɛ pewu kungo kɔnɔ. si bɛ ka tigɛ, fɛn tɛ ka turu a nɔnɔ, wa hali ni turuliw kɛra, si tadonni n'a moyali, o baara ka ca, wa u bɛ waati jan ta. Silurula min b'a ka si mɔ dun o man ca. Nka, o n'a la bee, siforo binni Mali yɔrɔ caman na, o ka kan ke duguw fɛ, o ka kan ke sigida lakodonnenw, gɔnɔsɛnsan ani kɔnyɔnyɛw fɛ, k'a da a naffa kan. Mali kɔnɔ, n'a bɔnɛ dɔnɔnimayɔrɔw la kɔrɔn fɛ, sɛsun bɛ kungo caman kɔnɔ Kayi, Kulukɔrɔ Sikaso, ani Segu marabolow. Afiriki tilenjɛnfinjamanaw kɔnɔ, Mali de tun ye fɔlɔ ye sisunkɔ la. Nkɛrɛ tɛ bi ye. Finfinbaw ni dɔgɔtigɛlaw bɛ ka cikɛdugu lamuɛw bali u dafinma ninini na ni sijɔtigɛba ye, bɛɛ si-gilen pɛnɛ, fɔɔ tɛ ka bɔ a la. A ko gɛlɛyara fɔ k'a damɛlɛma fɔ Sikaso ji ni kungo ɲɛmɔgɔyasɔ ye jiniriw ni segesegɛlaw ke a ko kan ni marabolo kɔlatigɛsɛkulu ke dɔnɛ ye walasa k'a dɔn sababu minnu bɛ ka si ni nɛrɛ halisi dɔgɔyɛ u ka kungow kɔnɔ.

Seku Ture ka fɔ la, o ye ji ni kungo cakɛda ɲɛmɔgɔ dɔ yɛ Sikaso, u ka bakaw jatɛbɛ y'a jira ko si ni nɛrɛ ye sudanmɛyɔrɔw ni lukɔrɔmayɔrɔ jiniw ye. U jɔyɔrɔ min be kungo lagɛnamayɔrɔ la, o bɛlen ka yen, sɔrɔ yiriwali jiriw fana don, ɲininɛ y'a jira ko gɛlɛya caman bɛ sisun ni nɛrɛsunɛw kan. Waatiyɛrɛma kɔlɔlɔw bɛ ka yɛlen jiri ninnu kan. O bɛ ka banaba bila jiri ninnu moyɔrɔ la, u ts ka bulubo kɔpuman, u tɛ ka den a ɲɛ mɔ, u tɛ ka bonya, ka janya i n'a fɔ kɔrɔlen. Kɛjɔlɔ sɛrɛkili kɔnɔ, dugu min bɛ wele Furu, waati kɛra a la, si ni nɛrɛ tun bannɛ ka don yen, o sababu jɔnjon ma sɛ don mɔgɔ si fɛ halili. ɲininɛ y'a jira ko si ni nɛrɛ bɛ ka halaki sɔn ka jamana kɔrɔ ka taa a fɛ, wa u nafa fanɛ bɛ ka bonya o cogoya sitɛlɛ la bawɔ jamana wɛrɛw bɛ ka samɛ u nafɔ dɔnɛ fɛn tan ni naani kɔnɔ. Sikɔlɔ, situlu ani nɛrɛsikɔlɔ kɛra nafɔlɔ ye bi, sangɔ musolakaw bɔɔ.

A yɛra k'a fɔ ko bintumayɔrɔ jiniɲaw kɔnɔ, si ni nɛrɛ caman bɛ sɔrɔ ɲɔrɔw kɔnɔ. O la, cikɛlaw bɛ sɛ k'u dɔn tɔn na, k'u lakana, k'u kɛsi ɲɔnɔkɛlaw tɔɔrɔ ma. U bɛ ɲɛ dugukɔlɔ suguya minnu kan kosɔbɛ, olu ye dugukɔlɔ bɔgɔjɛlilɛlamɔw walima dugukolo silisibɔgɔjɛlamaw ye. Si dɛnɔgɔ bɛ yɛlɛma-yɛlɛma san ni san. San dɔw la, a bɛ dɛn kosɔbɛ, san dɔw la a denw tɛ ɛɛya. Sanji hakɛ ɛɛya n'a dɔgɔya ani tiɲɛnitasumadon kungo kɔnɔ ani si ka dencogoyɛkɛlɛ san saba ɔ san saba, olu y'ɔ sabatuw dɔ ye. Lasina Dunbuya ka fɔ la, ale siglen bɛ Mali ni Kɔnɔwari dance ja, nɛrɛ ye jiri kɛrɛnkɛrɛnnen ye olu fɛ yen, A ligɛli kɔnnen don.

Dugumɔgɔ bɛɛ lajɛlen, ɔɛ ni musɔ, denmisɛn ni maakɔrɔ, bɛɛ b'a kɔlɔsi, bɛɛ b'a lakana. Dunbuyake ka fɔ la, nɛrɛ bɛ kɛ lɔn bɛɛ ye olu fɛ yen, A buluw n'a denw bɛ kɛ balo yɛ don ɔ don. O kɔrɔn, u ni kungo lakanacakɛda bolo bɛ ɲagɔn bolo su ni tile ka nɛrɛsunɛ lakana.

Balarisan koni ka ca kosɔbɛ Segu mara de kɔnɔ. Ni Bamakɔw mako b'a bulu n'a bolow la, u bɛ ci bila u donbagaw ma Segu, u ka na u sɛma. Bakari Jara ka fɔ la, ale ye ji ni kungo ɲɛmɔgɔ dɔ ye Segu, ni Segu tun ye balansando ye fɔlɔ, o ts bi ye, Duguba bonyakɔ lagu ye caman bɔ balansan hakɛ la, ka fara dɔgɔtigɛlaw ni tiɲɛnitasumadonnaw ka baara jɔgɔw kan. Jaratɛ ka fa la, balansan nafa dɔ y'a bɔluw, a faraw, n'a dilɛw ye, olu bɛɛ ye furaw ye. O kɔfɛ, a suma ka di. Segukaw be yen minnu b'a turu, k'a ladon, k'a tonobo hali n'o y'a sɔrɔ a den ts dun.

A bɛ cikɛlaw lasɔmi ni ja bɛ na. A ka gelen balansan ka silatunun Segu marabolo kɔnɔ bawɔ a jensennen bɛ fan bɛɛ wa a kɔlɔsilen don fana. Ji ni kungo lakanabagaw dagɔyɔrɔ min be Bamakɔ ba numanfɔbolo kan, o ɲɛmɔgɔ ye Madamu Gindo Jeriba Gindo ye.

Ale y'a jira ko si ni nɛrɛ ni balansan hakɛ dagɔyɔ ye jɔnkɔbaa ye. Mɔlidɔn bɛɛ bolo, ka da a kan hadamadenw ka ɲɛnamaya tɛ se ka sabali jiri kɔ. Seji caya sababu dɔ ye jiri ye. Jiri ye furu ye, dogo be bɔ a la, sɔw be bɔ n'a ye, bagɔnw balo be bɔ a la, u suturalan fana don.

Muda I Mayiga
Fuseyini Jabate
Mamadu Si
Mahamadu Kɔnta

Bololabaara gɛlɛya

Gɛlɛyaba bɛ Suleyimani Dambele ka baarayɔrɔ la. A bɛ SeguSɔmɔnɔbugu la. ɲininkali kɛra a la Segu bololabaarakɛlaw ka kɔw cogo la. A ye ɲininkali jaabi ni jigitigɛ ye, k'o sanni ts yɔn wa waati ka gelen. Nka mɔgɔ tɛ i jigitigɛ Alla la.

A ka kuma kɔnɔ, a ko gɛlɛya min be bololabaarakɛlaw kan Segu, o sababu ye an yɛrɛ ye. Jamanakanɔdenw t'u ka fɛn dilannenw fɛ fo jamana wɛrɛ taw. A k'a bɛ jamanadenw kun na, ko fɛn minnu bɛ bɔ kɔkan k'olu ye ɲuminɛ ye ka fɔnɛ en ka fɛn dilannenw kan.

A ko a ka kan ka ɲɛfɔ jamanakanɔdenw ye ko fɛɛ lɛ faso fɛn dilannenw bɔ. Segu mara bololabaarakɛlaw caman dɔnnen don ni dalifini dilanni ye ani galadon. Nɔɔmɔ ye bololabaara cakɛdaba ye Segu. Cakɛda in ka millina yɛ ka denmisɛnnin caman kalan walasa u jɔyɔrɔ ka bonya dinɛlatigɛ kɔnɔ. Cakɛda Ndɔmɔ dɔnnen don ni bogɔlanfini ɲumanw dilanni ye. O bogɔlanfini ɲuman ninnu be fɛɛrɛ dinɛ lan bɛɛ. Cakɛda ndɔmɔ baarakɛlaw bɛ . bogɔlanfini dilancogo ɲuman don. Hakilitagɔn na, bogɔlan ye an ka tladalafini ye, n'a kɔnimɔgɔfinlanna don k'a don gala la. Bosilan ye kungokonɔjiri dɔw fana n'u bulu n'ɔ nɔɔnɔ farali ye ngɔgɔn kan ka ɲɛ sanman dilan n'a ye i n'a fɔ : zorobilen ni nɛrɛ n'a ɲɔgɔnna caman.

