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Numeral systems in Mande languages

Systèmes des numéraux dans les langues mandé

СИСТЕМЫ ЧИСЛИТЕЛЬНЫХ В ЯЗЫКАХ МАНДЕ

Elena Perekhvalskaya and Valentin Vydrin



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Numeral systems in Mande languages¹

Elena Perekhvalskaya

Institute for Linguistic Studies, St. Petersburg, Russia

elenap96@gmail.com

Valentin Vydrin

INALCO — LLACAN — St. Petersburg State University

vydrine@gmail.com

1. Introduction

The counting systems and systems of numerals found in Mande languages are rather heterogeneous, and some of these systems display unique or, at least, typologically rare features. In this paper, we analyse these systems from a typological viewpoint, taking into account ideas formulated in fundamental works which have treated numerals in the languages of the world from universalist, theoretical and typological points of view (Greenberg 1978; Hurford 1975). We begin our analysis by presenting a conceptual framework and terminology for the study of counting systems. In the main part, we investigate eight numeral systems (those of old Bamana, modern Bamana, Boko, Dzuungoo, Mwan, Dan-Gwɛɛtaa, San-Maka, and Soninke) that represent different types of identifiable systems. Next, the data for these and some other Mande languages will be represented in a table, followed by comments on the most

¹ This work is related to research strand 3 “Typology and dynamics of linguistic systems” of the Labex EFL (financed by the ANR/CGI).

An earlier version of this study was published in Russian (Vydrin & Perekhvalskaya 2015), and numeral systems of Southern Mande were analyzed in (Perekhvalskaya 2012). However, the present paper is by no means a simple translation of those earlier articles: it is four times larger in size than (Vydrin & Perekhvalskaya 2015), the number of languages addressed has grown considerably, the mode of analysis has been radically changed, and the conclusions have been completely rewritten.

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interesting features of individual languages. The paper ends with an analysis of general trends and particularities of numeral systems in the Mande language family.

The main goal of this paper is to represent the Mande language data in a more or less standard format, so that these data might be easily comparable, and to provide a primary analysis. This paper is therefore data-oriented rather than theory-oriented.

The data represented in this paper are partly drawn from the field materials of the authors (especially for Bamata, Dan-Gwɛɛtaa, Mwan, San-Maka); otherwise, the data are provided with references for their sources.

1.1. Restricted systems and body part counting. Typologically, all numeral systems in the languages of the world are either restricted with no arithmetic base or non-restricted.

Restricted number systems consist of several elements, usually not more than five, and often of three or four numerals.² Numerals in these systems denote sets of concrete objects, rather than abstract numbers.

We assume that the emergence of numeral systems which have an arithmetic base is a relatively recent phenomenon. According to the World Atlas of Language Structures (Comrie 2005), there still exist “restricted” systems, which use three or four numerals. Larger numbers here are expressed by combinations of these few elements. Within the framework of such a system, the expression of numbers larger than 20 is extremely cumbersome, and as a result, there are limits of the application of exact counting (traces of words with meanings like “the final number” are attested in many languages whose systems are no longer restricted). Such systems are typical of small closed communities, which, until recently, were unconcerned by commercial relations, had no monetary system and conducted a traditional way of life based on hunting and gathering.

As a rule, these restricted systems coexist with extended body-part counting. In the course of such counting, parts of the body are named in an established order, and the name of a body part is used as the designation of a certain set (“fist” > five). Primarily, fingers and finger phalanges are used for counting.“

This technique allows, if necessary, for the accurate naming of numbers up to a hundred and even beyond.³ For larger numbers calculations use the body parts of a second and then a third person, and so on. It would be logical to assume that this practice explains the formation of more widespread positional (cyclic) systems of numerals. Most likely they originated from a system of counting by body parts.

² Cf. (Comrie 2005): “some languages have **restricted** numeral systems, by which I mean more specifically a numeral system that does not effectively go above around 20”.

³ For concrete examples of such systems see (Craig 2010; Saxe & Esmonde 2004).

Certain terms for numbers in Mande languages can be traced back to body parts: *hand, foot, mouth, head, human being*, a fact that can be explained in terms of original body-part counting. At the same time, there are terms for higher numerals which go back to the names of certain sets: *string of cowries, basket of cola nuts*.

Systems with an arithmetic base (all modern Mande systems belong to this type) are arranged similarly. The structure of a compound numeral in these systems can be described by Bernard Comrie's formula (Comrie n.d.): for a b -based numeral system, $(n \times b) + m$ (where $m < b$). Arithmetic operations are either implied (with the components combined through parataxis) or marked by auxiliary words (connectors).

1.2. Base of the counting system

Following (Comrie 1997; Comrie 1999), “by the “**base**” of a numeral system we mean the value n such that numeral expressions are constructed according to the pattern ... $xn + y$, i.e. some numeral x multiplied by the base plus some other numeral”.

It seems necessary to distinguish between the bases, which are used in multiplication (i.e., multiplicands), and the numerals used as the first component in addition (i.e., augends);⁴ in systems where subtraction is used, we can also single out the first components used in subtraction (minuends). By default, multiplicands (sole or together with their multipliers) can also be used in numerative systems as augends; in some languages, they can also serve as minuends.

The multiplicand of the lower order, i.e., the **radix** (Greenberg's “fundamental base”), defines the type of the numerical system. Different bases can be combined within a single numerative system, rudiments of older systems being preserved. The following radices are registered in natural languages (this list is certainly not exhaustive):

Radix	Type of the system
4	quaternary
5	quinary
10	decimal
12 ⁵	duodecimal

⁴ See (Greenberg 1990: 281) on the importance of distinguishing between the augend and addend, the multiplicand and multiplier in natural numerical systems.

⁵ “The question is how could a twelve-digit system ever appear? Examples of this count: the division of the year in 12 months, the count of time (12 hours a day), the division of the hour in 60 minutes, and 3600 seconds, the division of the circle in 360 degrees. This system was accepted in Europe, and then spread all over the world. Its origin is usually associated with Babylon and is determined by observations of the movement of the Moon <...> But how the achievements of the Ancient East could reach the remote mountains in the depths of Africa

15	pentadecimal (or quindecimal)
20	vigesimal
60	sexagesimal
80	octodecimal

In most instances, base (multiplicands), as well as augends and minuends, are simple (non-derived and non-compound) forms, although some exceptions to this rule can be found. For instance, in Boko there are augends '15' and '25' which are compound words.

Dmitry Olderogge singled out several counting systems in Africa which are differentiated by the number of "counting thresholds" (i. e., lower multiplicands and augends) they display:

1) A four-stage system: thresholds 5, 10, 15, 20. Numbers from 1 through 5 are simple; numbers from 6 through 9 follow the quinary model; numbers from 11 through 14 are derived from 10, and those from 16 through 19 are based on 15. The subsequent numerals are based on 20.

2) A three-stage system: thresholds 5, 10, 20.

3) A two-stage system: the thresholds are 10 and 20; no traces of the quinary model.

4) Complex vigesimal systems "existing among the communities who used to count cowries". The counting is decimal or/and vigesimal; however, there are special words for 400, 600, etc. (Olderogge 1984: 3–4).

1.3. Arithmetic in counting systems. Bernard Comrie (2005) mentions two operations of arithmetic implicitly used in counting systems: addition and multiplication. Quite a few systems also use subtraction, e.g. Latin *duo de viginti* 'eighteen' (2 from 20)."

Division in the numeral systems of natural languages is extremely rare. So, in (Comrie 1997) only Welsh is mentioned in this relation, where *hanner cant* '50' is 'half hundred'. According to Greenberg (1990: 280), if the numeral system of a language applies division, «'half' is the "unmarked fraction" and is almost always a simple lexical item, often derived from 'to split', or 'to break' or the like» (Greenberg adduces Orya (Indo-Aryan) as an exception, where 'quarter' is also used in the formation of compound numerals).

1.4. Classifiers or counting words. Some languages use classifiers, more or less grammaticalized elements located between the numeral and the noun designating the object counted, along the lines of *loaves* in *two loaves of bread* (rather than *two breads*

is unclear <...> Therefore, one should search the origin of this system in the hand count, and not fingers, but 12 phalanges" (Olderogge 1982: 28).

— although English *loaf* is not a true classifier word but a noun, in view of the lack of grammaticalization). The term “classifiers” is usually applied to languages of the Far East and Southeastern Asia and to some Amerindian languages, where the elements in question have reached an advanced stage of grammaticalization. Where the level of grammaticalization is more moderate, the terms “counting words” and “measure words” are usually preferred; this is the case in certain Mande languages. We provide information about such words whenever it is available. It is reasonable to think that they are in fact much more widespread, but often passed over in silence by the authors of grammatical descriptions.

1.5. Specialized counting systems. Two (or more) different systems may coexist simultaneously in a language, so that the same number can be coded in more than one way (*twenty-four* and *two dozen*). Typically, the subsidiary system is used for counting special objects (eggs, notches, stitches in knitting, tube diameter and the like).

In West Africa, money-counting often has features of a specialized system. In most Mande languages (and not only in Mande, cf. (Grandet 1973; Zepp 1983)) spoken in the Francophone countries, when money is counted, each numeral (with the exception of higher ones such as millions and billions) designates an amount five times higher than with other objects. So, in modern Bamana *mòbili kème fila* means ‘200 cars’, but *dòròme kème fila* is ‘1000 CFA francs’ (lit. ‘200 coins’); in Boko *dǎǎ dó* is ‘5 francs’ (lit. ‘one coin’); in Mwan *māā kème dō* is ‘100 hens’, but *gòlí kème dō* is ‘500 francs’ (lit. ‘100 coins’); *wáá yīzīē* ‘20,000’ (lit. 4 000), in Dzuungoo *dāsī fīí* ‘10 francs’ (lit. ‘two coins’).⁶

This rule of multiplication by five has a historical explanation. In the eighteenth century and in the first half of the nineteenth century, the most prevalent coin in circulation in West Africa was the Spanish silver dollar, which made *dollar* the default name for a coin. At the same period, a French coin, the *gourde*, equal to 5 francs, was also in circulation with a value more or less equal to the Spanish dollar (Curtin 1975: 264–270). Presumably in West African languages the term for the dollar was extended to the *gourde* (5 francs),⁷ and when (with French colonization) the French franc became

⁶ An anonymous reviewer commented that in these contexts, “it is not obvious that the numeral denotes 5 times its usual value, rather the head noun denotes a value of 5 francs”. That is true if we take expressions like Bamana *dòròme fila* ‘10 CFA francs’, lit. ‘two five-francs’; however, the word *dòròme* in Bamana (and its analogues in the other languages) is very often omitted, and in this case the numeral appears without any head noun and still denotes five times its usual value.

⁷ *Gourde* is the name of the national currency of Haiti since 1813. The word seems to go back to the Spanish *gordo* in *pesos gordo* ‘hard peso’. It cannot be excluded that the forms

the main and, eventually, the only currency, the word which originally meant ‘dollar’ (Bamana *dálasi*, Dzuungoo *dāsī*, etc.) was retained for the 5 fr. coin and remained the basic unit of money counting.⁸ Incidentally, in Gambia the word *Dalasi* has been retained as the name of the national currency.

Less clear is the Bamana word for ‘5 francs’, *dórǒmé* (which is much more frequently used than its synonym *dálasi*). It is generally believed (cf., for example, (Lagarde 1988)) that *dórǒmé* goes back to ‘dirham’, a currency used in Arabic countries (whose name in turn goes back to the Greek drachma). However, the dirham was always a coin of relatively small denomination; its weight was usually close to 3 g of silver. The Spanish dollar in the 18th and 19th centuries ranged between 24 and 30 g of silver. Therefore the dirham could not have been its monetary equivalent. One plausible account then is that the word *dórǒmé*, at some point, lost its connection with the dirham and became a default name for a coin, thus becoming a synonym of *dálasi*.

In due course this system was sometimes extended, at least in Guro and Mwan (but not in Bamana or Jula), to other currencies. In these languages, not only CFA francs are counted using the “multiply by five” rule, but also dollars, euros, etc.

In old Bamana, special terms were used when counting cowrie shells (for more detail see the end of section 2.1).

1.6. Internal and external syntax of numerals. By “internal syntax of numerals” we mean the manner in which the elements of compound numerals are combined, and by “external syntax”, we mean the way numerals interact with the nouns they determine.

Unfortunately, we do not have sufficient data on the external syntax of numerals in every language dealt with in this paper. However, we think that there is still some value in providing information on just a limited sub-sample of languages (especially those displaying some unusual features with respect to the common Mande background).

gǝlí (Mwan, Wan), *gǝlí*, *gǝlí* (Guro) ‘5 francs’, etc. go back to the name of this ancient French coin.

⁸ In modern Guinean Maninka, the word *dàlasi* means ‘one Guinean franc’. This semantic shift (“5 francs > 1 franc”) is due to the intricate history of the monetary system of this country. Before independence, *dàlasi* meant ‘5 CFA francs’ (as everywhere else in French West Africa). After independence (1958), when Guinea left the CFA franc zone and introduced the Guinean franc, *dàlasi* still meant ‘5 (Guinean) francs’. In 1972, the Guinean franc was replaced by a new currency, the sily. In Maninka, the term *dàlasi* was retained, but from then on it meant ‘1 sily’, rather than 5. When in 1986 the sily was replaced again by the Guinean franc, the word *dàlasi* was kept for ‘1 Guinean franc’.

1.7. Etymologies

Reconstruction of numeral proto-forms is not among the primary tasks of the present paper. However, some potential etymologies of particular forms will be proposed, whenever they are appropriate and useful for understanding the organization of a numeral system. Quite recently, a reconstruction of Mande numerals, against the background of the other Niger-Congo languages, was the subject of a special study by Konstantin Pozdniakov (2018). It seems appropriate to present here Pozdniakov's Proto-Mande etymologies to serve as a point of reference for our “local” etymologies. In some cases, we use brackets to add our own suggestions to the reconstructions (a dot under a letter indicates that the vowel belongs to the –ATR series).

‘1’ Two roots are candidates for the Proto-Mande level, **do* (**dô*) and **kelen*, of these **do* seems to be better supported.

‘2’ **pila* or **fila* (**pîdâ*).

‘3’ **sakpa*/**sagba*/**sawa*.

‘4’ The Proto-Mande form **náání/ nãĩi* is preserved in the Proto-Western Mande, while **sîiyá* is a Proto-Southeastern Mande innovation.

‘5’ **dúuru*/**sóóru* (**dôôdũ*).

‘6’ = ‘5+1’.

‘7’ = ‘5+2’.

‘8’ unclear (probably ‘5+3’, although other etymologies may also be possible).

‘9’ = ‘5+4’ or ‘10-1’.

‘10’ **pu*/**fu* (**pú*); **tan* is a Proto-Western Mande innovation stemming from the Niger-Congo root for ‘5’.

‘20’ < ‘human being’.

‘100’ **keme* (may be a recent itinerant word) or ‘20x5’.

‘1000’ **wulu*, **waga* (may be recent itinerant words).

1.8. Scope of the study

We have left certain topics outside our study: in particular, the range of problems concerning ordinal numerals, distributive numerals, and the adverbial use of numerals. We have also left aside some idiosyncratic features of individual numeral systems which have no bearing on our generalizations.

1.9. Mande family

For the convenience of readers, we reproduce here the genealogical tree of the Mande family, in a form of a hierarchical list (the inner classification follows (Vydrin 2009), in a simplified way). The language names are supplemented by ISO 639-3 codes (in italics). Names of those languages whose numeral systems are analyzed in detail are given in bold; the names of the other languages represented in section 2 are

underlined. If a language is known under different names, the alternative names are given in brackets. For some groups containing numerous closely related varieties with a status intermediate between a language and a dialect (such as the Manding group), the lists of varieties given here may not be exhaustive.

1. Western Mande
 - 1.1. Manding
 - 1.1.1. **Bamana (Bambara)** *bam*
 - 1.1.2. *Jula dyu*
 - 1.1.3. *Maninka man*
 - 1.1.4. Mandinka *mnk*
 - 1.1.5. *Xasonka kao*
 - 1.2. Mokole
 - 1.2.1. *Mogofin (Mikhifore) mfg*
 - 1.2.2. Kakabe *kke*
 - 1.2.3. *Koranko knk*
 - 1.2.4. *Lele llc*
 - 1.3. Vai-Kono
 - 1.3.1. Vai *vai*
 - 1.3.2. *Kono kno*
 - 1.4. Jogo-Jeri
 - 1.4.1. Jogo
 - 1.4.1.1. Jogo-Ton
 - 1.4.1.2. Jogo-Ligbi *lig*
 - 1.4.2. *Jeri jek*
 - 1.4.3. Jalkunan (Ble) *bxl*
 - 1.5. Southwestern–Susu
 - 1.5.1. Susu–Yalunka
 - 1.5.1.1. Susu (Soso) *sus*
 - 1.5.1.2. *Yalunka (Jalonke) yal*
 - 1.5.2. Southwestern Mande
 - 1.5.2.1. Kpelle
 - 1.5.2.1.1. Guinean Kpelle *gkp*
 - 1.5.2.1.2. *Liberian Kpelle xpe*
 - 1.5.2.1.3. *Kono knu*
 - 1.5.2.2. Looma
 - 1.5.2.2.1. *Liberian Looma lom*
 - 1.5.2.2.2. Guinean Looma (Toma) *tod*
 - 1.5.2.3. *Bandi bza*

- 1.5.2.4. Zialo *zil*
- 1.5.2.5. Mende *men*
- 1.5.2.6. Loko *lok*
- 1.6. Soninke–Bozo
 - 1.6.1. **Soninke** *snk*
 - 1.6.2. Bozo
 - 1.6.2.1. Bozo-Tigemaxo *boz*
 - 1.6.2.2. Kelengaxo *bzx*
 - 1.6.2.3. Jenaama *bze*
 - 1.6.2.4. Tiemacewe *boo*
- 1.7. Bobo
 - 1.7.1. Southern Bobo *bwq*
 - 1.7.2. Konabere *bbo*
- 1.8. Samogo
 - 1.8.1. Duun *dux*
 - 1.8.2. **Dzuun** *dnn*
 - 1.8.3. Kpan
 - 1.8.4. Banka *bxw*
 - 1.8.5. Seenku (Sembla) *sos*
 - 1.8.6. Jowulu *jow*
- 2. South-Eastern Mande
 - 2.1. Southern Mande
 - 2.1.1. Beng *nhb*
 - 2.1.2. Ngen *gnj*
 - 2.1.3. Gbin
 - 2.1.4. Gban (Gagu) *ggu*
 - 2.1.5. Wan *wan*
 - 2.1.6. Guro (Kweni) *goa*
 - 2.1.7. Yaure *yre*
 - 2.1.8. **Mwan (Mona)** *moa*
 - 2.1.9. Dan (Yacouba, Gio) *dnj*
 - 2.1.9.1. **Eastern Dan (Yacouba)**
 - 2.1.9.2. Western Dan (Yacouba)
 - 2.1.9.3. Kla-Dan *lda*
 - 2.1.10. Mano *mev*
 - 2.1.11. Tura (Wen) *neb*
 - 2.1.12. Goo
 - 2.2. Eastern Mande

2.2.1. San

2.2.1.1. **Southern San** *sbd*

2.2.1.2. San-Matya *stj*

2.2.1.3. San-Maya *sym*

2.2.2. Bisa *bib*

2.2.3. Boko-Busa

2.2.3.1. **Boko** *bqc*

2.2.3.2. Bokobaru *bus*

2.2.3.3. Busa *bqp*

2.2.3.4. Illo-Busa

2.2.4. Shanga-Kyenga

2.2.4.1. Shanga *sho*

2.2.4.2. Kyenga *tye*

1.10. Orthographic conventions

All Mande languages are tonal. In our paper, tonal marking follows the IPA system. This system is illustrated in the Table 1, with the example of the vowel *a*.

Table 1. Tonal marking

Type of system Tone	2-level system	3-level system	4-level system	5-level system
extra-high			ǎ	ǎ
high	á	á	á	á
mid		ā		ā
low	à	à	à	à
extra-low			ằ	ằ

If the tonal notation in a consulted source is different, it is converted to the IPA-based model here. Tonal notation in Bamana follows the rules formulated in (Konta & Vydrin 2014).

2. Sample studies: eight numeral systems representing different models

2.1. The modern and old Bamana systems

In modern Bamana, the counting system is practically identical to those found in the majority of languages of the Manding group (Maninka, Jula), and it is consistently decimal, with relics of quinary. However, another numeral system was predominant in Bamana till the mid-20th century, and it appears in colonial era grammars (Delafosse 1929; Molin 1956; Sauvart 1942). According to oral tradition,⁹ the archaic Bamana

⁹ Kalilou Tera, personal communication.

counting system was introduced by one of the rulers of the Segu kingdom which existed in the 17th-19th centuries and played a key role in the formation of the Bamana ethnic group. As late as the 1980-s, many Bamana speakers, especially natives of Segu, still mastered it, although they recognized that it was in the process of being abandoned and replaced by the decimal system. Nowadays, it is rarely used even by older generations, who, when questioned, often mix up features of the two systems or forget important details.

In the old Bamana system, the numerals of the first ten are the same as in the modern system. The same is mainly true for the second ten.

Table 2. Bamana numerals, first and second ten

1 <i>kélen</i>	6 <i>wóɔɔɔ</i>	11 <i>tân ní kélen</i> (10+1)
2 <i>fila</i>	7 <i>wólonfila, wólonfùla, wólonwùla</i>	12 <i>tân ní fila</i> (10+2)
3 <i>sàba</i>	8 <i>ségin, séegin</i>	etc.
4 <i>náani</i>	9 <i>kòntonɔ, kòntonɔn</i>	
5 <i>dúuru</i>	10 <i>tán</i>	

The divergences begin at the end of the second ten, where subtractive numerals emerge. Table 2 presents various forms in the old and modern systems. In the left column, the numerical values are indicated; for the compound numerals, the syntax of the form is clarified in brackets. For numerical values which can be expressed in the old system in two ways (or more), the alternative forms are separated by a tilde (~).

Table 3. The old and modern Bamana systems

	Old system	Modern system¹⁰
19	<i>mùgan kélen ká jè ~ mùgan kélen pà</i> (20-1) ~ <i>tan ní kòntonɔn</i> (10+9)	<i>tân ni kòntonɔn</i> (10+9)
20	<i>mùgan</i>	<i>mùgan</i>
21	<i>mùgan ni kélen</i> (20+1)	<i>mùgân ni kélen</i> (20+1)
29	<i>mùgan ni tàn kélen ká jè ~ mùgan ní tàn kélen pà</i> (20+10-1)	<i>mùgân ni kòntonɔn</i> (20+9)
30	<i>mùgan ni tán</i> (20+10)	<i>bî sàba</i> (10x3)
31	<i>mùgan ni tán ni kélen</i> (20+10+1)	<i>bî sàba ni kélen</i> (10x3+1)

¹⁰ The numerals for ‘10’ and ‘20’ in modern Bamana, when used in compound numerals which are not divisible by 10 and 20 respectively, appear with a postposed floating low tone; otherwise, they have no floating tone. This suggests that in this context they behave as nouns and therefore they likely carry the tonal article.

	Old system	Modern system ¹⁰
38	<i>dèbe fila ká jè ~ dèbe fila jà</i> (40-2)	<i>bî sàba ni séegin</i> (10x3+8)
40	<i>dèbe</i>	<i>bî náani</i> (10x4)
50	<i>dèbe ni tán</i> (40+10)	<i>bî dúuru</i> (10x5)
60	<i>mànkème</i>	<i>bî wóɔɔ</i> (10x6)
70	<i>mànkème ni tán</i> (60+10) ~ <i>kème tán jà</i> (80-10) ~ <i>kème tán ká jè</i> (80-10)	<i>bî wólonwùla</i> (10x7)
75	<i>mànkème ni tán ni dúuru</i> (60+10+5) ~ <i>kème dlá jà</i> (80-1/2)	<i>bî wólonwùla ni dúuru</i> (10x7+5)
80	<i>kème ~ bámanankème</i>	<i>bî séegin</i> (10x8)
90	<i>kème ni tán</i> (80+10)	<i>bî kòntɔntɔn</i> (10x9)
100	<i>kème ni mùgan</i> (80+20) ~ <i>sílameyakème</i>	<i>kème</i>
140	<i>kème fila mùgan ká jè</i> (80x2-20)	<i>kème ni bî náani</i> (100+10x4)
160	<i>kème fila</i> (80x2)	<i>kème ni bî wóɔɔ</i> (100+10x6)
200	<i>kème fila ni dèbe</i> (80x2+40)	<i>kème fila</i> (100x2)
600	<i>kème wólonwùla ni dèbe</i> (80x7+40) ~ <i>mànkaba</i>	<i>kème wóɔɔ</i> (100x6)
800	<i>bà</i>	<i>kème séegin</i> (100x8)
1000	<i>bà kelen ni kème fila ni dèbe</i> (800+80x2+40) ~ <i>sílameyaba kelen</i>	<i>bà</i>

The old Bamana system was characterized by a combination of the following COUNTING SYSTEMS:

— quinary (within the first ten): in this, both old and new systems coincide. Quinary manifests itself in the forms 6 *wóɔɔ* and 7 *wóronfila*. The latter form can be easily subdivided into two elements, *wóron-fila*, where *fila* is evidently identical with *fila* ‘two’. The other form, *wóɔɔ* ‘6’, is less transparent. Nonetheless it could plausibly be subdivided into two elements, *wóɔ-rɔ*. In this case, it is highly probable that the second element comes from the reconstructed Proto-Mande numeral **dɔ* ‘one’. In turn, the first element may be etymologically identical with the element *wóron-* attested in the numeral for ‘7’ (i.e., ‘6’ **wóron-dɔ* > *wóɔɔ* through elision of the foot-internal consonant, contraction of the two-feet structure into one foot with subsequent lenition **-d- > -r-* and regressive vocalic assimilation **-oo- > -ɔɔ-*). It would be logical to suppose that *wóron* could be an archaic term for ‘five’;

— heteroradical vigesimal (for tens). Numerals divisible by 20 (40, 60, 80, 100), contrary to expectations, are not formed through multiplication of the numeral for ‘20’, they are represented instead by simple forms (*dèbe* ‘40’, *kème* ‘80’) or forms derived

in idiosyncratic ways: *màrinkème* can be interpreted as ‘a Maninka hundred’, *bámanankeme* is ‘a Bamana hundred’, and *sílameyakeme* is ‘a Muslim hundred’;

— mixed octogesimal and decimal, for hundreds and thousands (the numerical value *bà* ‘800’ is equal to 80×10).

In the old Bamana system, the following ARITHMETIC OPERATIONS were used:

— addition, marked by the coordinative conjunction *ni* ‘and/with’ (*tân ni kélen* ‘11’ = $10+1$),

— multiplication, expressed by juxtaposition (*kème fila* ‘160’ = 80×2),

— subtraction ($‘19’ = 20 - 1$, *mùgan kélen jà*, lit. ‘twenty, make one lacking’, or *mùgan kélen ká jè*, lit. ‘twenty, let one be lacking’); the subtractable numerals are *kélen* 1, *fila* 2, *tân* 10 and *mùgan* 20 (and also ‘half’ = 5). Subtractive numerals are employed in an imperative construction with the verb *jà* ‘lack; take away’ or a subjunctive construction with the verb *jè* ‘miss, be absent; deprive’ (supposedly, preference for one verb or the other depends on the region);

— elements of division: when forming subtractive numerals, ‘5’ can be designated as a ‘half of ten’: *dèbe dlá jà* ‘35’ ($‘40 - \text{a half}’$, lit. ‘forty, make a half lacking’). The word for ‘half’ is normally *tíla*, but in this context it appears with a voiced initial consonant (although, rarely, it may also be found with a voiceless consonant).

The term *kème* appears in the numerals for 60, 80 and 100 which are etymologized as follows: *màrinkème* ‘60’ lit. ‘a Maninka hundred’; *bámanankeme* ‘80’ lit. ‘a Bamana hundred’ (the simple stem, *kème*, can also be used for 80); *sílameyakeme* ‘100’ lit. ‘a Muslim hundred’. 100 can also be designated by means of the “Bamana hundred”: *kème ni mùgan* ($80 + 20$). When *kème* is used in compound numerals, it designates, by default, ‘80’.

As for the ETYMOLOGY of the numerals for tens, Maurice Delafosse proposed that *mùgan* ‘20’ could be traced back to the word *mògɔ* ‘human being’ (for the number of a human's fingers and toes, cf. (Delafosse 1955: 520)), and *dèbe* ‘40’ to *dèben* ‘mat’ (for the number of fingers and toes of a couple lying on a mat, cf. (Delafosse 1929: 273–274; Delafosse 1955: 111)). These etymologies may be correct (especially for *mògɔ*, much less clearly for *dèbe*), all the more so given that irregular form modifications accompany numeral derivations from nouns in many African languages.

The stem *kème* ‘100/80’ (and various forms which can be traced back to it) is well represented in Mande languages, and there are good reasons to think that it spread through intra-African trade, and primarily the trade in cola nuts. One hypothesis is that it designated a standard cola package (which could vary regionally, leading to different meanings for the “Bambara hundred” and “Maninka hundred” in the old Bamana counting system). Alternatively, *kème* could originally stand for a string of cowrie shells, the predominant pre-colonial currency. Taking into account the role of Soninke

which was the dominant language of Ghana (the very first among the medieval empires of Western Sudan), the language of the *jùla* traders and the source of numerous loans in the sphere of cultural vocabulary in many languages of the region, it can be supposed that the ultimate origin of this stem could be Soninke, where it appears in the forms *kàmé* (in Western dialects) and *kèmé* (in Eastern dialects).

The etymology of the word *bà* ('800' in the old system, '1000' in the modern system) is not clear. It is noteworthy that in Bamana, there is a special word for counting money, *wáa* '1000' (while in Guinean Maninka and in interethnic Jula, *wáa* is the general word for '1000') which goes back to the noun *wága* ~ *wáa* 'basket for cola nuts' (storing 1000 nuts). This stem also appears in many other Mande languages.