Bubakari Dunbuya ye cakɛda ndɔmɔ tigi ye. A kɔ kabini san 2012, tuŋlaranke caman ye nali dabila an ka jamana kɔnɔ. Kelen-kelen de bɛ na an ka finiw san. O ɲɔgɔn cakɛda caman ye bogɔlan dilanni dabila. Bubakari Dunbuya ko cakɛda ndɔmɔ y'a cesiri ka bogɔlanfini dilan ka fisɛrɛ kɔkan.

Bɔgɔlandilannabaw jigiba be tuŋlarankew kan u ka fini sanberi malidenw t'a nala don Bubakari Dunbuya ko, ale hakili la, Mali ka kan ka bɔgɔlanfini don ba la. A ko n'an ye misali la Burukina Faso kan, u ka jamanakuntigi ko k'a bɔ, ka faso fini don. O t'ana b'a nege don jamanakɔnɔdenw na. Cakɛda ndɔmɔ bɛ k'a cesiri walasa bɔgɔlan bɛ don ba la.

Mamadu Si
Awa Sidibe

Figure 2. Title page and page 2 of *Kibaru* No 565.

Maninka texts are from *Dalu Kɛndɛ* 'The Sound Argument', a newspaper issued by the N'ko Academy (N'ko Dumbu), see Figure 3. Its first issue was published in the late 2007, and

since No. 14 (8 August 2011) it became a weekly periodical. In this newspaper, the N'ko alphabet is used.

Figure 3. Title page and page 2 of *Dalu Kɛndɛ* No 126.

From each periodical, five issues were chosen randomly. Electronic texts available in the corpora were processed to obtain syllable data according to the principles described in the next section.

3. Syllabification principles

In Manding languages, open syllables are absolutely predominant. They follow a simple CV pattern, where initial C is either a simple consonant or (less frequently) a prenasalized consonant. Vowels can be short or long and can be either oral or nasalized. In Bamana, syllables of a more complicated structure, CCV (with initial consonant cluster) and CVC (closed, with final consonant) appear as a result of an optional vowel elision in certain contexts; elided vowels can be always restored in a slow speech (Vydrin in press). A spelling taking account of the vowel elision (e.g., *fla* 'two', *tle* 'sun', *klo* 'yell', *marfa* 'gun', instead of *fila, tile, kulo, marifa*) was used in some periodicals (*Jama, Sankore*; both do not appear any more) and, occasionally, in some other publications. Such elision is not recommended in the standard orthography (Guide 1979) and is not found in the mainstream written media and literature. Such syllables do occasionally occur in the analyzed material in foreign personal names, however, as a rule, foreign names are adjusted to the open-syllable pattern, for instance, *Anzela Mɛrikɛli* for 'Angela Merkel'.

Bamana is written in a Roman-based alphabet containing the following letters (cf. Konta & Vydrin 2014):

a b c d e ɛ f g h i j k l m n ɲ ŋ o ɔ p r s t u v w y z.

Letters *c*, *j*, and *y* denote sounds [t͡ʃ], [d͡ʒ], and [j], respectively. Long vowels are represented by doubling the respective letter. Bamana is a tonal language, however, tones are not represented in the current orthography.

In general, syllable breaks in Bamana occur before consonants. Note that *n* following a vowel and preceding a consonant is a marker of the nasality of the vowel and is not considered a consonant. So $C_1V_1nC_2V_2$ is syllabified as $C_1V_1n\text{-}C_2V_2$. Word-initially, *n* before a consonant is treated as a part of the syllable prenasalizing the subsequent consonant. First person singular pronoun 'I' is written *n* in Bamana and is considered a syllable by itself.

Two different consecutive vowels do not occur in Standard Bamana, but they are occasionally found in foreign names where they are considered to belong to different syllables; therefore, no diphthongs are postulated. Additionally, for text containing the notation of tones, syllable breaks can occur between identical vowels bearing different tones. Final *w*, which is the plural marker, is converted to its phonetic value /u/ (becoming /ũ/ after nasals) and is always treated as a separate syllable.

In Bamana, auxiliary words followed by onsetless syllables (V) have their final vowels systematically assimilated, which fact is represented in the spelling: *bɛ a* → *b'a* [baa], *ka i* → *k'i* [kii] Such contracted forms were treated as syllables containing a long vowel: [baa], [kii], etc.

Guinean Maninka can be written using the Roman-based alphabet (cf. Diané & Vydrin 2014). Digraph *gb* denotes a single consonant phoneme /g͡b/:

a b c d e ɛ f g gb h i j k l m n ɲ o ɔ p r s t u w y

However, in today's Guinea, it is not Roman alphabet, but an original writing system N'ko which is most currently used for Maninka. This writing was created in 1949 by an autodidact Solomana Kante and since that time it has grown very popular among speakers of Manding languages. This writing correctly represents the phonology (including tonology) of Maninka. Nowadays, a quasi-totality of publications in Maninka appear in N'ko.

Here is the N'ko alphabet and main orthography rules (the phonemic values of N'ko symbols are given in slashes).

ߊ /a/, ߋ /e/, ߌ /i/, ߍ /ɛ/, ߎ /o/, ߏ /ɔ/, ߐ /N/, ߒ /b/, ߓ /p/, ߔ /t/, ߕ /j/, ߖ /c/, ߗ /d/, ߘ /r/, ߙ /rr/,
ߛ/s/, ߜ /gb/, ߝ /f/, ߞ /k/, ߟ /l/, ߠ /n*/, ߡ /m/, ߢ /ɲ/, ߣ /n/, ߤ /h/, ߥ /w/, ߦ /y/, ߧ /ŋ*/,
ߨ /g/

The seventh letter transcribed as /N/ corresponds to the syllabic nasal and is considered a vowel. There are two letters for sounds occurring as a result of nasal assimilation, they are accompanied by asterisks (*). Syllables starting with these two letters were treated as those with initial ߣ /n/ and ߢ /ɲ/, respectively. A special grammatical marker ߏ *o dennen*, which occurs only once in the texts under consideration, was treated as vowel /o/ according to its phonetic value. For foreign sounds, letters are being created by adding diacritical marks, e. g.: ߝ́ /v/, ߍ̇ /z/, ߛ̇ /ʃ/, ߢ̇ /ŋ/, ߤ̄ /q/, etc. The same principle is applied to denote /g/, which is phonemic (although marginal) in Maninka but does not have a proper single-letter representation in the N'ko alphabet. Nasalization of vowels is marked by an underscript dot: ߊ̣ /ã/, ߏ̣ /ẽ/.

In N'ko, superficial tones are marked on each syllable conjointly with vowel length. There are seven diacritics for tone/vowel length (and the absence of diacritics can be regarded as the eighth diacritic marker, a zero one). It is demonstrated below for the vowel /a/:

Short vowels: ߊ (no diacritic) /á/ (word-internally) or /á`/ (word-finally: high tone followed by a floating low tone), ߊ߫ /á/ (high tone word-finally), ߊ߬ /à/ (low tone), ߊ߭ /ǎ`/ (rising tone followed by a floating low tone, occurs only word-finally).

Long vowels: ߊ߯ /áa/ (high tone); ߊ߰ /àa/ (low tone), ߊ߮ /áa`/ (high tone followed by a floating low tone, occurs only word-finally), ߊ߱ /ǎa`/ (rising tone followed by a floating low tone, occurs only word-finally).

The floating low tone marked in the transcription by /`/ represents most often the so called tonal article.

To achieve proper representation of vowels, we have to take into account the *gbàrali* rule. According to this rule, if we have two identical short oral vowels with the same tonal mark in consecutive syllables of one word, only the second one is written. Note that *gbàrali* is applied only to vowels following different consonants.

The organization of the N'ko script allows for quite simple treatment of syllable borders in Maninka: they occur before consonants or between two consecutive vowels (including the syllabic nasal ߒ).

Similarly to Bamana, apostrophes are used in N'ko to mark the assimilation of vowels in contracted forms. Such apostrophes appear in two variants depending on the tone of the elided vowel: ߦߴߊ߬ *y'à ← yé à*, ߞߵߊ߬ *k'à ← kà à*. In view of a complex tonal contour in such situations, the respective syllables were considered as separate types.

To facilitate comparison with Bamana, we have also analyzed Maninka texts with tones stripped off, only taking vowel lengths and nasalization into account. The contracted forms containing both variants of apostrophes were treated as long syllables, to conform with to the Bamana case.

Table 1.

Summary of texts analyzed in the present work.

Bamana: *Kibaru*		Syllable tokens	Syllable types (non-tonal)	Syllable types (tonal)
1.	No. 12 (February 1973)*	4268	230	—
2.	No. 258 (July 1993)	7880	230	—
3.	No. 467 (December 2010)	21535	297	—
4.	No. 528 (January 2016)	20868	290	—
5.	No. 533 (June 2016)	19443	272	—
Maninka: *Dalu Kende*				
1.	No. 55 (18 June 2012)	10854	327	573
2.	No. 58 (16 July 2012)	11065	336	579
3.	No. 90 (28 March 2013)	10219	359	610
4.	No. 110 (2 September 2013)	6158	352	524
5.	No. 126 (6 January 2014)	15836	390	654

* Kibaru 12 was published in an old version of the Roman-based Bamana orthography which existed till 1980s. For the purpose of standardization, all texts in the Bamana corpus were converted to the new orthography.