The basic unit for MONEY COUNTING in Bamana is *dórmé* '5 CFA francs' (less frequently, *dálasí*, idem.), cf. in more detail 1.5. The existence of a special money count word *wáa* '1000' (= 5000 CFA francs) should also be mentioned. Maurice Delafosse (Delafosse 1929: 280–281) mentions the existence of special terms for counting cowrie shells which were the main currency in the Manding area during the pre-colonial period (these words are no longer used and we therefore reproduce Delafosse's spelling of the forms since we cannot verify their pronunciation):¹¹ *dã* '5 cowries', *daba* '10 cowries', *toko* '20 cowries',¹² *sîra* '200 cowries'. These words are always accompanied by regular numerals (*toko kele ni dã kele* '25 cowries', *toko fila* '40 cowries', etc.) and should therefore be classified as nouns.

There are several counting words in Bamana: *cè* 'man', *mùso* 'woman', *dén* 'child', 'fruit', *kílo* 'kilogram', *jié* 'content', *kîse* 'grain' (used for counting small objects), *kùru* 'ball, lump' (used for counting round objects), *kàla* 'stem' (used to count long objects). They are not yet fully grammaticalized as classifiers and belong to the part of speech of noun.

EXTERNAL SYNTAX OF BAMANA NUMERALS. Numerals follow the nouns they determine, and by default, neither noun, nor numeral has plural marker *-u* (*-w* in the

¹¹ The existence of these forms is confirmed by less regular data from the field notes (1887-1889) of Louis-Gustave Binger (Van den Avenne 2017: 146).

¹² Most probably, *toko* is a Senufo form in origin, cf. *tòkoo* '20' in Tyebara Senufo (Mills 2003: 1197) and *toko* '20' in Teen (Pozdniakov 2018: 210); otherwise, it may be a common areal term for '20' in the pre-colonial West Africa retained in some modern languages. *Togo* is used today in Ivorian French slang (i.e., in Nouchi; we are thankful to Coleman Donaldson for drawing our attention to this Nouchi form) for 100 francs. In Lafarge's dictionary (2002), this term is explained as follows: "par référence aux premières pièces qui portaient la mention AOF-Togo-Institut d'émission". It seems however more plausible that it goes back to the precolonial term (5fr x 20 = 100fr).

current orthography). This marker can nevertheless be added to the numeral (1) or to the noun (2) (seemingly without any distinction) to express definiteness.

- (1) *Npògotigi` ka kán kà dí jónni mà, cè sàba-w ni*
 girl-ART QUAL.AFF equal INF give who ADR man three-PL and
jógon cé?

RECP between

‘From among the three men, to whom should the girl be given?’

- (2) <...> *ù màa-w fila bée jè-ra kà Lansenì fò,*
 3PL human-PL two all gather-PFV.INTR INF Lansenì greet
à ye ù lámìnɛ.
 3SG PFV.TR 3PL answer

‘... both of them gathered to greet Lansenì, and he responded to their greeting’.

2.2. Boko numeral system

Boko (Eastern Mande) is spoken on both sides of the border between Nigeria and Benin. It is distant from the zone of Manding and Soninke dominance, which means that these two languages are unlikely donors of cultural vocabulary for Boko. The data on the Boko numerative system are given according to (Jones 1998; Jones 2004),¹³ cf. Table 4.

Boko is one of the rare languages in the Mande family where the quinary system continues beyond the first ten since the numerals for ‘15’ and ‘25’ serve as augends (for 16, 18, 26, 27) and minuends (for 14, 24). Otherwise, vigesimality is predominant in Boko.

BASIC NUMERALS. There are non-compound terms (at least, in synchrony) for the numerals from 1 to 5, and also ‘10’ *kwì*, ‘15’ *gěó*, ‘20’ *bàó*, ‘200’ ‘*ǎǎǎ*’.

In the forms for 6, 7, 8, there is an element *sOO-* which can be traced back to *sóó* ‘5’. In 6 *sóóló*, the element *-ló* derives, most probably, from *dó* ‘1’. In the numerals for 7 and 8, the final elements are identical with the numerals for 2 and 3. Therefore, the numerals of the first ten retain elements of the ancient quinary counting system. In the form *kěókwi* ‘9’, the element *kwì* ‘10’ is easily detectable. The initial element can be subdivided into *-ó-* which most likely goes back to *dó* ‘one’, and *kě* which can be linked to the verb *kě* ‘tear, break’. If this etymology is correct, *kěókwi* is a subtractive numeral (10 – 1), lit. ‘break one (from) ten’.

¹³ In this book, forms for numerals are often presented with variable tones, without any explanation of what conditions this variability. We have had to choose among the variants in a more or less random way.

Table 4. Boko numerals

1 <i>dó</i>	30 <i>bàá kwì</i> (20+10)
2 <i>plá</i>	35 <i>sómà òlá ~ sóà òlá ~ sǎà òlá</i> (−5 40)
3 'ààó	36 <i>bàá kwì ñ sǎóló ò</i> ((20 + 10) + (5 + 1))
4 <i>sǐǐ</i>	37 <i>bàá kwì ñ sóplá ò</i> ((20 + 10) + (5 + 2))
5 <i>sǎó</i>	38 <i>òlá plá sǎǐ</i> ((20x2) − 2)
6 <i>sǎóló</i> (5+1)	38 <i>òlá dó sǎǐ</i> ((20x2) − 1)
7 <i>sóplá</i> (5+2)	40 <i>òlá</i> (20x2)
8 <i>swààó</i> (5+3)	45 <i>òlá sǎó</i> ((20x2) + 5)
9 <i>kéókwì</i> (−1 10)	50 <i>òlá kwì</i> (40+10)
10 <i>kwí</i>	55 <i>sómà bà ààó</i> (−5 (20x3))
11 <i>kúèdó</i> (10 + 1)	56 <i>òlá kwì ñ sǎóló ò</i> ((40+10)+(5+1))
12 <i>kúèplá</i> (10+2)	57 <i>òlá kwì ñ sóplá ò</i> ((40+10)+(5+2))
13 <i>kúè 'ààó</i> (10+3)	58 <i>bà ààó plá sǎǐ</i> ((20x3)−2)
14 <i>gǎó mǎñ dó sǎǐ</i> (15-1)	60 <i>bà ààó</i> (20x3)
15 <i>gǎó</i> ((*foot)x1)	65 <i>bà ààó sǎó</i> ((20x3)+5)
16 <i>gǎó ñ mǎñ dó-ò</i> (15+1)	70 <i>bà ààó kwì</i> ((20x3)+10)
17 <i>gǎó ñ plá ò</i> (15+2)	80 <i>bà sǐǐ</i> (20x4)
18 <i>bàó plá sǎǐ</i> ((20x1)−2)	85 <i>bà sǐǐ sǎó</i> ((20x4)+5)
19 <i>bàó dó sǎǐ</i> ((20x1)−1)	90 <i>bà sǐǐ kwì</i> ((20x4)+10)
20 <i>bàó</i> (20x1)	100 <i>bà sǎó</i> (20x5)
21 <i>bàó ñ plá ò</i> ((20x1) + 1)	105 <i>bà sǎó sǎó</i> ((20x5)+5)
23 <i>bàó ñ 'ààó ò</i> ((20x1) + 3)	120 <i>bà sǎóló</i> (20x6)
24 <i>bàásǎó dó sǎǐ</i> ((20x1) + 5)−1)	140 <i>bà sóplá</i> (20x7)
25 <i>bàásǎó</i> ((20x1) + 5)	160 <i>bà swààó</i> (20x8)
26 <i>bàásǎó ñ mǎñ dó ò</i> (((20x1) + 5) + 1 thing)	180 <i>bà kéókwì</i> (20x9)
27 <i>bàásǎó ñ plá ò</i> (((20x1) + 5) + 2)	200 'àà dó (200x1)
28 <i>bàá kwì plá sǎǐ</i> (20+10−2)	300 'àà dó ñ bà sǎó ((200x1) + (20x5))
400 'àà plá (200x2)	
500 'àà plá ñ bà sǎó ((200x1) + (20x5))	
600 'àà 'ààó (200x3)	
700 'àà 'ààó ñ bà sǎó ((200x2) + (20x5))	

- 800 'ðáà sǐíó (200x4)
 900 'ðáà sǐíó ñ bà sǒó ((200x4) + (20x5))
 501 'ðáà plá ñ bà sǒó ñ mǝñ dó ò ((200x2) + (20x5) + 1 thing)
 750 'ðáà 'àǎó ñ bà sóplá kwì ò ((200x3) + (20x7) + 10)
 188 'ðáà dó kúèplá sǎí ((200x1) – 12)
 1000 'ðáà sǒó (200x5)
 1400 'ðáà sóplá (200x7)
 2944 'ðáà gǝó dó sǎí ñ bà sóplá ñ sǐíó ò (200 x (15-1) + (20x7) + 4)
 50,000 'ðáà sǒsǒó lǝè òlá kwí ((200x5redupl. part) (40+10))

The word for '10' *kwì* can be (very tentatively) linked to the stem for 'hand'. In modern Boko, 'hand' is 'ó, and a preliminary reconstruction for this root at the Proto-Eastern level is **gǝn* (cf. Proto-Southern Mande **kə* 'hand' and forms for '10' in Dan, Goo, Tura).

There are good reasons to think that the stem *gǝó* '15' may contain an element originally meaning 'foot': although the word for 'foot/leg' in Boko is *gbá*, a tentative pre-reconstruction for Proto-Eastern Mande is **gə* or **gwə* 'foot', cf. Henning Schreiber's (2008: 323) Proto-Eastern reconstruction **gwaN* 'foot', cf. also Southern San *gòã* (Anonym 2003), Lebir *gǎm* |gàní| (Vanhoudt 1999). The final element -ó in '15' may go back to *dó* '1', i.e. the term originally meant '(two hands and) one foot', this model for '15' is not exceptional in African languages (Pozdniakov 2018: 120).

The basic term of the vigesimal system *bà-* (presumably, from *bà* 'rope, string', i.e. 'string of cowrie shells') appears in the form *bǎó* '20', where the final element -ó may go back to *dó* 'one'; in *bǎásǒó* '25' (cf. *sǒó* '5', while the etymology of the linker -ǎ- is unclear); *bǎákwì* '30' (*kwì* < *kwí* '10'; the same linker -ǎ- as in '25'); 40 *òlá* (a contractive form of **bà* '20' + *plá* '2'), and in other numerals divisible by 20.

An etymology for 'ðáà' '200' may be suggested if we compare this form with those seen in the closely related languages Bokobaru, *wàà*, and Busa, *wàà*. It cannot be confirmed that these forms are related to the forms of the type *WAA*, *WAGA* for '1000' which are wide spread in Mande languages (usually with high tones), but it can be accepted as a potential hypothesis.

For counting from 20 through 2000, the vigesimal system is applied quite consistently: 900 'ðáà sǐíó ñ bà sǒó (200x4 + 20x5).

ARITHMETIC OPERATIONS, LINKERS AND INNER MORPHOSYNTAX OF COMPOUND NUMERALS IN BOKO.

In ADDITION, there are certain limitations on the units which can serve as addends. In particular, in the first, second and third tens, '4' *sǐíó* does not appear in this function, the relevant meanings being expressed via subtraction; '6' and '7' are not used to form '16' and '17', '26' and '27', the formulae "15+1", "15+2", "(20+5)+1", "(20+5)+2"

being preferred. By contrast, these units do appear in the compound numerals above 30.

There are different means used to express addition in the formation of numerals. Juxtaposition is used for the lower compound numerals ‘6’, ‘7’, ‘8’ (the model “5+X”) and higher ones divisible by 5: ‘25’, ‘45’ (the model “20xN+5”); ‘30’, ‘50’, ‘70’, ‘90’ (the model “20xN+10”). Juxtaposition is accompanied by fusion: the stems for the augends ‘5’ (in ‘6’, ‘7’, ‘8’) and ‘10’ (in ‘11’, ‘12’, ‘13’) are modified: ‘5’ *sóó* → *só-* or *sw-*; ‘10’ *kwí* → *kúě*. In ‘6’, the addend stem is also modified: ‘1’ *dó* → *-ló*. For higher numerals, there is no fusion, however, the addend ‘10’ changes its tone: *kwí* → *kwì*.

For numerals higher than 15 and not divisible by 5 (and not formed by subtraction, see below), addition is expressed by the comitative frame construction *ǵ ... ò* ‘with’. To add 1, one must use the numerative word *měǵ*: *bà sóó ǵ mǵ dó ò* (20x5+1 unit) ‘101’.

SUBTRACTION in Boko is comparable to addition in terms of its productivity. In the second and third fives, the subtrahend is ‘1’; for higher numerals, it can be ‘1’ and ‘2’ (for all minuends divisible by 5, i.e. “5xN–1 or 2”, N > 3), or ‘5’ (for minuends divisible by 20, beginning from 40, i.e. “20xN–5”, N > 1). For the hundreds (with minuend ‘ǵǵǵ’ ‘200’ or higher), the subtrahend can range between 1 and 25.¹⁴

There are three formal means for producing subtractive numerals.

The most prevalent is the following: the subtrahend follows the minuend and is followed by the postposition *sǎǐ* ‘without’ (the subtrahend *dó* ‘1’ can be preceded by the numerative word *mǵ*):

- (3) *ǵǵó (mǵ) dó sǎǐ*
 15 unit 1 without
 ‘14’

- (4) ‘ǵǵǵ *dó kúě-plá sǎǐ*
 200 1 10-2 without
 ‘188’ = 200x1 – (10 – 2)

In order to avoid repetition of the postposition *sǎǐ* within one compound numeral (when a subtrahend itself contains a subtrahend), the following formula is used:

- (5) *ǵǵǵ dó ǵǵó dó sǎǐ mǵ kú-ó*
 200 1 15 1 without FOC here-NEG
 ‘186’ = 200x1 – (15–1)

¹⁴ Therefore, Boko violates Greenberg's 12th (1990: 279) universal: “A subtrahend is always a simple lexical expression”.

If the subtrahend is 5 (for the minuends divisible by 20, beginning from 40), a special word *sómà* ‘–5’ (with phonetic variants *sóà*, *sǒà*, *súà*, *sǔà*) is used. This word precedes the minuend: *sómà bílá* ‘35’, *sómà bà ààǒ* ‘55’.¹⁵ The etymology of this word is unclear, although one may speculate that the initial element *só-* might be related to *sǒó* ‘5’. This model may seem to violate 10th Greenberg's generalization (1990: 278–279): “Subtraction is never expressed by the mere sequence of the subtrahend and minuend”. However, this is not a clear-cut case, since *sómà* is not a regular numeral, but rather a specialized subtrahend form (i.e., it is somewhat similar to the Tarahumara case cited by Greenberg).

The third means of formation is applied to only one subtractive numeral, *kéó kwì* ‘9’, lit. ‘cut-one ten’.

MULTIPLICATION is used for higher numerals. Only two basic numerals, *bà* ‘20’ and *’ààà* ‘200’, can function as multiplicands; the multiplication is expressed by juxtaposition (the multiplier follows the multiplicand), e.g. *’ààà ’ààǒ* (200x3) ‘600’. One complex numeral (itself formed through multiplication), *’ààà sǒó* (200x5) ‘1000’, can appear as a multiplicand, in which case its second component undergoes partial reduplication, and the multiplier is preceded by the linker *léè* ‘part, group’: *’ààà sǒsǒó léè plá* (200x5redupl. part 2) ‘2000’; *’ààà sǒsǒó léè ’ààà sǒó* (200x5redupl. part 200x5) ‘100,000’.

In Boko, there are three CLASSIFIERS (numerative words) which may appear when numerals are used as quantifiers: *gbéǒǒ*, for counting humans; *mèǒǒ*, for other objects; and *gèǒǒ* ‘time’, for actions. The rules of their use and their degree of obligatoriness are not discussed by Jones (1998: 128–129).

- (6) *Má pǒ bǐǐ mèǒǒ sǐǐ pì-ǒ ’è.*
 1SG.PFV thing alive object four ART-PL see.PFV
 ‘I saw these four living things’.

2.3. Numerals in Dzuungoo

Dzuungoo (Samogo group, Western Mande) is spoken in western Burkina Faso. The numerals of this language are represented in Table 5 according to (Solomiac 2014: 152–158).

In Dzuungoo, elements of a quinary system are practically absent: the only potential survival is seen in the form *ǰèènú* ‘7’, in which the element *nún* may be etymologically connected to *nùn* ‘5’. This hypothesis, however, is contradicted by its final position in the form (everywhere else in Dzuungoo, just as in all other Mande languages, the larger addend precedes the smaller one, without any exception).

¹⁵ However, according to Ross Jones (p.c.), *sómà* is an archaic word; younger people use “30+5” for ‘35’.

Table 5. Dzuungoo numerals

1 <i>sōō, sōn</i>	23 <i>móòzhìgī</i> (20+3)
2 <i>fī</i>	28 <i>móòhàálòn</i> (20+8)
3 <i>zhìgī</i>	29 <i>móòkyèèrón</i> (20+9)
4 <i>nààlén</i>	30 <i>mòòtsyèù</i> (20+10)
5 <i>nùn</i>	31 <i>mòòtsèù kó (dzín) sóó</i> ((20+10)+1)
6 <i>tsùnēmēn</i>	32 <i>mòòtsèù kó (dzín) fī</i> ((20+10)+2)
7 <i>jèènún</i>	40 <i>dzyèè</i>
8 <i>jáálòn</i>	50 <i>dzyèètsyèù</i> (40+10)
9 <i>kyèèrón</i>	60 <i>mùéy</i>
10 <i>tsyèù</i>	70 <i>mùéy kó tsèù</i> (60+10)
11 <i>téēhsōn</i> (10+1)	80 <i>cèèn</i> (as determiner), <i>cèènsōō</i> (in counting)
12 <i>téēhfī</i> (10+2)	90 <i>cèèn kó tsyèù</i> (80+10)
13 <i>téēhzhìgī</i> (10+3)	100 <i>càànmóò</i> (80+20)
14 <i>téēhnààlén</i> (10+4)	110 <i>càànmóò kó tsyèù</i> ((80+20)+10)
15 <i>téēhnùn</i> (10+5)	120 <i>cààndzyèè</i> (80+40)
16 <i>téēhstùnēmēn</i> (10+6)	130 <i>cààndzyèè kó tsyèù</i> ((80+40)+10)
17 <i>téēhnyèènún</i> (10+7)	140 <i>cèènfīmòòyáá</i> ((80x2) – 20)
18 <i>téēhàálòn</i> (10+8)	160 <i>cèènfī</i> (80x2)
19 <i>téēhkyèèrón</i> (10+9)	180 <i>cèènfī kó mòò</i>
20 <i>mòò</i>	200 <i>cànfóōdzyèè</i> (80x2 + 40)
21 <i>móòsōn</i> (20+1)	400 <i>cèènún</i> (80x5)
22 <i>móòfī</i> (20+2)	800 <i>gúrúsōn</i> (800x1)
1000 <i>gúrúsōn kó cànfóōdzyèè</i> (800x1 + ((80x2) + 40)), or <i>wāākērēn</i> , or <i>gbáásōō</i>	
1200 <i>jēyn shē zhìgī</i> (cowrie string 3)	

BASIC NUMERALS. Apart from the numerals of the first ten, there are simple forms for the following numbers: 10 *tsyèù*, 20 *mòò*, 40 *dzyèè*, 60 *mùéí*, 80 *cèèn*, 800 *gúrúsōn*. The numeral ‘20’ *mòò* is a full homonym of the noun for ‘human being’. Therefore, while in several other Mande languages the etymological development ‘human being’ > ‘20’ (the number of fingers and toes of a human) is somewhat blurred (e.g., Bamana *mògɔ* ‘human being’ vs. *mùgan* ‘20’, Susu *mìxí* ‘human being’ vs. *mòxɔpèñ* ‘20’), in Dzuungoo it is straightforward. The forms for ‘40’ and ‘80’ may be borrowed from the Old Bamana system (*dèbe* and *kème* respectively),¹⁶ and the same origin cannot be excluded for ‘60’ (cf. Old Bamana *mànkeme*). The term for 800 *gúrúsōn* can be

¹⁶ For ‘80’ some speakers use an extended form, *bāmāā náá cèèn*, lit. ‘Senufo's 80’, which corresponds exactly to the *bámanankeme* ‘80’ of Old Bamana (the original meaning of the term *Bámàna*, *Bámbara* is ‘pagan, non-Muslim’. It is locally applied to various ethnic groups).

subdivided into *gúrí* which may be etymologically identical to forms found widely in Western Mande for 1000 (Bozo-Tigemaxo *gulu*,¹⁷ Mandinka *wílí* ~ *wíli*, Loko *wul*, etc.), and *sōn* which goes back to *sōō* ‘1’.

The numerals of the second ten contain the stem *téēŋ*-, which might be connected with the numeral 10 *tsyéù*.

The counting system from 20 through 80 is based on the heteroradical vigesimal principle, and above 80 it is taken over by an octogesimal model. The element *cààn* ~ *càn*, which regularly appears in compound numerals (100 (80+20), 110 (80+20+10), 120 (80+40), 130 (80+40+10), 200 (80x2+40) etc.), is formally distinct from the numeral *cèèn* ‘80’, but they are, without any doubt, etymologically related. In one numeral, *cèènfií* ‘160’ (80x2), the original form *cèèn* ‘80’ appears unmodified.

When counting thousands (and higher), Dzuun people cross over to a decimal system and use only the Jula loan *wāākērēn* (< *wáa kelen*), or the Dzuun calque *gbáásōō*. The expression *jēyn shē* ‘cowrie string’ is used as a base with the numeral value ‘400’ only in the compound numeral ‘1200’.

ARITHMETIC OPERATIONS, LINKERS AND INNER MORPHOSYNTAX OF COMPOUND NUMERALS IN DZUUNGOO

ADDITION. There are three formal models of addition:

a) through fusion of the summands, with one or both components undergoing modification in the great majority of cases. This model is applied to the numerals:

— from 11 through 19, which are accompanied by both segmental and suprasegmental modification of the stem ‘10’ (*tsyéù* → *téēŋ*-) and by tonal rising on the first syllable of the component for the units (*zhìigī* → *zhíigī* ‘3’, *kyèèrón* → *kyéèrón* ‘5’, etc.). The numeral ‘11’ is an exception, because the name of the unit is modified segmentally, and not tonally (*sōō* → *sōn*). Solomiac's hypothesis is that the final element -ŋ of the form *téēŋ*- may go back to the connector **kó* whose high tone may also have been retained as a floating high tone at the end of *téēŋ*;

— from 21 through 29, where the smaller addend is not modified, while the name of the larger summand (the augend) is tonally modified (*mòò* → *móò*- ‘20’). Solomiac attributes this to the omission of the connector **kó*;

¹⁷ In fact, no phonological reconstruction for Proto-Mande (or even the majority of the lower-level branches) has been carried out so far, so any etymological remarks can only be preliminary in nature. It can be said however that a semi-regular (secondary) correspondence “Bozo *g*- : Manding *w*- before back rounded vowels” can be confirmed by the following comparative series: ‘cola nut’ Bozo-Tigemaxo *goro* : Bamana *wòro*; ‘to smoke (meat, fish)’ Bozo-Tigemaxo *gusu* : Bamana *wúsu*, and some others.

— ‘100’ (80+20) and ‘120’ (80+40), where the first summand is segmentally modified (*cèèn* → *cààn*- ‘80’), and the second one raises its initial tone. In the numeral *cànfóōdzyèè* ‘200’ (80x2 + 40), the first addend, although complex, is segmentally modified (*cèèn**fíí* ‘160’ → *cànfóō*-), while the second one maintains its form.

b) Through simple juxtaposition of the summands (without any formal modification of the components), for the numerals ‘30’, ‘50’.

c) With the connector *kó* ‘and’ between the addends, the addends are not modified in form. This model is used for linking tens and units in numbers higher than 30 (31 = (20+10)+1, 32 = (20+10)+2, etc.; 110 = (80+20)+10, 130 = (80+40)+10), but also for ‘70’ (60+10) and ‘90’ (80+10) where both addends are simple. When the second (smaller) addend is a unit, it can be preceded by the word *dzín* meaning ‘unit’ (original meaning: ‘child, fruit, grain’). Addition with *kó* is also used for higher numerals, e.g.:

(7) *cànfóōdzyèè kó cèèn**fíímòòyáá kó sóó*
 80x2+40 and 80x2-20 and 1
 ‘341’ (200+141)

(8) *cèènnún kó càn**fóōdzyèè kó cèèn**fíímòòyáá kó sóó*
 80x5 and 80x2+40 and 80x2-20 and 1
 ‘741’ (400+200+141)

SUBTRACTION in compound numerals is limited in its use. In fact, the only attested case is represented by the numeral for 140 derived from 160 through subtraction (by means of the marker *yáá* ‘without’): *cèèn*-*fíí*-*mòò*-*yáá* 140 (80x2-20).

MULTIPLICATION is applied to only one base, ‘80’ (to be more precise, the data are missing for numerals above 1200) and is expressed by simple juxtaposition of the components, the multiplicand *cèèn* ‘80’ preceding the multiplier. Multiplication in Dzuungoo produces only two forms, *cèèn* *fíí* ‘160’ (without any modification of the components) and *cèènnún* ‘400’¹⁸ (the second component raises its tone). Contrary to expectations, the numerals for ‘240’, ‘320’, ‘580’ etc. are not formed by means of multiplication, but by addition, where *cèèn**fíímòòyáá* ‘200’ = 80x2+40 and *cèènnún* ‘400’ = 80x5 appear as augends (cf. examples (7), (8)), which can be interpreted as evidence for evolution toward a mixed decimal-vigesimal system.

The study of higher numerals in Dzuungoo is complicated by the fact that practically all speakers are bilingual in Jula, and most often they count in Dzuungoo up to 29 and then switch into Jula (Solomiac 2014: 152).

¹⁸ In an unpublished list of Dzuungoo numerals (courtesy of Paul Solomiac), the numeral for 400 is spelled as *cèèn nún*. In (Solomiac 2014: 155) it is spelled as one word and with a single *n*: *cèènnún*.

Besides the traditional compound numeral *gúrúsōn kó cānfóōdzýèè* (800+80x2+40) following the octogesimal model, 1000 can be designated in the modern language by the Jula loan *wāākērēn* or by the better-integrated form *gbáá (sōō)* ‘(one) thousand’. Thus, elements of a decimal model have begun to penetrate the numeral system of Dzuungoo.

EXTERNAL SYNTAX OF NUMERALS

Numerals follow the nouns they determine. In this construction, as a rule, the noun cannot carry any other determiner, and the numeral has none either. More rarely, the numeral can have a plural marker or a definite article, both of which express the same meaning of definiteness.

2.4. Numerals in Mwan

Mwan (South Mande < Southeastern Mande) is spoken by some 17,000 people in the central part of Côte d’Ivoire. The data were collected by Elena Perekhvalskaya during her fieldwork. See also (Perekhvalskaya 2017: 726–727).

Table 6. Mwan numerals

1	<i>dō</i>	11	<i>vū tā do</i> (10+1)
2	<i>plē</i>	12	<i>vū tā plē</i> (10+2)
3	<i>yāgā</i>	13	<i>vū tā yāgā</i> (10+3)
4	<i>yīzīē</i>	20	<i>mīā dō</i> (20x1)
5	<i>sóó</i>	22	<i>mīā dō bē plē</i> (20x1 + 2)
6	<i>sláádō</i> (5+1)	30	<i>mīā dō bē vū</i> (20x1 + 10)
7	<i>slááplē</i> (5+2)	35	<i>mīā dō bē vū tā sóó</i> (20x1 + 10 + 5)
8	<i>sláā</i> (5+3)	40	<i>mīā plē</i> (20x2)
9	<i>sláyīzīē</i> (5+4)	50	<i>mīā plē bē vū</i> (20x2 + 10)
10	<i>vū</i>	57	<i>mīā plē bē vū tā slááplē</i> (20x2 + 10 + (5+2))
60	<i>mīā yāgā</i> (20x3)		
70	<i>mīā yāgā bē vū</i> (20x3 + 10)		
79	<i>mīā yāgā bē vū tā sláyīzīē</i> (20x3 + 10 + 9 (= 5+4))		
100	<i>kēmè dō</i> (100x1)		
120	<i>kēmè dō mīā dō</i> (100 + 20)		
140	<i>kēmè dō ké mīā plē</i> (100x1 + 20x2)		
200	<i>kēmè plē</i> (100x2)		
248	<i>kēmè plē mīā plē bē slā</i> (100x2 + 20x2+8 (= 5+3))		
338	<i>kēmè yāgā ké mīā dō bē vū tā slā</i> (100x3 + 20x1 + 10 + 8 (= 5+3))		
565	<i>kēmè sóó mīā yāgā bē sóó</i> (100x5 + 20x3+5)		
787	<i>kēmè slááplē mīā yīzīē bē slááplē</i> (100x7 + 20x4+7 (= 5+2))		
1000	<i>wáá dō</i> (1000x1)		
2400	<i>wáá plē kēmē yīzīē</i>		

The numeral system of Mwan combines vigesimal (in the first hundred) and decimal (above 100) models. The numeral bases are *mīā* ‘20’, *kēmè* ‘100’ and *wáá* ‘1000’. Obviously, the decimal model should be regarded as predominant in Mwan, while the elements of the vigesimal model may have been borrowed from the neighbouring Guro language (cf. Table 10). It should be noted that the Mwan and Guro communities are connected by intense commercial and marital ties; Guro speakers are much more numerous, and many Mwan speak some Guro. However, since the forms of the numerals for 20 in Mwan (*mīā*) and Guro (*yō*) are not related, we can speak of borrowing of the model, but not of the forms (structural borrowing, in Haspelmath's (2009) sense).

The other augends are *sóó* ‘5’ and *vū* ‘10’, both of Proto-Mande origin. We can speculate that the Mwan word for 20, *mīā*, might be etymologically related to the word *mēē* ‘human’. *Kēmè* and *wáá* have most probably been borrowed from Manding.