Note that the number of theoretically possible open syllables in Bamana reaches $21\times(7\times4)+1 = 589$ (we have 21 consonants, seven vowels can be short and long, oral and nasal, plus syllabic *n*). In Maninka, with four tonal contours taken into account, we get:

20×(7×4×4)+1×4×2 = 2248 (20 consonants including *g*, seven vowels plus a syllabic nasal, which has no length contrast). As one can see from Table 1, only about 1/4 of theoretically imaginable syllables is attested in practice for text with explicit tone marking (Maninka) and less than 1/2 for texts without notation of tones (Bamana).

4. Results

Several discrete models proved to yield satisfactory fits to the observed rank–frequency distributions of syllables in Bamana and Maninka. These include: Bissinger geometric distribution (1-parametric), mixed negative binomial distribution (4-parametric), positive negative binomial distribution (2-parametric), Jain–Poisson distribution (2-parametric), and some others. The determination coefficient R^2 is higher than 0.91 for all the analyzed samples and even reaches $R^2 > 0.99$ in many cases. To choose a proper model, we also applied the test based on the discrepancy coefficient $C = \chi^2/N$, where N is the sample size and χ^2 is the value from the Pearson χ^2 goodness-of-fit test (Mačutek & Wimmer 2013). Another criterion was the number of fitting parameters: distributions with fewer parameters are preferable since they allow for their simpler interpretation.

The one-parametric Bissinger geometric distribution yields $C > 0.025$ for tonal Maninka and non-tonal Bamana texts, so it was excluded (for a satisfactory fit, $C < 0.02$ is preferable, see Mačutek & Wimmer 2013). Two remaining distributions are two-parametric.

- Positive negative binomial distribution (parameters k and p):

$$P_r = \frac{1}{1-p^k}\binom{k+r-1}{r}p^k(1-p)^r, \quad r = 1,2,3,\ldots.$$

- Jain–Poisson distribution (parameters a and b):

$$P_r = \frac{1}{r!}(1-b)(a+br)^r e^{-(a+br)}, \quad r = 0,1,2,\ldots.$$

We have also tested the continuous model being the Yule distribution (parameters s and K):

$$P_r = A\frac{K^r}{r^s}.$$

With the normalization condition applied,

$$\int_1^\infty P_r \, dr = 1,$$

the normalization constant A can be written as

$$A = \frac{1}{E_s(-\ln K)},$$

where E_s is the exponential integral, which can be expressed using the incomplete gamma-function (Abramowitz & Stegun 1972):

$$\mathrm{E}_s(x) = \int_1^\infty \frac{e^{-xt}}{t^s}\, dt = x^{s-1}\,\Gamma(1-s,x).$$

The results of fitting are demonstrated in Figures 4–6 and Tables A1–A2 in the Appendix. Distribution parameters are summarized in Tables 2–3. For calculations, Altmann-Fitter and GnuPlot were used. Auxiliary computations were done with LibreOffice Calc.

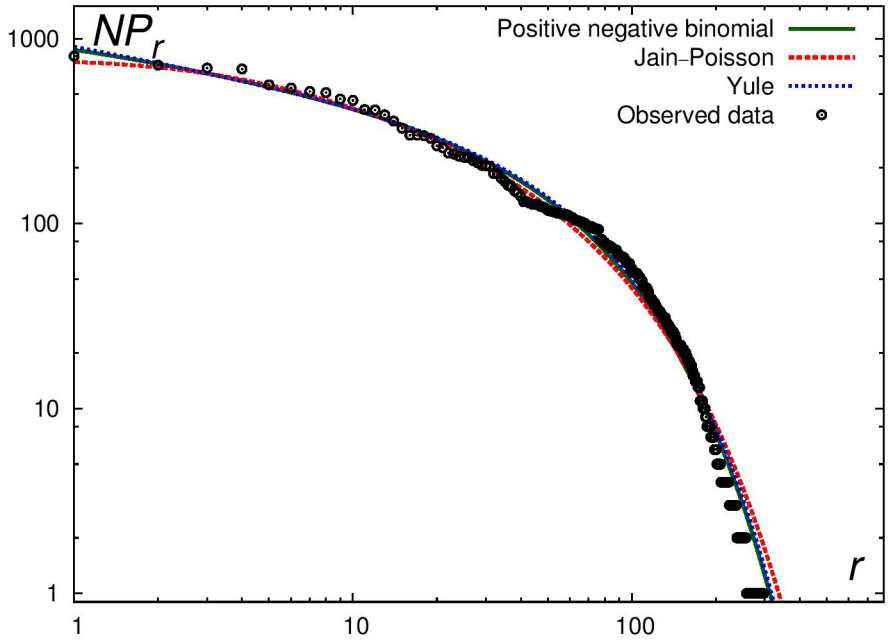

Figure 4. Rank–frequency distribution and fits for syllables (without tones) in *Kibaru* No. 467.

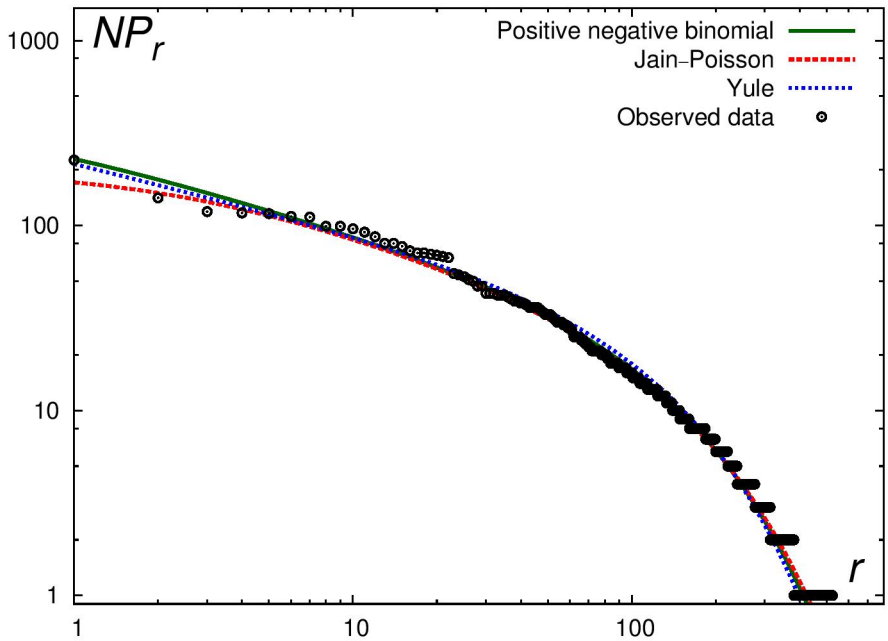

Figure 5. Rank–frequency distribution and fits for syllables (with tones) in *Dalu Kɛndɛ* No 110.

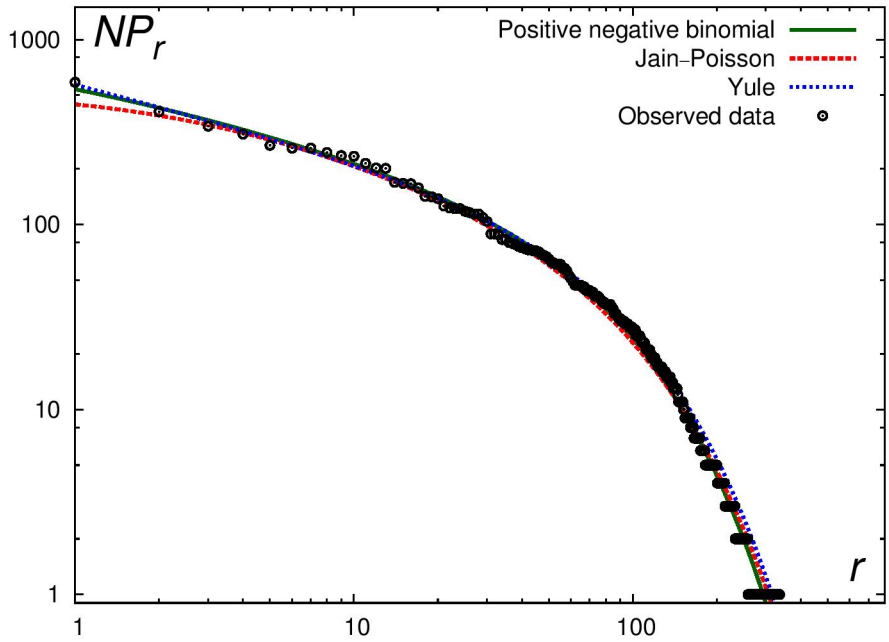

Figure 6. Rank–frequency distribution and fits for syllables (without tones) in *Dalu Kɛndɛ* No. 58.