ADDITION. Several models of addition are used:

— for the numerals ‘6–9’, the model is *sló-á-N*. The element *sló-* certainly stands for ‘5’ and provides evidence for the reconstruction of a word-internal consonant in this numeral, **sóló* (lost in the independent numeral *sóó* ‘5’). The second element, *-á-* goes back, most probably, to the superessive postposition *tā*. The third element is the second addend, which may be fused (*slóā* ‘8’) or not (*slóádō* ‘6’, *slóáplē* ‘7’, *slóáyīzīē* ‘9’);

— for numerals above 10, the connector for the names of tens and units is a full-fledged superessive postposition *tā*;

— for those numerals from 30 onwards divisible by 10 but not divisible by 20, the model is *mīā N bē vū* (i.e., 20 N *bē* 10, or “20 N + 10”). The connector *bē* goes back to the noun *bē* ‘grain’, this word is also used in singulative meaning (‘single object out of a mass or pair’: *ylè bē dō* ‘one eye’, *zlò bē* ‘a bee’);

— for numerals above 100, *ké* (a comitative preposition) serves to connect names of hundreds and names of tens.

MULTIPLICATION is expressed through simple juxtaposition of the multiplicand and the multiplier. The multiplicands in Mwan are *mīā* ‘20’, *kēmè* ‘100’, *wáá* ‘1000’.

No subtraction is used in the formation of compound numerals.

Money counting has the same features as in numerous other languages of West Africa: when combined with the noun *gòlí* ‘money; 5 franc coin’ (or even in its absence, when money is meant), a numeral designates a quantity multiplied by five: *gòlí kēmè dō* ‘500 francs’ (lit. ‘100 5-franc coins’); *wáá yīzīē* ‘20,000’ (lit. ‘4 thousands’).

EXTERNAL SYNTAX. Numerals follow the determined noun which appears without the plural marker (*mū*): *mēē plē* ‘two people’.

2.5. Dan-Gwɛetaa numerals

Dan-Gwɛetaa is one of the numerous varieties of Dan (Southern Mande) spoken in the west of Côte d'Ivoire. The Dan-Gwɛetaa data were collected by Valentin Vydrin during his fieldwork; also see (Vydrin 2017).

Table 7. Dan-Gwɛetaa numerals

1 <i>dō</i>	11 <i>kòdòṅ dō ɾ gā dō</i> (10x1 + 1)
2 <i>plè ~ pèèdā</i>	12 <i>kòdòṅ dō ɾ gā plè</i> (10x1 + 2)
3 <i>yààgā</i>	13 <i>kòdòṅ dō ɾ gā yààgā</i> (10x1 + 3)
4 <i>yìisĩɾ</i>	20 <i>kòdòṅ plè</i> (10x2)
5 <i>sɔ́dũ</i>	21 <i>kòdòṅ plè ɾ gā dō</i> (10x2 + 1)
6 <i>sɔ́dō</i> (5+1)	22 <i>kòdòṅ plè ɾ gā plè ~ pèèdā</i> (10x2 + 2)
7 <i>sɔ́plè</i> (5+2)	30 <i>kòdòṅ yààgā</i> (10x3)
8 <i>sáàgā</i> (5+3)	40 <i>kòdòṅ yìisĩɾ</i> (10x4)
9 <i>súèsĩɾ</i> (5+4)	90 <i>kòdòṅ súèsĩɾ</i> (10x9)
10 <i>kòdòṅ dō</i> (10x1)	100 <i>kāl̩ dō</i> (100x1)
102 <i>kāl̩ dō wāà plè</i> (100x1 and 2)	
111 <i>kāl̩ dō wāà kòdòṅ dō wāà dō</i> (100x1 and 10x1 and 1) ~ <i>kāl̩ dō ɾ kò dō wāà dō</i> (100x1 its hand x1 and 1)	
200 <i>kāl̩ plè</i> (100x2)	
1000 <i>gblú dō</i> (1000x1)	
2000 <i>gblú plè</i> (1000x2)	
2222 <i>gblú plè wāà kāl̩ plè ɾ kò plè wāà ɾ gā plè</i> (1000x2 and 100x2 its hand x2 and its bone x2)	
10,000 <i>gblú kòdòṅ dō</i> (1000x10x1)	
100,000 <i>gblú kāl̩ dō</i> (1000x100x1)	
1,000,000 <i>gblú ɓěě dō</i>	

In Dan-Gwɛetaa, a quinary model appears in the numerals from 6 through 9, although it is obscured by fusion: comparison with other South Mande languages allows us to reconstruct the model “5-*tà*-1/2/3/4 (*tà* is a superessive postposition, ‘on, upon’), but ‘5’ has contracted into one featural foot with the postposition in all the forms. For numerals above 10, the model is consistently decimal. The word for tens, *kòṅ* ~ *kòdòṅ*, is etymologically related to the noun *kò* ‘hand / two hands’. The word for ‘hundred’, *kāl̩*, is a noun, most probably a Manding loan (cf. above for the discussion concerning the word *kème* in Bamana). The word *gblú* ‘1000’ is also a noun; its

original meaning is ‘basket’ (for cola nuts),¹⁹ cf. above on the etymology of the word *wáa* ‘1000’ used for money counting in Bamana.

ADDITION manifests itself through several models:

— for the numerals 6 through 9, the model is reconstructible as *5 *tā* X, where X = 1 through 4 (see above);

— for numerals above 10 and indivisible by 10, the model is: “N_x10 *ṛ* *gā* N”; *ṛ* *gā* means literally ‘its bone’ (*ṛ* is a singular reflexive pronoun, while *gā* is a polysemous noun whose basic meaning is ‘bone’ or ‘grain’, but also ‘unit’, cf. (Erman 2005));

— for numerals above 100, the previous model (construction with the singular reflexive pronoun) competes with the regular coordinative construction expressed by the coordinative personal pronoun *wāā* (on coordinative pronouns in Eastern Dan, see (Vydrin 2010)); for more detail see (Vydrin 2017: 487–488). In the construction with the reflexive pronoun, the word for ‘10’ is *kḏ* ‘hand / pair of hands’, rather than *kḏḏḏ* (the latter is certainly derived from *kḏ*, although it is unclear what element it has fused with).

MULTIPLICATION is expressed through simple juxtaposition of the multiplicand and the multiplier. The multiplicands in Dan-Gwɛetaa are *kḏḏḏ* ‘10’, *kāl̄* ‘100’, *gblūū* ‘1000’, *gblūū* *ḡḡḡ* ‘1,000,000’.

Subtraction and division are absent from the Dan-Gwɛetaa numeral system.

EXTERNAL SYNTAX. The basic syntax of the numerative construction is the same as elsewhere in the Mande family: the numeral follows the noun, and, most often, the plural marker *dū* is absent: *sààgā* *sḏḏḏ* ‘5 arrows’. However, this marker can appear after the noun or after the numeral, and in both cases it expresses restrictive meaning: *ḡḡ sḏḏḏ-dū* = *ḡḡ-dū sḏḏḏ* ‘exactly 5 persons’.

In complex numerals, the count noun is repeated after each component (9a), with the exception of those cases where the reflexive pronoun is used as connector (9b)

(9a) *tḏ* *kāl̄* *dō* *wāā* *tḏ* *kḏḏḏ* *dō* *wāā* *tḏ* *dō*
 chicken 100 1 they.and chicken 10 1 they.and chicken 1

or

(9b) *tḏ* *kāl̄* *dō* *ṛ* *kḏ* *dō* *ṛ* *gā* *dō*
 chicken 100 1 REFL.SG hand one REFL.SG bone one
 ‘111 chickens’

¹⁹ In fact, *gblūū* in Dan may be etymologically related to the root WULU ~ WULI ~ GULU attested in many Mande languages for ‘1000’. The historical development **gúlú* > **g^wlú* > **gblū* > **gblūū* would be quite normal and typical for Dan.

There are several COUNTING WORDS in Dan-Gwɛetaa which diverge in their degrees of grammaticalization (all can also be used as regular nouns). The most advanced in this direction (although still not quite obligatory in their use) are:

gā ‘single object out of a mass/group’ (original meaning: ‘bone, grain, drop’). This word has further grammaticalized as a connector in compound numerals, see above;

ḡē ‘oblong object’ (original meaning: ‘fruit’);

dǎ ‘living being’ (original meaning: ‘child’).

Even less grammaticalized in the function of classifiers or measure words are the following nouns: *kp̄r̄* ‘ball’ (for spherical objects), *gèè* ‘(dead) body’ (for carcasses of animals), *b̄r̄r̄* ‘bunch, bundle’ (for carcasses of animals), *yǎ* ‘eye’ (for the content of receptacles).

2.6. San-Maka numerals

San-Maka (Eastern Mande < Southeastern Mande) is spoken by some 230,000 people in the province of Nayala in Burkina Faso (Berthelette 2001). The data were collected by Elena Perekhvalskaya during her fieldwork; additional data are drawn from (Paré 1999). The tilde ~ separates off phonetic variants.

Table 8. San-Maka numerals

1	<i>gōōḡ</i>	20	<i>fòó</i>
2	<i>páā</i>	21	<i>fòó ḡ gōōḡ</i> (20 + 1)
3	<i>sōō</i>	25	<i>fòó ḡ sōō</i> (20 + 5)
4	<i>síí</i>	30	<i>fù-sōō ~ pù-sōō</i> (10x3)
5	<i>sóró</i>	33	<i>fù-sōō ká sōō</i> (10x3+3)
6	<i>sōrō</i>	35	<i>fù-sōō ká sóró</i> (10x3 + 5)
7	<i>sōbāā</i>	37	<i>fù-sōō ká sōbāā</i> (10x3 + 7 (5+2))
8	<i>kíwísí</i>	40	<i>fù-síí ~ pù-síí</i> (10x4)
9	<i>mānāgòrō</i>	50	<i>fù-sóró ~ pò-sóró</i> (10x5)
10	<i>fù</i>	57	<i>fù-sóró ká sōbāā</i> (10x5 + 7 (5+2))
11	<i>fù lù gōōḡ</i> (10+1)	60	<i>fù-sōrō ~ pò sōō</i> (10x6)
12	<i>fù lù páā</i> (10+2)	70	<i>fù-bō-mā-lé</i> (-10)
13	<i>fù lù sōō</i> (10+3)	80	<i>pāābīē ~ bīē</i>
90	<i>pāābīē ká fù</i> (80+10)		
100	<i>pāābīē ká fòó, bīē fòó</i> (80 + 20)		
150	<i>pāābīē ká fù-bō-mā-lé, bīē fù-bō-mā-lé</i> (80 + 70 (-10))		
151	<i>pāābīē ká fù-bō-mā-lé, bīē fù-bō-mā-lé ká gōōḡ</i> (80 + 70 (-10) + 1)		
160	<i>bīē-páā</i> (80x2)		
800	<i>dúú gōōḡ</i> (800x1)		
64,000	<i>dúú-pāābīē</i> (800x80)		

576,000	<i>dúú-bīē mānāgòrō</i> (800x720 (80x9))
639,279	<i>dúú-bīē-mānāgòrō ká fùbōmālé ká mānāgòrō</i> (800x799 {720 (80x9) + 79 [(80-10) + 9]}).
1,000,000	<i>mílínóóné góōh</i>
1,000,000,000	<i>mílíáárè góōh</i>

A quinary system in San-Maka is no longer evident, but traces of it can be found. Interpretation of the term for 7 *sōbāā* as 5+2 is rather straightforward: the element *-bāā* goes back to *pāā* ‘two’ (consonant voicing in word-internal position is common in Mande languages, and the tonal modification HM > MM can be explained by the phonetic integration of the components of the former compound), and the initial element, *sō-* goes back to ‘5’, *sóro*²⁰. *Sōrō* ‘6’ is most likely a compound ‘5+1’ by origin, where the initial element *sō-* is the same as in ‘7’, and the final *-rō* goes back to Proto-Mande **dō*. Therefore, the form *gōōh* ‘1’ in San-Maka should be regarded as an innovation, i.e., the situation is very similar to that of *wóro* ‘6’ in Manding; cf. a similar suggestion (although presented without details) in (Pozdniakov 2018: 219).

The form for ‘8’, *kíwísí* (in other San varieties *cígísí*, *kígísí*, *tīgísí* (Berthelette 2001: 62)) is opaque; it is certainly neither ‘5+3’, nor ‘10-2’. The only plausible interpretation along these lines would be ‘4x2’ (cf. *síí* ‘4’), otherwise it should be regarded as a non-derived word of unknown origin.

The numeral for ‘9’, *mānāgòrō*, is most probably ‘10 – 1’ in origin, in which case the element *-gòrō* can be interpreted as an archaic form of ‘1’, and the initial element *mānā-* is opaque (at least at the current stage of our knowledge of San-Maka).

There is a special (non-compound) word for ‘20’ which seems to be the only relic of a vigesimal system; it does not appear in numerals divisible by 20. To the contrary, two other base numerals, 80 and 800, are relevant. The numeral for 80 *pāā bīē* ‘bundle of cowries’²¹ is the fundamental base of the octogesimal model. The term *dúú* ‘800’ is a noun, rather than a numeral; it is obligatorily accompanied by a numeral (*dúú gōōh* ‘800’ = 800x1).

The peculiarity of the San-Maka system is a complete lack of 100 and 1000 count bases.

In ADDITION, the following strategies are used.

a) in the formation of the numerals 6 and 7, we can postulate addition without a connector (a fact obscured by fusion);

²⁰ It is true that in San-Maka, ‘3’, *sōō*, may look like a better candidate, however, this similarity is likely superficial, since the model ‘5+2’ is very typical of Mande languages, while ‘3+2 = 7’ makes no sense.

²¹ Frequently used in compound numerals in an abridged form, *bīē* ‘bundle’, in which case the subsequent coordinative conjunction *ká* is omitted.

- b) with the linker *lù*, in the formation of the numerals 11-19: *fù lù s̄s̄* ‘13’ (10 + 3);
- c) with the linker *ŋ* (a possessive marker), for the numerals 21-29: *fòó ŋ s̄s̄* ‘23’ (20 + 3); *fòó ŋ kíwísí* ‘28’ (20 + 8);
- d) with the linker *ká* (a comitative marker) for the addition:
 - of units to tens in numerals bigger than 30: *fù-s̄s̄ ká sórō* ‘35’ (10x3 + 5); *fù-sórō ká s̄bāā* ‘57’ (10x5 + 7 (5+2));
 - of the tens to 80: *pāā-bīē ká fù-b̄-mā-lé* ‘150’ (80+[80-10]).

MULTIPLICATION is expressed by juxtaposition. The multiplicands are 10, 80 and 800. The multipliers with 10 are limited to 3 through 6. With 80, multipliers 2-9 are used. With 800, the multiplier can be any number from 1 to 799: *dúú fù-síí* ‘32000’ (800x40); *dúú-bīē-mānāgòr̄ ká fùb̄māl̄ ká mānāgòr̄* ‘639200’ (800x799 {720 (80x9) + 79 [(80-10) + 9]}).