Table 2
Fitting parameters for non-tonal syllable distributions

Kibaru	JP				pnb				Yule			
	a	*b*	R^2	*C*	*k*	*p*	R^2	*C*	*s*	*K*	R^2	*C*
No. 12	1.2965	0.8437	0.951	0.0335	0.7445	0.0181	0.972	0.0237	0.2236	0.9815	0.976	0.0162
No. 258	1.2240	0.8434	0.937	0.0412	0.8013	0.0198	0.988	0.0149	0.2267	0.9823	0.994	0.0079
No. 467	1.5179	0.8442	0.990	0.0216	0.7072	0.0165	0.988	0.0171	0.2720	0.9836	0.987	0.0139
No. 528	1.0575	0.8447	0.969	0.0270	0.6756	0.0169	0.985	0.0175	0.2925	0.9828	0.983	0.0151
No. 533	0.9290	0.8514	0.946	0.0402	0.6883	0.0164	0.988	0.0206	0.3241	0.9852	0.991	0.0147
Dalu Kende												
No. 55	1.2248	0.8523	0.992	0.0132	0.6133	0.0137	0.994	0.0107	0.3640	0.9866	0.995	0.0068
No. 58	1.1631	0.8500	0.988	0.0123	0.6082	0.0142	0.994	0.0084	0.3879	0.9870	0.996	0.0065
No. 90	1.1015	0.8511	0.994	0.0085	0.5545	0.0129	0.993	0.0091	0.3765	0.9858	0.993	0.0100
No. 110	1.2166	0.8568	0.990	0.0130	0.5885	0.0123	0.991	0.0131	0.3487	0.9865	0.992	0.0126
No. 126	1.2433	0.8507	0.992	0.0103	0.5983	0.0135	0.992	0.0107	0.3320	0.9850	0.991	0.0129

Table 3
Fitting parameters for tonal syllable distributions

Dalu Kende	JP				pnb				Yule			
	a	*b*	R^2	*C*	*k*	*p*	R^2	*C*	*s*	*K*	R^2	*C*
No. 55	1.1083	0.8894	0.976	0.0163	0.5306	0.0069	0.977	0.0171	0.3974	0.9921	0.983	0.0180
No. 58	1.0238	0.8869	0.964	0.0195	0.5202	0.0072	0.967	0.0197	0.4190	0.9922	0.973	0.0175
No. 90	0.9493	0.8895	0.982	0.0192	0.4711	0.0064	0.977	0.0189	0.4240	0.9919	0.986	0.0339
No. 110	1.2256	0.8910	0.967	0.0212	0.5572	0.0070	0.974	0.0222	0.3679	0.9920	0.988	0.0217
No. 126	1.0722	0.8893	0.980	0.0147	0.5085	0.0067	0.977	0.0157	0.3933	0.9917	0.983	0.0286

It is easy to note that the values of the *K* parameter in the Yule distribution are close to unity. The limit $K = 1$ corresponds to the Zipf's law and we can observe from Tables 2–3 that *K* increases as the number of types grows (tonal versus non-tonal syllables). So, a nearly

Zipfian behavior of the distribution of syllables in languages with a high variety of syllable types is expectable.

5. Discussion

We have analyzed distribution of syllables in texts from written press in Bamana and Guinean Maninka, two related languages from the Manding group of the Mande family in West Africa. In view of predominantly open syllables in these languages, the number of types seems insufficient to achieve the Zipfian behavior reported in some previous studies.

Texts in Bamana are written using a Roman-based alphabet without marking of tones while the Maninka texts are in the N'ko alphabet, which uses a superficial notation of tones. To facilitate comparisons with Bamana, the Maninka data were also calculated for the case with tonal distinctions neglected.

Rank–frequency distributions of syllables were fitted using two discrete distributions, Jain–Poisson and positive negative binomial. In most cases, a satisfactory fit was achieved, with the determination coefficient $R^2 > 0.95$ and discrepancy coefficient $C < 0.02$.

The calculated values of the following parameters remain very close for texts in the same language: b of the Jain–Poisson distribution and p for the positive negative binomial distribution. Moreover, the intervals of b for the first distribution partly overlap between Bamana and Maninka, [0.843; 0.852] versus [0.850; 0.857]. As the number of syllable types increases between non-tonal and tonal texts in Maninka, b increases and p decreases.

The Yule distribution was used as a continuous model. Previously, it was found to yield a good description for the distribution of letters (Tambovtsev & Martindale 2007) and symbols in the Vai syllabary (Rovenchak et al. 2018). In most cases, $R^2 > 0.98$ and $C < 0.02$ as well for this distribution. The observed increase in the values of the parameter K of this distribution is in agreement with the expected Zipfian dependence previously reported for some languages, which corresponds to the limit $K = 1$.

We hope that the results of this study will be useful for understanding the nature of rank–frequency distributions of language units smaller than words. They can be of interest both for cross-language comparisons and for quantitative analysis of different language levels.

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References

Abramowitz, M., & Stegun, I. A. (1972). *Handbook of mathematical functions*. Tenth printing. National Bureau of Standards.

Altmann, G. (2000). *Altmann-Fitter 2.1.* Lüdenscheid: RAM-Verlag.

Altmann, G. (2014). Supra-sentence levels. *Glottotheory* 5, pp. 25–39.

Adsett, C. R., & Marchand, Y. (2010). Syllabic complexity: A computational evaluation of nine European languages. *Journal of Quantitative Linguistics* 17(4), pp. 269–290. DOI: 10.1080/09296174.2010.512161

Choi, S.-W. (2000). Some statistical properties and Zipf's law in Korean text corpus. *Journal of Quantitative Linguistics* 7(1), pp. 19–30. DOI: 10.1076/0929-6174(200004)07:01;1-3;FT019

Diané, M., & Vydrin, V. (2014). Propositions pour l'orthographe du maninka (Guinée). In: *Mandenkan* 52, pp. 3–21. DOI: 10.4000/mandenkan.301

Fenk, A., & Fenk-Oczlon, G. (1993). Menzerath's law and the constant flow of linguistic information. In: Köhler, R., & Rieger, B. B. (eds.). *Contributions to Quantitative Linguistics. Proceedings of the First International Conference on Quantitative Linguistics, QUALICO, Trier, 1991,* pp. 11-31. Springer: Dordrech. DOI: 10.1007/978-94-011-1769-2

Guide (1979). *Guide de transcription et lecture du bambara*. Bamako: Imprimerie DNAFLA.

Kelih, E. (2013). Phonemhäufigkeiten in slawischen Sprachen: Empirisches Verhalten und Modellierung. *Anzeiger für slavische Philologie* 41, 75–108.

Konta, M., & Vydrin, V. (2014). Propositions pour l'orthographe du bamanankan. In: *Mandenkan* 52, pp. 22–54. DOI: 10.4000/mandenkan.318

Koščová, M., Mačutek, J., & Kelih, E. (2016). A data-based classification of Slavic languages: Indices of qualitative variation applied to grapheme frequencies. *Journal of Quantitative Linguistics* 23.2, pp. 177–190. DOI: 10.1080/09296174.2016.1142327

Liu, Yu-Cheng, & Nouvel, D. (2017). A Bambara tonalization system for word sense disambiguation using differential coding, segmentation and edit operation filtering. In: *Proceedings of the 8th International Joint Conference on Natural Language Processing (IJCNLP 2017), Nov 2017*, pp. 694–703. Taipei, Taiwan.

Mačutek, J., & Wimmer, G. (2013). Evaluating goodness-of-fit of discrete distribution models in quantitative linguistics. *Journal of Quantitative Linguistics* 20(3), pp. 227–240. DOI: 10.1080/09296174.2013.799912

Nettle, D. (1998). Coevolution of phonology and the lexicon in twelve languages of West Africa. *Journal of Quantitative Linguistics* 5(3) pp. 240-245. DOI: 10.1080/09296179808590132

Peust, C. (2008). On consonant frequency in Egyptian and other languages. *Lingua Aegyptica* 16, pp. 105–134. DOI: 10.11588/propylaeumdok.00002676

Radojičić, M., Lazić, B., Kaplar, S., Stanković, R., Obradović, I., Mačutek, J., & Leššová, L. (2019). Frequency and length of syllables in Serbian. *Glottometrics* 45, pp. 114–123.

Rovenchak, A. (2011). Phoneme distribution, syllabic structure, and tonal patterns in Nko texts. In: *Mandenkan* 47, pp. 77–96.

Rovenchak, A. (2015). Quantitative studies in the corpus of Nko periodicals". In: Tuzzi, A., Benešová, M., & Mačutek, J. (eds.), *Recent Contributions to Quantitative Linguistics*, pp. 125–138. Berlin–Boston: Mouton de Gruyter. DOI: 10.1515/9783110420296-012

Rovenchak, A. & Buk, S. (2018). Part-of-speech sequences in literary text: Evidence from Ukrainian. *Journal of Quantitative Linguistics* 25(1), pp. 1–21. DOI: 10.1080/09296174.2017.1324601

Rovenchak, A., Riley, Ch., & Sherman, T. (2018). The Diary of Boima Kiakpomgbo from Mando Town (Liberia): A quantitative study of a Vai text. *Journal of Quantitative Linguistics* 25(3) pp. 271-287. DOI: 10.1080/09296174.2017.1373510

Schiller, N. O., Meyer, A. S., Baayen, R. H., & Levelt, W. J. M. (1996): A comparison of lexeme and speech syllables in Dutch. *Journal of Quantitative Linguistics* 3(1), pp. 8–28. DOI: 10.1080/09296179608590060

Strauss, U., Fan, F., & Altmann, G. (2008). *Problems in Quantitative Linguistics 1*.

Lüdenscheid: RAM-Verlag.

Tamaoka, K., & Makioka, Sh. (2004). Frequency of occurrence for units of phonemes, morae, and syllables appearing in a lexical corpus of a Japanese newspaper. *Behavior Research Methods, Instruments, & Computers* 36(3), pp. 531–547. DOI: 10.3758/BF03195600

Tambovtsev, Yu., & Martindale, C. (2007). Phoneme frequencies follow a Yule distribution. *SKASE Journal of Theoretical Linguistics* 4(2) available at http://www.skase.sk/Volumes/JTL09/pdf_doc/1.pdf

Vydrin, V. (2012). Une bibliographie préliminaire des publications maninka en écriture N'ko. In: *Mandenkan* 48, pp. 59–121.

Vydrin, V. (2013). Bamana Reference Corpus (BRC). *Procedia – Social and Behavioral Sciences* 95, pp. 75–80. DOI: 10.1016/j.sbspro.2013.10.624

Vydrin, V. (in press) Vowel elision and reduction in Bambara. *Italian Journal of Linguistics.*

Vydrin, V., Bergman, T. G., & Benjamin, M. (2001). Mandé Language Family of West Africa: Location and Genetic Classification. *SIL International 2000 (003)*. SIL Electronic Survey Reports (April 1). http://www.sil.org/silesr/2000/2000-003/Manding/Manding.htm. Archived from the original on January 01, 2018 under the following link: https://web.archive.org/web/20180101194619/http://www-01.sil.org/SILESR/2000/2000-003/Manding/Manding.htm

Vydrin, V., Maslinsky, K., Méric, J. J., & Rovenchak, A. (2011–2019a). *Corpus bambara de référence*. http://cormand.huma-num.fr.

Vydrin, V., Maslinsky, K., Rovenchak, A., & Sory 2 Condé, I. (2011–2019b). *Corpus maninka de référence*. http://cormand.huma-num.fr/cormani/

Vydrin, V., Rovenchak, A., & Maslinsky, K. (2016). Maninka Reference Corpus: A Presentation. In: *Actes de la conférence conjointe JEP-TALN-RECITAL 2016*, volume 11 : TALAF 87–94. Paris: Association Francophone pour la Communication Parlée (AFCP) et Association pour le Traitement Automatique des Langues (ATALA).

Wimmer, G., & Altmann, G. (1999). *Thesaurus of univariate discrete probability distributions*. Stamm, Essen, 1999.

Appendix

Table A1
Frequencies of first 50 top-ranked syllables in *Kibaru*.

r	*Kibaru* 12				*Kibaru* 258				*Kibaru* 467			
	Syl	N_r	pnb	Yule	Syl	N_r	pnb	Yule	Syl	N_r	pnb	Yule
1	ka	145	165.6	167.8	la	298	279.7	303.0	ka	803	868.8	901.8
2	la	134	141.9	141.1	ka	266	246.9	254.4	ma	718	729.4	734.6
3	na	130	127.4	126.5	ma	204	226.0	227.9	na	692	647.4	647.0
4	ma	129	117.1	116.4	ye	198	210.5	209.7	la	684	590.1	588.5
5	ye	123	109.1	108.7	ko	194	198.1	195.8	ni	563	546.4	544.7
6	a	121	102.6	102.4	ni	192	187.8	184.6	ra	541	511.2	509.9
7	ba	118	97.1	97.1	u	190	178.8	175.1	u	518	481.7	480.9
8	u	108	92.3	92.5	li	179	170.9	166.8	ye	510	456.5	456.1
9	ni	96	88.0	88.4	ra	169	163.8	159.6	li	471	434.3	434.5
10	bɛ	91	84.2	84.8	na	167	157.4	153.0	a	463	414.7	415.3
11	kɔ	89	80.8	81.5	ya	155	151.5	147.1	ri	413	397.0	398.0
12	ra	87	77.6	78.4	a	154	146.0	141.7	ba	411	380.9	382.3
13	o	77	74.7	75.6	si	136	140.9	136.7	kɛ	387	366.2	367.9
14	kɛ	74	72.0	73.0	ti	135	136.2	132.0	bɛ	358	352.6	354.7
15	ko	71	69.5	70.6	bɛ	128	131.7	127.6	si	327	340.1	342.3
16	rɔ	64	67.2	68.3	kɔ	121	127.5	123.6	o	300	328.3	330.9
17	li	64	65.0	66.1	o	119	123.5	119.7	ya	300	317.4	320.1
18	ri	53	62.9	64.0	ba	118	119.7	116.1	ko	298	307.1	310.0
19	gɔ	52	60.9	62.1	rɔ	117	116.1	112.6	kɔ	289	297.3	300.4
20	ti	51	59.1	60.3	kɛ	110	112.7	109.3	rɔ	263	288.2	291.4
21	ɲɛ	51	57.3	58.5	gɔ	107	109.4	106.2	gɔ	257	279.5	282.9
22	ki	45	55.6	56.8	ri	97	106.2	103.2	sa	240	271.2	274.7
23	si	45	54.0	55.2	den	97	103.2	100.4	ti	238	263.3	266.9
24	nɔ	43	52.5	53.7	de	90	100.4	97.7	lo	231	255.8	259.5
25	ru	40	51.0	52.2	sa	89	97.6	95.0	mi	228	248.7	252.5
26	lo	40	49.6	50.8	ki	83	94.9	92.5	san	227	241.8	245.7
27	sɛ	40	48.2	49.5	bɛɛ	80	92.3	90.1	ja	219	235.3	239.2
28	bɛɛ	39	46.9	48.2	min	79	89.9	87.8	ɲɛ	213	229.0	232.9
29	se	38	45.7	46.9	tɛ	79	87.5	85.5	da	206	222.9	226.9
30	fa	37	44.4	45.7	mɔ	78	85.2	83.4	fa	205	217.1	221.1
31	min	37	43.3	44.5	ɲɛ	76	83.0	81.3	nɔ	203	211.5	215.6
32	ya	36	42.2	43.4	kan	73	80.8	79.3	di	186	206.1	210.2
33	ga	36	41.1	42.3	nɔ	69	78.7	77.3	ta	186	200.9	205.0
34	rɛ	36	40.0	41.2	gi	68	76.7	75.5	kan	176	195.9	200.0
35	mɔ	35	39.0	40.2	lo	68	74.8	73.6	se	169	191.1	195.2
36	ku	33	38.0	39.2	un	67	72.9	71.9	wa	161	186.4	190.5
37	i	32	37.1	38.3	mi	66	71.0	70.1	min	158	181.9	186.0
38	don	32	36.2	37.3	don	66	69.3	68.5	nɛ	150	177.5	181.6
39	kan	32	35.3	36.4	len	66	67.5	66.9	mɔ	146	173.3	177.4
40	di	31	34.4	35.6	wa	63	65.9	65.3	ki	140	169.2	173.3
41	yɛ	31	33.6	34.7	da	62	64.3	63.8	sɛ	131	165.2	169.3
42	man	31	32.8	33.9	mu	56	62.7	62.3	le	131	161.3	165.4
43	tɔ	31	32.0	33.1	gu	56	61.2	60.9	fɛ	129	157.6	161.7
44	fɔ	30	31.2	32.3	le	54	59.7	59.5	ku	127	154.0	158.0
45	sa	29	30.5	31.5	du	54	58.2	58.1	mu	127	150.4	154.5
46	san	28	29.8	30.8	bi	54	56.8	56.8	rɛ	126	147.0	151.0
47	len	28	29.1	30.1	ja	53	55.5	55.6	nin	124	143.7	147.7
48	ja	27	28.4	29.4	gɛ	52	54.1	54.3	fi	123	140.5	144.4
49	an	27	27.8	28.7	san	50	52.9	53.1	man	121	137.3	141.3
50	tɛ	27	27.1	28.1	kaa	50	51.6	51.9	len	118	134.3	138.2

r	*Kibaru* 528				*Kibaru* 533			
	Syl	N_r	pnb	Yule	Syl	N_r	pnb	Yule
1	ka	884	938.8	964.6	ka	851	825.0	891.4
2	la	726	773.3	774.1	la	650	685.0	701.5
3	ma	686	678.0	675.7	na	628	603.8	606.1
4	ni	678	612.5	610.5	ma	608	547.6	543.9
5	na	619	563.1	562.1	ni	531	505.1	498.5
6	ra	592	523.7	523.7	ra	489	471.0	462.9
7	ye	563	491.0	492.0	ye	483	442.7	433.9
8	a	548	463.1	465.1	u	462	418.5	409.3
9	li	546	438.9	441.6	li	427	397.4	388.2
10	u	480	417.5	420.8	a	383	378.7	369.6
11	kɛ	406	398.4	402.2	kɛ	373	361.9	353.0
12	ri	402	381.0	385.4	bɛ	360	346.7	338.1
13	ba	351	365.3	370.0	ba	332	332.9	324.6
14	si	342	350.8	355.8	si	314	320.2	312.2
15	bɛ	316	337.4	342.7	o	285	308.4	300.8
16	o	286	325.0	330.6	kɔ	255	297.4	290.2
17	kɔ	264	313.4	319.2	ri	253	287.2	280.3
18	ko	262	302.6	308.5	ya	251	277.6	271.1
19	rɔ	261	292.4	298.4	rɔ	249	268.6	262.5
20	ya	258	282.8	288.9	ti	243	260.1	254.3
21	ti	240	273.7	279.9	da	229	252.0	246.6
22	gɔ	238	265.1	271.4	ko	229	244.4	239.3
23	lo	238	257.0	263.3	fa	225	237.1	232.4
24	da	236	249.2	255.6	ja	198	230.2	225.9
25	fa	211	241.8	248.2	kan	195	223.6	219.6
26	mi	209	234.8	241.2	lo	190	217.3	213.6
27	sa	201	228.1	234.4	sa	187	211.3	207.9
28	min	195	221.6	227.9	gɔ	185	205.5	202.4
29	ki	194	215.4	221.7	san	172	200.0	197.2
30	kan	185	209.5	215.8	di	172	194.7	192.1
31	san	185	203.8	210.0	tɛ	162	189.6	187.3
32	mɔ	179	198.3	204.5	min	156	184.6	182.6
33	se	168	193.1	199.2	sɛ	153	179.9	178.1
34	baa	167	188.0	194.1	se	151	175.3	173.8
35	sɛ	156	183.1	189.1	nɛ	149	170.9	169.6
36	di	155	178.4	184.4	ɲɛ	144	166.7	165.6
37	wa	153	173.9	179.7	ta	140	162.6	161.7
38	ɲɛ	151	169.5	175.3	mi	137	158.6	157.9
39	nɔ	151	165.2	171.0	gi	133	154.7	154.3
40	ta	150	161.1	166.8	mɔ	132	151.0	150.8
41	ja	141	157.1	162.7	wa	131	147.4	147.4
42	sɔ	141	153.3	158.8	baa	130	143.9	144.0
43	le	134	149.6	155.0	rɛ	130	140.6	140.8
44	nɛ	131	146.0	151.3	nɔ	124	137.3	137.7
45	ku	127	142.5	147.8	len	123	134.1	134.7
46	dɔ	126	139.1	144.3	le	121	131.0	131.8
47	gu	126	135.8	140.9	ku	120	128.0	128.9
48	so	123	132.6	137.7	ki	119	125.1	126.1
49	len	123	129.5	134.5	lan	118	122.3	123.4
50	gi	122	126.5	131.4	un	114	119.5	120.8