SUBTRACTION in San-Maka is used in the formation of the numeral ‘70’, *fù-b̄-mā-lé* (lit. “ten take.away-me-on”), i.e. ‘minus ten’: in this construction the numeral *pāā bīē* ‘80’ is not named, but implied.

COUNTING WORDS. In San-Maka there is one counting word, *māŋ* ‘thing’, for all types of counted objects. It is used with every numeral except for *gōōŋ* ‘one’. Moïse Paré considers this classifier to be optional (Paré 1999: 81), but in Elena Perekhvalskaya's field data it appears consistently, except in the context of nouns denoting people: *nēl̄ páá* ‘two daughters’, but *cōŋ māŋ páá* ‘two houses’. The counting word also appear when numerals are used in predicative function:

- (10) *Māā cōŋ n̄ māŋ s̄s̄.*
 1SG-POSS house IPF thing three
 ‘I have three houses (my houses are three)’.

EXTERNAL SYNTAX. Numerals follow the determined noun which appears without the plural marker *ŋ/-n̄*, see examples above.

2.7. Soninke numerals

Soninke is a Western Mande language spoken by more than 2 millions people in Mali, Senegal and Mauritania, but also in the Gambia and Burkina Faso. Soninke was the dominant language of the first great empire of Western Sudan, Ghana (or Wagadu), and exerted a tangible influence on the languages of the region. Soninke differs considerably from other Mande languages in many respects, this divergence is particularly visible in terms of the morphology and syntax of the numeral system. Our analysis of Soninke numerals is based primarily on (Creissels & Urmanchieva 2017: 261–262), but also on (Diagana 1995: 150–159) and (Diagana 1994: 249–274). When the sources provide different forms (which may be due to dialectal divergence), we give the forms from (Creissels & Urmanchieva 2017).

Table 9. Soninke numerals

1	<i>báané</i>	30	<i>tánjikké</i>
2	<i>hílló</i>	40	<i>tánnáxaté</i>
3	<i>sikkó</i>	50	<i>tánkárágé</i>
4	<i>nàxàtó</i>	60	<i>tándúmé</i>
5	<i>kàràgó</i>	70	<i>tánpéré</i>
6	<i>tùnmú</i>	80	<i>táncégé</i>
7	<i>jérú</i>	90	<i>tánkábé</i>
8	<i>ségú</i>	100	<i>kámé</i>
9	<i>kàbú</i>	200	<i>kámó hilli</i>
10	<i>tánmú</i>	1000	<i>wújìné</i>
11	<i>tánmú dò báané</i>	6000	<i>wújùnú tùnmì</i>
20	<i>tánpíllé</i>	1,000,000	<i>míliyò</i>

The Soninke numeral system is strictly decimal. As in Dzuungoo (and in contrast to the majority of Mande languages), there are no traces of the quinary model even in the first ten: ‘6’ *tùnmú* and ‘7’ *jérú* seem to be simple stems, both having good cognates in Bozo languages (Bozo-Tigemaxo (Anonyme 1982): ‘6’ *tuumi*, ‘7’ *jyenì*) and in the Samogho group (Dzuungoo (Solomiac 2014): ‘6’ *tsùnmēn*, ‘7’ *jèènúnn*). ‘8’ *ségú* has good cognates in Bozo, but also in the Manding and Mokole groups. ‘9’ *kàbú* is a common innovation in the Soninke-Bozo group (cf. Bozo-Tigemaxo *kaawi*, in other Bozo varieties *kafi*, *kapi*) with unclear etymology.²²

Arithmetic operations in the Soninke numeral system are trivial. ADDITION is used to combine numerals of different orders. It is always marked by the standard coordinative/ comitative preposition/conjunction *‘dó*. MULTIPLICATION is applied to the bases *tánmú/tán-* ‘10’, *kámé/kámó* ‘100’, *wújìné/wújùnú* ‘1000’ and *míliyò* ‘1,000,000’; the forms *tán-*, *kámó*, *wújùnú* appear in compounds formed through multiplication (*kámó* and *wújùnú* are, in fact, regular plural forms of *kámé* and *wújùné*). In compound numerals with the multiplicand *tán* ‘10’, most multipliers appear in modified forms: they have high tone (whatever the tone of the original form may be), and the initial consonant undergoes alternation (in Soninke there is a regular alternation of initial consonants after the nasal element: $N + s \rightarrow nc$, $N + h \rightarrow np$, etc.

²² It cannot be excluded altogether that *kàbú* ‘9’ is a subtractive numeral in origin, in which case the element *-bu/-bi* (in Bozo, *-wi*, *-fi*, *-pi*) could be traced back to the archaic Mande root **pu* ‘10’. It can be suggested (rather speculatively, as it is hard to prove or disprove) that the final element *-mú* in the numeral ‘10’ *tánmú* goes back to the the same archaic stem **pu*.

However, consonant alternations in the names of tens are sometimes in disagreement with the general rule.). Ex. (Creissels & Urmanchieva 2017: 262):

- (11) *wújùnú tùmì dó kàmó hillì dó tán-jíkké dò tùmú*
 1000 6 and 100.pl 2 and 10-3 and 6
 ‘6236’

MORPHOLOGY and EXTERNAL SYNTAX.²³ There are three different strategies for combining numerals with the nouns they determine:

— *báané* ‘1’ behaves as an adjective: it follows the determined noun which appears in its non-autonomous form, and the numeral assumes HL tone: *yítte* ‘tree’ + *báané* ‘1’ → *yítí báané* ‘one tree’;

— numerals from 2 through 10 follow the determined noun, they assume a low tone, and their final vowel is replaced by *-i*. The determined noun appears in its plural form: *yàxàré* ‘woman’ (sg.), *yàxàrú* ‘women’ (pl.), *jérú* ‘7’ → *yàxàrú jèrì* ‘seven women’;

— numerals from 20 and above, very atypically for Mande languages, precede the determined noun which appears in its singular form and assumes a tonal contour typical of the head noun in a genitival construction (LH): *yúgúxàsè* ‘elderly man’ (sg.), *yúgúxàsò* ‘elderly men’ (pl.), *tánpíllé* ‘20’ → *tánpíllé yùgùxàsé* ‘twenty elderly men’. One could interpret such constructions as genitive, where the numeral appears as a dependent noun; in this case, the literal translation would be something like “a score of elderly men”. However, this interpretation is contradicted by the syntax of compound numerals which combines the first and the second strategies above: the part for the tens (hundreds, thousands...) precedes the noun (which appears in plural form, if not followed by ‘1’), and the part for the units follows it, while the preposition/conjunction *dó* ‘and’ is placed between the higher numeral and the count noun.

- (12) *wújùnè dó kàmó sègì dó tóngú jèrì*
 1000 and 100.pl 8 and hoe.PL 7
 ‘1807 hoes’ (Diagana 1995: 157)

3. A general survey of numeral systems in Mande family

Table 10 displays the main characteristics of the numeral systems of 30 Mande languages (including the 8 languages analyzed above whose names are in bold) representing all 11 groups of the family. The total number of languages in the Mande family is between 60 and 70 (the definitive figure depends on decisions on the status of closely related varieties), so, in our sample, about half of the Mande languages are

²³ Only the main features of the morphosyntax of Soninke numerals are analyzed, some peripheral ones have been left aside.

represented. There are good reasons to think that the languages remaining outside our sample might not display characteristics radically different from those included in our survey; in other words, we consider our survey to be quite representative.

Table 10 is followed by concise comments on any interesting points of the numeral systems of those languages not analyzed above.

General comments on Table 10.

The column “Numerals ‘5+N’” is relevant only for languages with elements of quinary (even if marginal and/or synchronically obscure). In this column, numerals formed through addition with the augend ‘5’ are presented.

In the column “Multiplicands”, all the numerals able to appear as multiplicands are provided, and the column “Augends” lists all the simple numerals or stems²⁴ which can function as augends. If a numeral can be used in both functions, it is presented in both columns (e.g., 10 *tâŋ* in Mandinka). If a multiplicand or an augend is a bound morpheme, it is given with a dash (e.g., 5 *sũã-* in Kla-Dan which appears in compound numerals *sũãàdò* ‘6’ = ‘5+1’, *sũãâplë* ‘7’ = ‘5+2’, etc.).

Multiplicands displaying nominal, rather than numeral, properties²⁵ are followed by the label “Nom”, and those with numeral properties prevailing have the label “Num”. The absence of a label means that the required information is lacking. This distinction is not relevant for lexemes/stems (such as *bî* ‘10’ in modern Bamana or *gô* ‘10’ in Goo) which can have only ‘2’ or more as multiplier; such forms are provided with the label “Irr”.

In the column “Connectors”, connective elements are provided, with their literal meanings or etymologies and comments on their spheres of use. By default, the connectors are used in addition constructions; in the exceptional case of a multiplicative connector, this fact is specially mentioned.

²⁴ For example, in Mano ‘12’ is *vù dōó wélé pèèlē* (10 1 grain 2). Therefore, *vù* cannot be used as an augend without being accompanied by a numeral for units (the multiplier), and it is therefore not mentioned in the column “Augends”.

²⁵ We take as the standard test the ability or inability of a lexeme to express its basic meaning without being accompanied by the numeral ‘1’. So, in modern Bamana one may say *mìsi kème* ‘100 cows’, but to say ‘1000 cows’ the numeral *kélen* ‘1’ must be added (*mìsi bà kélen*). Therefore, *kème* ‘100’ is a numeral and *bà* ‘1000’ is a noun.

Another test is the possibility of forming an ordinal numeral on the basis of the lexeme in question. So, in modern Bamana, one can say *mògò kème-nan* <human 100-ORD> ‘100th person’, but for 1000 no ordinal is directly available, only *mògò bà kélen-nan* <human 1000 one-ORD> ‘1000th person’. However, ordinal numerals lie beyond the scope of this paper, and we cannot apply this test systematically (in fact, for many languages in our sample this information is not available); therefore, it was not taken into account.

Table 10. Summary table

Language	Simple numerals (<10)	Numerals '5+N'	Multiplicands	Augends	Subtrahends & division	Connectors
Bamana (old system)	1 <i>kélen</i> 2 <i>fila</i> 3 <i>sàba</i> 4 <i>náani</i> 5 <i>dúuru</i> 8 <i>séegin</i> 9 <i>kònwòntòn</i>	6 <i>wóɔrɔ</i> 7 <i>wóronwila</i>	80 <i>kème</i> Num 800 <i>bà</i> Nom	5 <i>wó-</i> 10 <i>tán</i> Num 20 <i>mùgan</i> Num 40 <i>dèbe</i> Num 60 <i>mànkème</i> Num 80 <i>kème</i> Num 100 <i>silameyakème</i>	Sbtr.: 1, 2, 10, 20 Division: 5 <i>dlá</i> (5 = 10/2)	<i>ni</i> 'and'
Bamana (modern system)	1 <i>kélen</i> 2 <i>fila</i> 3 <i>sàba</i> 4 <i>náani</i> 5 <i>dúuru</i> 8 <i>séegin</i> 9 <i>kònwòntòn</i>	6 <i>wóɔrɔ</i> 7 <i>wóronwila</i>	10 <i>bî</i> Irr 100 <i>kème</i> Num 1000 <i>bà</i> Nom 1000 <i>wáa</i> Nom (for money) 1000000 <i>míliyɔn</i> Nom	5 <i>wó-</i> 10 <i>tán</i> Num 20 <i>mùgan</i> Num 100 <i>kème</i> Num	—	<i>ni</i> 'and'
Mandinka (Creissels & Sambou 2013)	1 <i>kílin</i> 2 <i>fúlá</i> 3 <i>sàbá</i> 4 <i>náani</i> 5 <i>líulu</i> 8 <i>sáyí</i> 9 <i>kònóntó</i>	6 <i>wóoró</i> 7 <i>wórowùlá</i>	10 <i>tâŋ</i> Num 100 <i>kémé</i> Num ~ Nom 1000 <i>wúlí</i> ~ <i>wílí</i> Nom 1000000 <i>míliyón</i> Nom	5 <i>wó-</i> 10 <i>tâŋ</i> Num 20 <i>mùwáŋ</i> Num 100 <i>kémé</i> Num ~ Nom	—	<i>níŋ</i> 'and'
Kakabe (Vydrina 2017)	1 <i>kélen`</i> 2 <i>fila</i> 3 <i>sàba</i> 4 <i>náani</i> 5 <i>lɔ́lu</i> 8 <i>ságin</i> 9 <i>kònwòntɔ`</i>	6 <i>wóɔrɔ</i> 7 <i>wóɔwila</i>	10 <i>bíí`</i> Irr 100 <i>kème</i> Num 1000 <i>wáa</i> Nom 1000000 <i>míliyɔn</i> Nom	5 <i>wó-</i> 10 <i>tán`</i> Num 20 <i>mùgan</i> Num 100 <i>kème</i> Num	—	<i>nín</i> 'and'

Language	Simple numerals (<10)	Numerals '5+N'	Multiplicands	Augends	Subtrahends & division	Connectors
Vai (Welmers 1976)	1 <i>lòndó</i> 2 <i>fè'á</i> 3 <i>sàkpá</i> 4 <i>náánì</i> 5 <i>sóó'ù</i>	6 <i>sòṅ lòndó</i> , 7 <i>sòṅ fè'á</i> , 8 <i>sòṅ sàkpá</i> , 9 <i>sòṅ náánì</i>	20 <i>mò (bándé)</i> (‘entire person’) Num 100 <i>hóndô</i> Nom 1000 <i>táúsùṅ</i> Nom?	5 <i>sòṅ</i> Num 10 <i>táṅ</i> Num 20 <i>mò (bándé)</i> (‘entire person’) Num	—	ø (< 20), <i>àkó</i> ‘after it’ (> 20)
Jogo-Ton (Sapozhnikova 2017)	1 <i>dīē</i> 2 <i>fálá</i> 3 <i>sègbā</i> 4 <i>nāānì</i> 5 <i>sōolò</i>	6 <i>māar'ó</i> 7 <i>màalā</i> 8 <i>màsègbá</i> 9 <i>mànānī</i>	20 <i>kēlē</i> Irr 100 <i>kēmē</i> Num 1000 <i>wúlú</i> Nom	5 <i>mà-</i> 10 <i>tán, táá</i> Num 20 <i>kēlē</i> Num 100 <i>kēmē</i> Num	— Division: 50 <i>kēmē tárá</i> (50 = 100/2)	<i>tó</i> ‘and’
Jogo-Ligbi (Persson & Persson 1976; Persson & Persson 2007)	1 <i>díén</i> 2 <i>fàlà</i> 3 <i>sigbá</i> 4 <i>nāani</i> 5 <i>sóoló</i>	6 <i>mòódó</i> , 7 <i>màúlà</i> , 8 <i>màsègbá</i> , 9 <i>màdáané</i>	20 <i>cělē</i> 100 <i>cēmē</i> 1000 <i>wúlú</i>	5 <i>mà- ~ mò-</i> 10 <i>tààn</i> 15 <i>tígán</i> 20 <i>kēlē</i> Num 30 <i>túdó ~ tírró</i> 100 <i>cēmē</i>	— Division: 50 <i>címé tàdá</i> , <i>kyémé tàrá</i> (50 = 100/2)	<i>tó</i> ‘and’
Jalkunan (Heath 2017)	1 <i>dúli</i> 2 <i>flā</i> 3 <i>sigbō</i> 4 <i>nāānī</i> 5 <i>sóoló</i>	6 <i>mī-īlō</i> 7 <i>mà-álā</i> 8 <i>mà-sigbō</i> 9 <i>má-nānī</i>	20 <i>jáā'</i> Irr 1000 <i>wà?à</i> Nom, <i>búúli</i> Nom	5 <i>mī- ~ ma-</i> 10 <i>táá/tàà</i> Num 20 <i>jálámà</i> Num	—	<i>rá</i> (11-19) <i>í</i> (N20 + 10) <i>tú</i> (N10 + units, > 20)
Susu (Shluinsky 2017; Touré 1994)	1 <i>kérén</i> 2 <i>fírín</i> 3 <i>sàxán</i> 4 <i>náání</i> 5 <i>súúlí</i>	6 <i>sénní</i> (?) 7 <i>sólófèrè</i> 8 <i>sólómásàxán</i> 9 <i>sólómánáaní</i>	10 <i>tòngó</i> Irr 100 <i>kēmē</i> Num 1000 <i>wúlù</i> Nom	5 <i>sóló-</i> 10 <i>fúú</i> Num 20 <i>mòxṅèñ</i> Num 100 <i>kēmē</i> Num	—	<i>nùn</i> ‘and’
Kpelle (Konoshenko 2017)	1 <i>tááj, tòno ~ tànóḡ</i> 2 <i>hwèèlě ~ hwèèlé</i>	6 <i>mèidà</i> 7 <i>mèihwéélě</i> 8 <i>mèiháábà</i> 9 <i>mèìnááj</i>	10 <i>pòŭ</i> Num 100 <i>ḡwúḡ</i> Nom 1000 <i>wáá</i> Nom	5 <i>mèi</i> Num 10 <i>pòŭ</i> Num	—	<i>kóú</i> ‘bone, grain, unit’ for Nx10+N, Nx100+Nx10