Table A2. Frequencies of first 50 top-ranked syllables in *Dalu Kɛndɛ*.

i	*Dalu Kɛndɛ* 55 (tonal)						*Dalu Kɛndɛ* 55 (non-tonal)				
	Syllable		N_i	JP	PNB	Yule	Syl	N_i	JP	PNB	Yule
1	lá	lá	441	396.2	439.4	418.3	la	507	470.9	508.3	528.0
2	dá	dá	246	325.2	333.9	315.1	ma	394	417.1	404.4	404.8
3	bá	bá	235	278.8	279.7	266.1	ka	345	367.4	347.5	344.6
4	kà	kà	228	246.7	245.2	235.5	ba	338	329.1	309.6	306.2
5	dí	dí	212	223.0	220.7	213.8	da	301	299.2	281.7	278.5
6	mà	mà	208	204.6	202.0	197.3	na	255	275.0	260.0	257.1
7	ná	ná	199	189.8	187.1	184.1	lu	247	255.1	242.3	239.8
8	kó	kó	197	177.4	174.9	173.2	di	231	238.2	227.4	225.4
9	ò	ò	190	167.0	164.7	164.0	ko	222	223.7	214.7	213.0
10	má	má	186	158.0	155.9	156.0	le	211	211.0	203.5	202.3
11	dɔ́	dɔ́	186	150.1	148.2	149.0	a	208	199.9	193.7	192.8
12	lù	lù	159	143.2	141.4	142.8	dɔ	204	189.9	184.9	184.3
13	à	à	157	137.0	135.4	137.3	o	196	181.0	177.0	176.6
14	lè	lè	148	131.4	129.9	132.3	li	169	172.8	169.7	169.6
15	kɛ́	kɛ́	142	126.3	125.0	127.7	kɛ	153	165.4	163.1	163.2
16	yé	yé	136	121.7	120.5	123.4	N	153	158.7	157.0	157.2
17	lí	lí	131	117.4	116.3	119.6	kɔ	144	152.4	151.3	151.7
18	ní	ní	121	113.5	112.5	116.0	ye	140	146.6	146.0	146.6
19	ká	ká	117	109.8	109.0	112.6	ya	139	141.2	141.1	141.8
20	yá	yá	113	106.5	105.7	109.5	fa	126	136.2	136.5	137.4
21	kɔ́	kɔ́	112	103.3	102.6	106.5	ni	122	131.5	132.1	133.1
22	bà	bà	103	100.3	99.7	103.7	kan	120	127.1	128.0	129.1
23	Ń	Ń	103	97.6	97.0	101.1	dɛ	120	123.0	124.2	125.4
24	nɛ́n	nɛ́n	95	94.9	94.5	98.6	ra	115	119.1	120.5	121.8
25	kán	kán	92	92.5	92.1	96.3	sa	112	115.4	117.0	118.4
26	rá	rá	89	90.1	89.8	94.0	si	111	111.9	113.7	115.1
27	lú	lú	88	87.9	87.6	91.9	ta	109	108.6	110.5	112.1
28	ɲá	ɲá	86	85.8	85.5	89.9	ɲa	108	105.4	107.5	109.1
29	mén	mén	86	83.8	83.6	87.9	nɛn	105	102.4	104.6	106.3
30	sí	sí	83	81.9	81.7	86.1	tɛ	101	99.5	101.9	103.6
31	tá	tá	79	80.0	79.9	84.3	nin	95	96.8	99.2	101.0
32	k`à	k`à	73	78.3	78.2	82.6	mɛn	88	94.2	96.7	98.5
33	tɛ́	tɛ́	72	76.6	76.5	80.9	baa	87	91.7	94.3	96.1
34	dɛ́	dɛ́	71	75.0	75.0	79.3	do	82	89.3	91.9	93.8
35	fá	fá	68	73.4	73.5	77.8	ri	81	87.0	89.7	91.5
36	dó	dó	67	72.0	72.0	76.3	kaa	81	84.8	87.5	89.4
37	sá	sá	66	70.5	70.6	74.9	man	79	82.7	85.4	87.3
38	là	là	66	69.2	69.2	73.6	mɔɔ	75	80.6	83.4	85.3
39	bɛ́ɛ	bɛ́ɛ	65	67.8	67.9	72.2	tii	74	78.7	81.4	83.4
40	lé	lé	63	66.6	66.7	70.9	ku	74	76.8	79.5	81.5
41	báa	báa	63	65.3	65.5	69.7	nu	69	74.9	77.7	79.7
42	ló	ló	58	64.1	64.3	68.5	wa	68	73.2	75.9	77.9
43	án	án	57	63.0	63.1	67.3	ki	65	71.5	74.2	76.2
44	dà	dà	55	61.9	62.0	66.2	bɛɛ	65	69.8	72.6	74.6
45	fà	fà	55	60.8	61.0	65.1	ne	65	68.2	71.0	73.0
46	nà	nà	55	59.7	59.9	64.0	ran	63	66.7	69.4	71.4
47	bó	bó	54	58.7	58.9	62.9	bo	62	65.2	67.9	69.9
48	kú	kú	53	57.7	57.9	61.9	don	59	63.8	66.4	68.5

49	◌̃	dòn	53	56.8	57.0	60.9	lo	58	62.4	65.0	67.0
50	◌̄	kí	52	55.8	56.1	60.0	an	57	61.0	63.6	65.7

Table A2. Frequencies of first 50 top-ranked syllables in *Dalu Kɛndɛ* (continued).

i	*Dalu Kɛndɛ* 58 (tonal)						*Dalu Kɛndɛ* 58 (non-tonal)				
	Syllable		N_i	JP	PNB	Yule	Syl	N_i	JP	PNB	Yule
1	◌́	lá	522	449.6	476.2	457.1	la	587	518.7	538.6	569.5
2	◌̀	kà	238	353.9	359.4	339.2	ma	407	446.3	427.0	429.6
3	◌́	kó	230	298.6	299.7	284.0	ka	340	388.4	366.0	362.3
4	◌́	ná	214	262.0	261.9	249.8	lu	308	345.6	325.4	319.8
5	◌́	má	213	235.6	235.0	225.7	na	268	312.7	295.7	289.5
6	◌̄	dɔ́	213	215.3	214.7	207.5	da	259	286.6	272.5	266.2
7	◌́	dá	208	199.1	198.5	193.0	ko	259	265.1	253.6	247.5
8	◌̀	lù	205	185.8	185.3	181.1	a	245	247.1	237.7	232.0
9	◌̀	à	198	174.6	174.1	171.0	dɔ	236	231.7	224.2	218.7
10	◌̀	mà	194	164.9	164.6	162.4	ba	234	218.3	212.3	207.3
11	◌̄	dí	189	156.5	156.3	154.8	li	214	206.4	201.9	197.1
12	◌́	bá	176	149.1	148.9	148.1	le	202	195.9	192.5	188.1
13	◌̀	ò	166	142.5	142.4	142.1	di	201	186.5	184.1	180.0
14	◌̄	lí	165	136.5	136.5	136.7	fa	169	178.0	176.4	172.6
15	◌́	yá	141	131.1	131.2	131.8	ya	167	170.2	169.3	165.9
16	◌́	yé	136	126.2	126.3	127.2	o	166	163.1	162.9	159.7
17	◌́	kɛ́	131	121.7	121.9	123.1	kan	158	156.6	156.8	154.0
18	◌̀	lè	131	117.6	117.8	119.2	kɛ	142	150.5	151.3	148.6
19	◌̄	ní	119	113.7	114.0	115.7	sa	141	144.9	146.0	143.7
20	◌́	kán	107	110.2	110.4	112.3	ye	138	139.7	141.2	139.0
21	◌́	fá	105	106.8	107.1	109.2	kɔ	126	134.8	136.6	134.6
22	◌́	mɛ́n	105	103.7	104.1	106.3	ni	123	130.2	132.2	130.5
23	◌́	lú	103	100.8	101.1	103.5	N	122	125.9	128.1	126.6
24	◌̄	kɔ́	103	98.0	98.4	100.9	dɛ	122	121.8	124.3	122.9
25	◌́	ká	102	95.4	95.8	98.4	ɲa	118	117.9	120.6	119.4
26	◌́	sá	98	93.0	93.4	96.0	nin	116	114.3	117.1	116.1
27	◌̄	Ń	96	90.6	91.1	93.8	si	114	110.9	113.7	112.9
28	◌́	nɛ́n	96	88.4	88.8	91.6	nɛn	114	107.6	110.6	109.9
29	◌́	ló	90	86.3	86.7	89.6	mɛn	109	104.5	107.5	107.0
30	◌́	ɲá	86	84.3	84.7	87.7	lo	104	101.5	104.6	104.2
31	◌̀	k`à	79	82.4	82.8	85.8	ri	89	98.6	101.8	101.6
32	◌̄	sí	77	80.5	81.0	84.0	tɛ	89	95.9	99.2	99.0
33	◌́	kú	77	78.8	79.2	82.3	ku	88	93.3	96.6	96.6
34	◌́	án	71	77.1	77.6	80.6	kaa	83	90.9	94.1	94.2
35	◌́	dɛ́	71	75.5	75.9	79.0	nu	83	88.5	91.8	92.0
36	◌́	lé	71	73.9	74.4	77.5	man	80	86.2	89.5	89.8
37	◌̀	nìn	70	72.4	72.9	76.0	ra	79	84.0	87.3	87.7
38	◌̀	nù	70	71.0	71.5	74.6	ta	78	81.9	85.1	85.7
39	◌́	bó	69	69.6	70.1	73.2	bo	76	79.8	83.1	83.7
40	◌́	bɛ́ɛ	68	68.2	68.7	71.9	ran	75	77.9	81.1	81.8
41	◌́	té	66	67.0	67.4	70.6	nɛ	74	76.0	79.2	80.0
42	◌̀	là	65	65.7	66.2	69.3	an	73	74.2	77.4	78.2
43	◌̀	fà	63	64.5	65.0	68.1	baa	73	72.4	75.6	76.5
44	◌́	dó	59	63.3	63.8	66.9	bɛ	72	70.7	73.8	74.8
45	◌̄	rí	58	62.2	62.7	65.8	do	72	69.1	72.1	73.2