Language	Simple numerals (<10)	Numerals '5+N'	Multiplicands	Augends	Subtrahends & division	Connectors
	3 <i>hààbă</i> ~ <i>hààbá</i> 4 <i>nááj</i> 5 <i>lólí</i>					ø for Nx1000 + Nx100
Looma (Mishchenko 2017; Mishchenko p.c)	1 <i>gílà(g)</i> 2 <i>félé(g)</i> 3 <i>sáwà(g)</i> 4 <i>nááni(g)</i> 5 <i>dóólù(g)</i>	(6 <i>dòzità</i>) 7 <i>dófèlà</i> 8 <i>dósáwà</i>	10 <i>pù(g)</i> Irr 100 <i>ú(g)</i> Nom 1000 <i>wà(g)</i> Nom 1000000 <i>wùlù(g)</i> Nom	5 <i>dO-</i> 10 <i>pùgò</i> Num	9 <i>tàwù(g)</i> (*'1-10')	<i>mázú</i> 'on, upon' for Nx10+N, ø for all upper orders
Loko (Vydrin & Morozova 2017)	1 <i>ngèrá(η)</i> , <i>ngílá(η)</i> 2 <i>fèlè(η)</i> , <i>fèè(η)</i> 3 <i>cáwá(η)</i> , <i>sáwá(η)</i> 4 <i>náái(η)</i> , <i>nái(η)</i> 5 <i>ndó(η)</i> , <i>ndóú(η)</i>	6 <i>ngóhita(η)</i> 7 <i>ngòfèlà(η)</i> 8 <i>ngòsákpá(η)</i>	10 <i>pubu</i> Irr 100 <i>kemε</i> Nom 1000 <i>wul</i> Nom	5 <i>ngɔ-</i> 10 <i>pùù(η)</i> Num	9 <i>ká-rábúú(η)</i> , <i>raabu(η)</i> (*'1-10')	<i>mañu</i> 'on, above'
Bozo-Tigemaxo (Blecke 1996; Blecke p.c.)	1 <i>sana</i> ; <i>kɔ</i> ~ <i>kuɔ</i> ~ <i>kuɔ</i> in compounds 2 <i>fende</i> ~ <i>pende</i> 3 <i>sio</i> ~ <i>siyo</i> 4 <i>nara</i> 5 <i>kɔlɔ</i> 6 <i>tuumi</i> 7 <i>jeeni</i> 8 <i>seki</i> 9 <i>kiewi</i> ~ <i>kiawi</i>	—	10 <i>tã</i> (20=10x2, 30=10x3) Num 100 <i>kemε</i> Num 1000 <i>gulu</i> Nom	10 <i>tã</i> Num 40 <i>lewε</i> Num 60 <i>menikemε</i> 80 <i>kienima</i> ~ <i>bambarakierima</i> 100 <i>silambekierima</i>	70 = 80-10 <i>kienima tã kē</i>	<i>yee</i> 'and'
Soninke (Creissels & Urmanchieva 2017)	1 <i>báané</i> 2 <i>hílló</i> 3 <i>sikkó</i> 4 <i>nàxàtó</i>	—	10 <i>tán-</i> Irr 100 <i>kàmé</i> Num 1000 <i>wújìné</i> Num	10 <i>tánmú</i> Num 100 <i>kàmé</i> Num 1000 <i>wújìné</i> Num	? 10 <i>kàbú</i> (*'1-10')	` <i>dó</i> 'and'

Language	Simple numerals (<10)	Numerals '5+N'	Multiplicands	Augends	Subtrahends & division	Connectors
	5 <i>kàràgó</i> 6 <i>tùnmú</i> 7 <i>ǰérú</i> 8 <i>ségú</i> 9 <i>kàbú</i>					
Dzuungoo (Solomiac 2014)	1 <i>sōō</i> , <i>sōn</i> 2 <i>fíí</i> 3 <i>zhìigī</i> 4 <i>nààlén</i> 5 <i>nùn</i> 6 <i>tsùnmmēn</i> 7 <i>ǰèènún</i> 8 <i>ǰáálòn</i> 9 <i>kyèèrón</i>	—	80 <i>cèèn</i> Nom	10 <i>tsyéù/téēŋ</i> Num 20 <i>mòò/móò</i> Num 40 <i>dzyèè</i> Num 60 <i>mùéy</i> Num 80 <i>cààn</i> Num 800 <i>gúrú-sōn</i> Num	140 = 80x2-20 <i>cèènǰíímòòyáá</i>	ø (11-30, 50, 100, 120) <i>kó</i> 'and' (>30)
Seenku (Prost 1971)	1 <i>sòèn</i> 2 <i>fíí</i> 3 <i>sùèè</i> 4 <i>nàà</i> 5 <i>nò</i> 6 <i>tsiìn</i> 7 <i>nyèèn</i> 8 <i>kàà</i> 9 <i>kòomèn</i>	—	20 <i>tégé</i> Irr 200 <i>bí</i> Irr (2000 <i>dan</i>)	10 <i>tó</i> Num 20 <i>fúé</i> Num	—	<i>nè</i> 'with' (20xN + 10), <i>wéè</i> (special postposition for numerals, 10xN+unit)
Jowulu (Carlson 1993; Prost 1958)	1 <i>tèèñ</i> 2 <i>fúúli</i> 3 <i>byài</i> (Prost <i>dyue</i>) 4 <i>píírèi</i> 5 <i>táá</i> 10 <i>byí</i>	6 <i>táámànì</i> (Prost <i>tonte</i>)	20 <i>yàà</i> Irr 1000 <i>wáá</i> Nom	5 <i>táá</i> (5 + 1 = 6) 10 <i>bù</i> Num 20 <i>kòñ</i> Num	7 <i>ǰòò-póni</i> (-3) 8 <i>fúl-póni</i> (-2) 9 <i>tèè-póni</i> (-1)	<i>nì</i> 'plus' (11-19) <i>fá</i> 'add' (20xN + N)

Language	Simple numerals (<10)	Numerals '5+N'	Multiplicands	Augends	Subtrahends & division	Connectors
Bobo (le Bris & Prost 1981)	1 <i>tèlè, tàlá</i> 2 <i>pālā</i> 3 <i>sàà</i> 4 <i>nàà</i> 5 <i>kòò</i>	6 <i>kònālā</i> , 7 <i>kòpārā</i> , 8 <i>kòròsòòn</i> , 9 <i>kòrònòòn</i>	20 <i>kiē</i> Irr 100 <i>zò, zòò</i> Irr 1000 <i>sānā</i>	5 <i>kò-</i> ~ <i>kòrò-</i> 10 <i>fūn</i> Num 20 <i>kiòrò</i> Num 100 <i>zòlò</i> Num 1000 <i>sànōn</i>	—	∅ for 11-19, 20xN + 10, 100xN + 10 <i>nē nōmā</i> 'with child' for the others
Beng (Paperno & Maloletnyaya 2017)	1 <i>dō</i> 2 <i>plāṅ</i> 3 <i>ṅāṅ</i> 4 <i>siéṅ</i> 5 <i>sóṅ</i>	6 <i>sódō</i> 7 <i>sóplā</i> 8 <i>sówà</i> 9 <i>sīsí</i>	10 <i>bū</i> Num 100 <i>làà</i> Nom 1000 <i>kéṅ</i> Nom	5 <i>só-</i> 10 <i>bū</i> Num	—	<i>àsíṅ</i> for units <i>nā ... lō</i> 'and' for upper orders
Gban (Fedotov 2017)	1 <i>dó</i> 2 <i>fěí</i> 3 <i>yāà</i> 4 <i>ziě</i> 5 <i>súú</i>	6 <i>sédò</i> , 7 <i>séfěí</i> , 8 <i>sěāà</i> , 9 <i>tíziě</i>	10 <i>vũ</i> Num 100 <i>lú</i> Nom 1000 <i>wlú</i> Nom 10,000 <i>kpě</i> Nom 1,000,000 <i>mlíó</i> Nom	5 <i>sě-</i> 10 <i>vũ</i> Num	—	<i>ěkpāà</i> 'it is on it' or <i>wlí</i> 'bone, fruit' for units ∅ for upper orders
Guro (Kuznetsova 2008; Kuznetsova & Kuznetsova 2017)	1 <i>dū</i> 2 <i>fíé</i> 3 <i>yāá, yāáká</i> 4 <i>zìé ~ zìyé, zìèkě</i> 5 <i>sólú</i>	6 <i>sūēdū ~ sūēlū</i> 7 <i>sūlàyíé</i> 8 <i>sūlāá</i> 9 <i>sūlāzìé</i>	20 <i>yō</i> Nom 200 <i>wúlù</i> Nom 2000 <i>bàà</i> Nom	5 <i>sū-</i> 10 <i>vū</i> Num	—	<i>lā ~ tā</i> 'on, above', for 6-9, 11-19 <i>wólé</i> 'bone' for 20-29 <i>é tā lē</i> 'on its...' after <i>bàà</i> or <i>wúlù</i>
Yaure (Kushnir 2017; Kushnir p.c.)	1 <i>tù</i> 2 <i>fíílí ~ fílí</i> 3 <i>yààgá</i> 4 <i>sìjìé</i> 5 <i>sóólú</i>	6 <i>šéédù</i> 7 <i>šálàvílí</i> 8 <i>šálàà</i> 9 <i>šálàsìé</i>	10 <i>fù</i> Num 100 <i>yāà</i> Nom 1000 <i>kpí</i> Nom	5 <i>šá-</i> 10 <i>fù</i> Num (20 <i>yō</i> Nom)	—	<i>lā</i> 'on' for 7-9 (also 6?) <i>tá</i> 'on' for 11-19 <i>wéjé</i> 'bone' for 21-99 ∅ for '100xN + 10xN' and for '1000xN + 100xN' <i>pá</i> multiplier for 30-90

Language	Simple numerals (<10)	Numerals '5+N'	Multiplicands	Augends	Subtrahends & division	Connectors
Mwan (Perekhval'skaya 2017)	1 <i>dō</i> 2 <i>plē</i> 3 <i>yāgā</i> 4 <i>yiziē</i> 5 <i>sóó</i>	6 <i>slúádō</i> 7 <i>slúáplē</i> 8 <i>slóā</i> 9 <i>slúáyiziē</i>	20 <i>mīā</i> Nom 100 <i>kēmè</i> Nom 1000 <i>wáá</i> Nom	5 <i>slú-</i> 10 <i>vū</i> Num	—	- <i>á-</i> for 5-9 <i>tā</i> 'on' for 11-19 <i>bē</i> 'grain' for '20N+10', '20N+N' <i>ké</i> 'with' for '100xN + 10xN' ø for higher orders
Dan-Gwɛɛtaa (Vydrin 2017)	1 <i>dō</i> 2 <i>plē ~ pèèdā</i> 3 <i>yāāgā</i> 4 <i>yīisīr</i> 5 <i>sóóǎǎ</i>	6 <i>sóódō</i> 7 <i>sóóplē</i> 8 <i>sāāgā</i> 9 <i>sūēsīr</i>	10 <i>kūāñ/kōñ</i> Nom/ <i>kō</i> 100 <i>kāñ</i> Nom 1000 <i>gblú</i> Nom 1,000,000 <i>gblú bēē</i> Nom	5 <i>sO-</i>	—	* <i>tā</i> 'on' for 6-9 <i>r gā</i> 'its grain/unit' for 11-99 <i>wāā</i> 'and' >100
Kla-Dan (Makeeva 2017)	1 <i>dō</i> 2 <i>plē ~ pèèdā</i> 3 <i>yāāgā</i> 4 <i>yīisiè</i> 5 <i>sóóǎǎ</i>	6 <i>sūāādō</i> 7 <i>sūāāplē</i> 8 <i>sūāā</i> 9 <i>sūāāyīisiè</i>	10 <i>kūāñ/kōñ</i> Nom 100 <i>kāñ</i> Nom 1000 <i>wāā</i> Nom	5 <i>sūā-</i>	—	- <i>ā-</i> < * <i>tā</i> 'on' for 6-9 (<i>ā</i>) <i>gā</i> '(its)grain/unit' > 10
Mano (Khachaturyan 2017)	1 <i>dōó</i> 2 <i>pèèlē</i> 3 <i>yāākā</i> 4 <i>yīisē</i> 5 <i>sóóǎǎ</i>	6 <i>sáládō</i> 7 <i>sálápèèlē</i> 8 <i>sálákā</i> , <i>sáláyīikā</i> 9 <i>sélésè</i> , <i>sélēisè</i>	10 <i>vū</i> Nom 100 <i>ḡwū</i> Nom 1000 <i>wáá</i> Nom	5 <i>sá-</i>	—	- <i>lá-</i> for 6-9 <i>wélé</i> 'bone, grain' for '10xN + 1xN' <i>lā</i> 'on' for '100xN + 10xN', '1000xN + 100xN'
Tura (Idiatov 2005; Idiatov & Aplonova 2017)	1 <i>dó</i> 2 <i>pīǎǎ</i> 3 <i>yākā</i> 4 <i>yīsé</i> 5 <i>súǎǎ, sóóǎǎ</i>	6 <i>sāādó</i> , 7 <i>sāāpīǎǎ</i> , 8 <i>sāākā</i> , 9 <i>sōisē</i>	10 <i>kūā</i> Irr (< 100), <i>kōǎ</i> (> 100) 100 <i>kāǎ</i> Nom 1000 <i>wāā</i> Nom	5 <i>sāā-/sǎ-</i> 10 <i>bùù</i> Num	—	<i>nǎ wēē</i> 'and grain' for '10xN + 1xN' <i>nǎ</i> for upper orders