46	fɔ́	57	61.1	61.6	64.7	tii	71	67.5	70.5	71.6
47	bà	57	60.0	60.5	63.6	yi	69	65.9	68.9	70.1
48	dén	56	59.0	59.5	62.6	bɛɛ	68	64.5	67.4	68.7
49	rá	55	58.0	58.4	61.5	sɛ	67	63.0	65.9	67.2
50	bɛ́	54	57.0	57.5	60.5	wa	65	61.6	64.5	65.8

Table A2. Frequencies of first 50 top-ranked syllables in *Dalu Kɛndɛ* (continued).

i	*Dalu Kɛndɛ* 90 (tonal)						*Dalu Kɛndɛ* 90 (non-tonal)				
	Syllable		N_i	JP	PNB	Yule	Syl	N_i	JP	PNB	Yule
1	lá	455	437.1	487.4	441.4	la	525	505.8	551.2	539.3
2	dá	258	330.2	356.2	326.3	ma	377	421.7	422.9	409.5
3	kà	251	274.6	291.5	272.6	ka	355	362.4	355.5	346.5
4	kó	244	239.2	251.4	239.3	da	320	320.3	311.8	306.5
5	à	243	214.2	223.4	215.9	a	302	288.7	280.3	277.8
6	dí	205	195.2	202.4	198.3	na	284	263.8	256.2	255.7
7	mà	198	180.2	185.9	184.2	ko	255	243.6	236.8	237.8
8	ná	197	167.9	172.5	172.6	lu	220	226.7	220.7	222.9
9	má	179	157.6	161.3	162.9	di	217	212.3	207.1	210.2
10	Ń	177	148.8	151.8	154.5	le	213	199.9	195.3	199.2
11	ò	171	141.1	143.6	147.2	N	203	188.9	184.9	189.4
12	dɔ́	170	134.4	136.4	140.7	dɔ	187	179.2	175.8	180.7
13	kán	139	128.4	130.0	134.9	ba	185	170.5	167.6	172.8
14	lù	139	123.0	124.3	129.7	kan	182	162.7	160.1	165.7
15	lè	137	118.1	119.1	124.9	o	172	155.6	153.4	159.1
16	bá	131	113.7	114.5	120.6	ya	145	149.0	147.2	153.1
17	kɔ́	124	109.6	110.2	116.5	li	144	143.0	141.5	147.5
18	yá	113	105.9	106.3	112.8	kɔ	141	137.5	136.2	142.3
19	kɛ́	110	102.4	102.7	109.4	kɛ	140	132.3	131.3	137.5
20	lí	106	99.2	99.3	106.2	fa	118	127.5	126.7	132.9
21	ká	104	96.2	96.2	103.1	sa	115	123.1	122.4	128.6
22	yé	95	93.4	93.3	100.3	dɛ	105	118.9	118.4	124.6
23	k`à	90	90.8	90.5	97.6	lo	99	114.9	114.6	120.8
24	nà	87	88.3	88.0	95.1	ye	97	111.2	111.0	117.2
25	bó	87	86.0	85.6	92.7	kaa	96	107.7	107.6	113.8
26	ló	83	83.8	83.3	90.4	ɲa	96	104.4	104.4	110.5
27	lú	81	81.7	81.1	88.3	ta	92	101.2	101.3	107.4
28	ní	79	79.7	79.1	86.2	tii	89	98.2	98.4	104.4
29	fá	78	77.8	77.2	84.3	bo	88	95.4	95.7	101.6
30	lé	76	76.0	75.3	82.4	nɛn	86	92.7	93.0	98.9
31	nɛ́n	73	74.3	73.6	80.6	si	84	90.1	90.5	96.3
32	mɛ́n	72	72.7	71.9	78.9	nin	84	87.6	88.1	93.8
33	ɲá	72	71.1	70.3	77.2	ni	82	85.3	85.8	91.4
34	là	70	69.6	68.7	75.6	ran	80	83.0	83.6	89.0
35	dó	70	68.2	67.3	74.1	bɛ	78	80.9	81.4	86.8
36	sá	70	66.8	65.9	72.6	ra	78	78.8	79.4	84.7
37	kú	67	65.5	64.5	71.2	ku	78	76.8	77.4	82.6
38	fɔ́	63	64.2	63.2	69.8	do	77	74.8	75.5	80.6
39	dà	62	62.9	61.9	68.5	mɛn	76	73.0	73.7	78.7
40	á	59	61.7	60.7	67.2	ki	68	71.2	71.9	76.9
41	í	59	60.6	59.6	66.0	tɛ	67	69.5	70.2	75.1
42	bɛ́	58	59.5	58.4	64.8	baa	65	67.8	68.6	73.3

43	ꞵ̄	tá	57	58.4	57.4	63.6	fɔ	65	66.2	67.0	71.6
44	ꝟ̄	sí	56	57.3	56.3	62.5	sɛ	60	64.7	65.5	70.0
45	ꝟ̄	kí	54	56.3	55.3	61.4	ri	60	63.2	64.0	68.4
46	ꞑ̀	bà	54	55.4	54.3	60.3	yi	60	61.8	62.5	66.9
47	ꞵ̄	rá	52	54.4	53.4	59.3	i	59	60.4	61.1	65.4
48	ᶇ̀	dɛ̀	52	53.5	52.4	58.3	ja	57	59.0	59.8	64.0
49	ᶇ̌	dɛ́	51	52.6	51.5	57.3	sii	54	57.7	58.5	62.6
50	ᶇ̄	sé	51	51.7	50.7	56.4	nu	54	56.4	57.2	61.2

Table A2. Frequencies of first 50 top-ranked syllables in *Dalu Kɛndɛ* (continued).

i	*Dalu Kɛndɛ* 110 (tonal)						*Dalu Kɛndɛ* 110 (non-tonal)				
	Syllable		N_i	JP	PNB	Yule	Syl	N_i	JP	PNB	Yule
1	ꞗ̄	lá	226	197.0	229.0	214.9	la	265	261.3	290.5	286.7
2	ꞑ̄	má	141	171.0	177.0	165.2	ma	257	230.0	227.9	222.1
3	ᶇ̄	dá	119	149.9	149.9	141.2	ka	192	202.2	194.2	190.2
4	ꞑ̄	bá	117	134.3	132.3	126.0	ba	153	181.0	172.1	169.8
5	ꞑ̀	mà	116	122.3	119.8	115.1	a	153	164.4	156.0	154.9
6	ꝟ̀	kà	112	112.8	110.2	106.8	na	149	151.2	143.5	143.4
7	ꝟ̌	kó	111	105.0	102.5	100.1	da	149	140.2	133.4	134.1
8	ꞌ̀	à	99	98.5	96.1	94.6	ko	119	131.0	125.0	126.2
9	ᶇ̄	dí	99	93.0	90.7	89.8	li	112	123.1	117.8	119.5
10	ꞗ̄	ná	96	88.1	86.1	85.7	di	111	116.2	111.6	113.7
11	ꞗ̀	ò	92	83.9	82.1	82.1	le	109	110.1	106.1	108.5
12	ᶇ̄	dɔ́	87	80.1	78.5	78.9	dɔ	102	104.7	101.2	103.8
13	ꝟ̄	lí	80	76.7	75.3	76.0	o	98	99.8	96.8	99.6
14	ꞵ̄	ká	80	73.7	72.4	73.4	ra	92	95.4	92.8	95.7
15	ꝟ̌	kɛ́	77	70.9	69.8	70.9	lu	91	91.4	89.1	92.2
16	ꞵ̄	kán	73	68.3	67.4	68.7	kan	90	87.7	85.8	88.9
17	ᶇ̀	lè	71	66.0	65.2	66.7	lo	90	84.3	82.7	85.9
18	ᶇ̄	Ń	71	63.8	63.1	64.8	ya	84	81.1	79.8	83.1
19	ᶇ̌	ló	70	61.8	61.2	63.0	dɛ	82	78.2	77.1	80.4
20	ꞵ̄	yá	69	60.0	59.4	61.3	si	82	75.5	74.6	77.9
21	ꝟ̄	ní	68	58.2	57.8	59.7	kɛ	80	72.9	72.2	75.6
22	ꞵ̄	rá	67	56.6	56.2	58.3	fa	80	70.5	70.0	73.3
23	ᶇ̀	lù	55	55.0	54.7	56.9	ri	75	68.3	67.9	71.2
24	ꞌ̄	á	54	53.6	53.4	55.5	N	75	66.2	65.9	69.2
25	ꞗ̀	nà	53	52.2	52.0	54.3	ja	71	64.2	64.1	67.3
26	ꝟ̄	rí	51	50.9	50.8	53.1	ni	70	62.3	62.3	65.5
27	ᶇ̌	dɛ́	50	49.7	49.6	51.9	ta	64	60.4	60.6	63.8
28	ᶇ̄	yé	47	48.5	48.5	50.8	sa	60	58.7	58.9	62.1
29	ᶇ̄	kɔ́	47	47.4	47.4	49.8	tɛ	58	57.1	57.4	60.6
30	ꞑ̀	fà	43	46.3	46.4	48.7	kɔ	56	55.5	55.9	59.0
31	ꞌ̀ʻʜ	k`à	43	45.3	45.4	47.8	baa	52	54.1	54.5	57.6
32	ꝟ̄	sí	43	44.3	44.5	46.8	ku	51	52.6	53.1	56.2
33	ꞵ̄	já	42	43.4	43.6	45.9	tii	49	51.3	51.8	54.8
34	ᶇ̌	tɛ́	42	42.5	42.7	45.1	ye	48	50.0	50.6	53.5
35	ᶇ̄	bɔ́	42	41.6	41.9	44.2	bɔ	48	48.7	49.4	52.3
36	ᶇ̌	kú	41	40.8	41.1	43.4	yi	46	47.5	48.2	51.1
37	ᶇ̄	sá	40	40.0	40.3	42.7	nin	46	46.4	47.1	49.9
38	ꞗ̀	là	39	39.3	39.5	41.9	kaa	45	45.3	46.0	48.8
39	ꝟ̀	sì	39	38.5	38.8	41.2	ɲa	44	44.2	44.9	47.7

40	ꔰ	lé	38	37.8	38.1	40.5	do	41	43.1	43.9	46.6
41	ꕞ	nɛ́n	38	37.1	37.4	39.8	mi	39	42.2	43.0	45.6
42	ꔆ	fá	37	36.4	36.8	39.1	ki	39	41.2	42.0	44.6
43	ꔋ	bà	36	35.8	36.1	38.5	nɛn	39	40.3	41.1	43.6
44	ꔓ	lú	36	35.2	35.5	37.8	nu	37	39.4	40.2	42.7
45	ꔊ	báa	36	34.6	34.9	37.2	du	37	38.5	39.4	41.8
46	ꔟ	yí	36	34.0	34.4	36.6	se	37	37.7	38.5	40.9
47	ꔢ	ŋá	35	33.4	33.8	36.1	ji	36	36.8	37.7	40.1
48	ꔇ	tá	34	32.9	33.3	35.5	ran	36	36.1	36.9	39.2
49	ꔤ	sé	33	32.3	32.7	34.9	nɛ	35	35.3	36.2	38.4
50	ꔈ	tíi	33	31.8	32.2	34.4	man	35	34.6	35.4	37.6

Table A2. Frequencies of first 50 top-ranked syllables in *Dalu Kɛndɛ* (continued).

i	*Dalu Kɛndɛ* 126 (tonal)						*Dalu Kɛndɛ* 126 (non-tonal)				
	Syllable		N_i	JP	PNB	Yule	Syl	N_i	JP	PNB	Yule
1	ꔢ	lá	649	600.1	678.8	622.0	la	737	682.1	771.3	752.7
2	ꔇ	ná	372	483.8	508.6	469.6	ma	549	610.1	608.0	589.0
3	ꔤ	dá	353	411.8	422.5	397.1	na	499	539.6	519.5	507.1
4	ꔥ	dí	328	363.2	368.1	351.7	ka	434	484.3	461.0	453.9
5	ꔦ	dɔ́	321	327.6	329.7	319.4	da	426	440.8	418.2	415.2
6	ꔅ	ò	320	300.0	300.7	294.9	a	418	405.5	384.9	384.9
7	ꔋ	mà	309	277.9	277.7	275.2	lu	418	376.2	357.9	360.2
8	ꔡ	kó	307	259.7	258.9	259.0	dɔ	355	351.4	335.4	339.4
9	ꔉ	kà	302	244.2	243.1	245.2	di	353	330.1	316.1	321.5
10	ꔀ	à	284	231.0	229.6	233.3	ba	333	311.4	299.3	305.8
11	ꔎ	má	239	219.4	217.9	222.8	ko	333	295.0	284.4	291.8
12	ꔍ	bá	238	209.1	207.6	213.5	o	324	280.2	271.2	279.2
13	ꔕ	lù	237	200.0	198.4	205.2	le	288	267.0	259.2	267.8
14	ꔈ	ní	218	191.8	190.2	197.7	li	236	255.0	248.4	257.4
15	ꔠ	kɛ́	194	184.3	182.7	190.8	ni	228	244.1	238.5	247.8
16	ꔣ	lè	189	177.5	175.9	184.4	kɛ	225	234.0	229.3	238.9
17	ꔞ	lí	187	171.3	169.7	178.6	ra	223	224.8	220.9	230.6
18	ꔓ	lú	181	165.5	164.0	173.2	fa	221	216.2	213.0	222.9
19	ꔦ	kɔ́	178	160.2	158.7	168.1	N	214	208.2	205.7	215.6
20	ꔤ	yé	173	155.2	153.7	163.4	kan	210	200.8	198.8	208.8
21	ꔢ	yá	158	150.6	149.1	159.0	ya	201	193.8	192.4	202.4
22	ꔆ	fá	156	146.2	144.8	154.8	kɔ	200	187.3	186.3	196.3
23	ꔃ	rá	156	142.2	140.8	150.8	dɛ	177	181.1	180.6	190.5
24	ꔄ	kán	146	138.3	137.0	147.1	sa	175	175.3	175.2	185.0
25	ꔇ	nɛ́n	139	134.7	133.4	143.6	ye	173	169.9	170.0	179.8
26	ꔀ	á	134	131.3	130.0	140.2	nɛn	164	164.7	165.1	174.8
27	ꔉ	ká	131	128.0	126.8	137.0	ta	153	159.7	160.5	170.0
28	ꔧ	Ń	130	125.0	123.7	133.9	nin	152	155.1	156.0	165.4
29	ꔡ	ló	126	122.0	120.8	131.0	baa	150	150.6	151.8	161.1
30	ꔇ	nà	125	119.2	118.1	128.2	lo	140	146.4	147.7	156.9
31	ꔀ꞉꞉	k`à	119	116.5	115.4	125.5	si	138	142.3	143.8	152.8
32	ꔋ	mén	114	114.0	112.9	122.9	tɛ	133	138.4	140.1	149.0
33	ꔢ	ŋá	104	111.5	110.5	120.4	ŋa	132	134.7	136.5	145.2
34	ꔍ	bɛ́ɛ	103	109.2	108.1	118.0	ku	127	131.2	133.1	141.6
35	ꔇ	tɛ́	102	106.9	105.9	115.7	kaa	126	127.7	129.8	138.2
36	ꔰ	lé	99	104.8	103.8	113.5	ri	118	124.5	126.6	134.8

37		sà	96	102.7	101.7	111.3	mɛn	116	121.3	123.5	131.6
38		kú	94	100.7	99.7	109.2	bɛɛ	103	118.3	120.6	128.5
39		bà	93	98.7	97.8	107.2	mɔɔ	102	115.4	117.7	125.5
40		sí	92	96.9	96.0	105.3	ja	97	112.6	114.9	122.5
41		dɛ́	91	95.1	94.2	103.4	wa	96	109.9	112.3	119.7
42		tá	91	93.3	92.5	101.6	bɛ	95	107.2	109.7	117.0
43		là	87	91.6	90.8	99.8	bo	89	104.7	107.2	114.3
44		báa	84	90.0	89.2	98.1	mi	88	102.3	104.8	111.7
45		Ǹ	84	88.4	87.6	96.4	do	85	99.9	102.4	109.3
46		dɛ̀	84	86.9	86.1	94.8	ran	84	97.6	100.2	106.8
47		rí	80	85.4	84.6	93.2	don	83	95.4	98.0	104.5
48		sá	78	84.0	83.2	91.7	man	83	93.3	95.8	102.2
49		bó	78	82.6	81.8	90.2	ne	82	91.2	93.8	100.0
50		nìn	76	81.2	80.5	88.7	fɛ	81	89.2	91.7	97.8

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