Language	Simple numerals (<10)	Numerals '5+N'	Multiplicands	Augends	Subtrahends & division	Connectors
Goo (Aplonova & Vydrin 2017)	1 <i>dó</i> / <i>dóó</i> 2 <i>pě̀l̩</i> / <i>pě̀l̩̀</i> 3 <i>yààká</i> / <i>yààkà</i> 4 <i>yìsá</i> / <i>yìsà</i> 5 <i>sóólú</i> / <i>sóólǔ</i>	6 <i>sǎ́ládó</i> / <i>sǎ́ládò</i> 7 <i>sǎ́lápě̀l̩</i> / <i>sǎ́lápě̀l̩̀</i> 8 <i>sǎ́lǎàká</i> / <i>sǎ́lǎàkà</i> 9 <i>sě̀sá</i>	10 <i>gó</i> Irr 10 <i>kòò</i> Nom (in compounds '100N+10N') 100 <i>kě̀ĩ</i> Irr 1000 <i>gbí́l̩</i> Nom	5 <i>sǎ́-</i> (10 <i>gòò</i> Nom) 100 <i>kě̀ĩl̩</i> Num	—	- <i>lǎ-</i> for 6-9 <i>wě̀</i> 'grain' for '10xN+1xN' <i>wǎà pò</i> ~ <i>wǎà pòó</i> 'and thing' for '100xN+1xN'
Wan (Nikitina 2017; Nikitina ms.)	1 <i>dō</i> 2 <i>pīlōŋ</i> 3 <i>ǎ́</i> 4 <i>sīyá</i> 5 <i>sǒǒlǔ</i> 6 <i>wǎǎŋ</i> 7 <i>síǎǎ</i> 8 <i>sényǎ</i>	9 <i>sǒlǎsīyá</i>	(3 <i>ǎ́</i>) (4 <i>sīyá</i>) (5 <i>sǒǒlǔ</i>) 20 <i>mīŋ</i> Nom 100 <i>cēmē</i> , <i>kēmē</i> Nom 1000 <i>wǎǎ</i>	(4 <i>sīyá</i>) (5 <i>sǒǒlǔ</i>) 10 <i>sóŋyǒlǔ</i> Num	—	<i>tā</i> 'on' for 11-19 <i>ōŋ</i> 'each other' for '20xN+10'
Boko (Jones 1998)	1 <i>dó</i> 2 <i>plá</i> 3 <i>'ààó</i> 4 <i>sīíŋ</i> 5 <i>sǒó</i>	6 <i>sóòlǒ</i> 7 <i>sóòplá</i> 8 <i>sóààó</i>	20 <i>bā</i> Nom 200 <i>ǎǎ</i> Nom	10 <i>kwì/kúè-</i> 15 <i>gě̀ó</i> 25 <i>bǎásǒó</i>	1, 2, 5; up to 25	∅ for '6-8', '20xN+5', '20xN+10' <i>ĩ</i> ... <i>ò</i> 'with' for >15 (not divisible by 5)
San-Maka (Paré 1999)	1 <i>gōōŋ</i> 2 <i>pāā</i> 3 <i>sōō</i> 4 <i>síí</i> 5 <i>sórō</i> 8 <i>kíwísí</i> 9 <i>mānāgòrō</i>	6 <i>sōrō</i> 7 <i>sōbāā</i>	10 <i>fū</i> Num 80 <i>pāābīē</i> , <i>bīē</i> Num 800 <i>dúú</i> Num	5 <i>sō-</i> 10 <i>fū</i> Num 20 <i>fōó</i> Num 80 <i>pāābīē</i> Num	70 (80-10) <i>fū-bō-mā-lé</i>	∅ for '6, 7' <i>lū</i> for '11-19' <i>ĩ</i> for '21-29' <i>ká</i> for '10xN+1xN' (>30), '80xN + 10xN'

Comments on individual languages (not analyzed specially in section 2).

3.1. MANDINKA: Unlike in other Manding varieties, in compound numerals from 30 to 90 divisible by 10, it is the regular form *tâŋ* that is used, rather than **bî*.

In a numerative construction (noun + numeral), a numeral can have the plural marker *-lu*, always preceded by the definite article *-o*, to express definiteness. The same meaning can be expressed by the article *-o* without the plural marker (Creissels & Sambou 2013: 221–22).

3.2. VAI: The numeral system, as represented in (Welmers 1976: 67–73), is very transparent. The forms for ‘6–9’ are made by simple juxtaposition of numerals (although ‘5’ appears in an abridged form, *sôŋ* instead of *sóó’ù*). ‘20’ *mò bándé* (lit. ‘entire person’) is a combination of two separate words, rather than one compound word, and in numerals divisible by 20, the multiplier is inserted between *mò* and *bándé*, e.g.: ‘40’ *mǎ fê’á bándé*, ‘80’ *mǎ nááni bándé*.

Beginning from 100, the system is decimal; the numerals for 100 and 1000 are English loans.

3.3. JOGO-TON: The autonomous form for ‘20’, *kēlḕmò*, could be etymologised as a compound whose initial element, *kēlḕ*, might go back to the widespread Western Mande form **kélén* ‘1’ (while in modern Jogo ‘1’ is *dīē*), and *mò* is a shortened form of the word *mògò* ~ *mògò* ‘human being’. I.e., *kēlḕmò* could originally mean ‘one human being’, which would be very much in line with the general tendency in the Mande family, and the multiplicand form *kēlḕ* could be regarded as a result of subsequent truncation. There are however some weak points in this etymology: taking into account the regular syntax of numerals, one would expect to find the elements in the inverse order (along the lines of **mò-kēlḕ*).

As in Old Bamana, Jogo uses division: ‘50’ is designated as *kēmḗ tárá*, lit. ‘half (*tárá*) of a hundred’.

3.4. JOGO-LIGBI: The numeral *tígán* ‘15’ probably contains an archaic stem **kan* or **gan* ‘foot, leg’ (cf. 2.2 for a discussion of the etymology of ‘15’ in Boko). However, in modern Ligbi the word for ‘foot, leg’ is *kpɔ́*, and the same form is attested in all the other languages of the group (Jogo, Jeri, Jalkuna). Therefore, if *tígán* is a relatively recent Jogo-Ligbi innovation, the element *-gán* is difficult to interpret as ‘foot’. According to (Persson & Persson 2007), there is a special word for ‘30’ (*túdó* or *túró*), which may be an element of a heterogeneous quindecimal system (30 = 15x2).

What was said about the etymology of ‘20’ in Jogo-Ton can also be applied to the Jogo-Ligbi forms *kèlémó* / *cě̀lè*.

3.5. JALKUNAN: The tones borne by numerals undergo significant modifications depending on the context. Space constraints prevent us from presenting these modifications here; for the details see (Heath 2017: 90–95).

The forms for ‘20’, *jálámà* / *jáǎ́*, may go back to a proto-form similar to those in Jogo and Ligbi (**kélé-mə*), although the sonorization of the initial consonant (**k-* > **c-* > *j-*) is yet to be explained. The irregular form for ‘20’ *jén* appearing in the numeral ‘30’, *jén-tàà*, may display the original vowel of the form ‘20’.

One of the terms for ‘1000’, *wàʔà*, seems to be a Manding borrowing. The other, *búúli*, also means ‘finger’ (Heath 2017: 94), and may be a remnant of the extended bodypart count.

The connectors *rá* and *í* are most probably allomorphs of one and the same morpheme (Heath, p.c.), which may be identical to the article-like noun suffix in Jalkunan which has the same forms.

3.6. SUSU: The form *tòngó* used as the base for the names of tens is homonymous with the verb *tòngó* ‘take’ (Touré 1994: 166), which can presumably be explained through particularities of Susu finger counting.

The form for ‘20’, *məxǝnɛ́*, looks very much like the word for ‘human being’ in Manding and other languages of the Great Manding macro-group (Mokole, Vai-Kono, Jogo-Jeri); in Susu the corresponding word may be etymologically related too, but it has different vocalization: *mìxí* ‘person’. A borrowing from Manding or Mokole cannot be excluded.

3.7. KPILLE (GUINEAN VARIETY): *ɲwúŋ* ‘100’ probably goes back to *ɲwùŋ* ‘head’, although the tonal difference between these forms is yet to be explained.

The use of the connector *kóú* is not limited to units. For higher orders, addition is expressed by juxtaposition; optionally, the counted noun can be repeated before each order. When counting years, the postposition *púlû* ‘after, behind’ can be optionally inserted between the thousands and the hundreds (Konoshenko, p.c.):

- (13) *gòlǎŋ ɲwáá tónó 'púlû ɲùŋ mɛ̀nǎáŋ kóú pòú mɛ̀nǎáŋ kóú lóólí*
 year 1000 1 after 100 9 grain 10 9 grain 5
 ‘the year 1995’

3.8. LOOMA (GUINEAN VARIETY): In the form *dòzità* ‘6’, *dò-* goes back to *dóólù(g)* ‘5’, while the element *-zità* may contain the archaic stem for ‘1’, *-ta*, cf. *tá* ‘certain, some’ (cf. also Kpille *tááŋ* ‘one’). The element *-zì-* may be etymologically related to the inessive postposition that appears in different Looma dialects in the forms *sù/zù* and *sì/zì*.

Just as in Guinean Kpelle, *ú(g)* ‘hundred’ is similar to *ù(g)* ‘head’; the Kpelle and the Looma forms are undoubtedly identical etymologically (Looma tones are regularly the inverse of the tones found in Kpelle). In all likelihood, this word for ‘100’ can be explained as reflecting an extended body-part system (unfortunately, we have no information on the ways in which body parts are used for counting among different Mande peoples).

In Guinean Looma, both stems for ‘1000’ found widely across the Western Mande languages, *wà(g)* and *wùlù(g)*, do appear; however, the latter has been reinterpreted as ‘1,000,000’.

There is one (at least etymologically) subtractive numeral: 9 *tàwù(g)*, where *-wù(g)* < *pù(g)* ‘10’, and the initial element *tà-* may go back to the word *tá* ‘certain, some’ (cf. Kpelle *tááj* ‘one’). If this etymology is correct, this form violates Greenberg's (1990: 278) 10th generalization: “Subtraction is never expressed by the mere sequence of the subtrahend and the minuend”.

3.9. LOKO: In the form *ngóhita(η)* ‘5’, the element *-hita(η)* can be interpreted in the same way as *-zità* in Looma (Loko *h* : Looma *z* is a regular correspondence), while *ngó-* is an archaic stem for ‘5’ used in compounds.

There are special forms for two numerals used in counting: *kárábúú(η)* ‘9’ and *képù(η)*, *kápùù* ‘10’. The etymology of the element *ká-/ké-* is not clear.

The reduplicated form *pubu* that appears in compound numerals divisible by ten (*pubu fee* ‘20’, *pubu naai* ‘40’, etc.) is certainly the plural form of *pùu(η)* ‘10’; in Loko reduplication is a regular means of plural formation.

There is one numeral which is subtractive by origin, 9 *rábúú(η)*. It seems to be composed according to the same model as *tàwù(g)* ‘9’ in Looma.

3.10. BOZO-TEGEMAXO: Oddly, ‘20’ is *tã fende* ‘10x2’ and ‘30’ is *tã sio* ‘10x3’, while the other numbers divisible by 20 are designated by special words, and ‘50’ = ‘40 + 10’ (*lewe ye tã*), ‘90’ = ‘80 + 10’ (*kienima ye tã*). This fragment of the counting system, most probably, is borrowed from Old Bamana (or, alternatively, one could speculate that ‘40’ was borrowed by Old Bamana from Bozo). There is only one subtractive numeral, $70 = 80 - 10$ *kienima tã kē* lit. “80 ten lack”.

3.11. SEENKU: The word for ‘20’ used as an augend, *fũě*, could be a loan from the Eastern Mande languages, cf. San-Maka *fôó*. The origin of the multiplicand for ‘20’, *tégé*, is not quite clear; an ancient borrowing from Senufo or Teen (Gur family) cannot be excluded (cf. footnote 10). ‘200’ is expressed by a compound *tégé tő* ‘20x10’, and the base *bĩ* ‘200’ is used only in multiplication, beginning from 400 (*bĩ fĩ* ‘200x2’). *dan* ‘2000’

looks like a numeral base; however, it is not used as such, because for higher numeral Seenku speakers usually switch into Jula.

The numerals follow the determined nouns, which appear in their plural form (with the exception of those preceded by the numeral ‘1’). In compound numerals, the determined noun is repeated before the component belonging to each order.

3.12. JOWULU: Quinary counting is represented only by the form *táámàni* ‘6’ where the initial element is certainly *táá* ‘5’, but the final element is unclear. In (Prost 1958) we find the form *tonte* ‘6’ whose final element seems to be more transparent and can be traced back to the numeral ‘one’, *tèèni* (Carlson 1993), *tèna* (Prost 1958).

One would expect a numeral base ‘200’, but in (Carlson 1993) numerals between 100 and 1000 are missing. The form *yàà* ‘20’ used in compounds (‘40’, ‘60’, ‘100’, etc.) means ‘rope’ (evidently it goes back to the name for a bunch of cowrie shells). The subtractive numerals are *jòò-póni* ‘7’, *fúl-póni* ‘8’ and *tèè-póni* ‘9’, see discussion of these forms in (Pozdniakov 2018: 224).

3.13. BOBO: Despite the existence of a numeral base for 100 *zòlō*²⁶ whose abridged variant also appears in higher numerals divisible by 100 (200 *zò pālā*, 300 *zòò sàà*, 400 *zòò nàà*, etc.), numerals above 100 are formed according to the vigesimal principle: 120 *kìē kònālā* (20x6), 180 *kìē kòrònòòn* (20x9), etc.

The numeral ‘1’ is *tèlè* when counting, and *tàlá* when it determines a noun.

3.14. BENG: In the numerals 6 through 9, compounding is accompanied by a loss of nasalization, cf.

‘2’ *plāṅ* vs. ‘7’ *sóplā*,

‘3’ *ṅāṅ* vs. ‘8’ *sówā*,

‘4’ *síéḡ* vs. ‘9’ *sīsí*,²⁷

and also ‘5’ *sóḡ* vs. ‘6’ *sódō*.

However, an alternative interpretation is also possible: in most other South Mande languages, numerals 2 through 5 have no nasal elements. It is probable that the Beng numerals for 6 through 9 have retained the original forms of the root, while numerals 2 through 5 have undergone nasalization.

²⁶ Le Bris et Prost (1981: 39) mention that the root *zòlō*, pl. *zòò* is “proper to South Mande languages” (in fact, they mean Eastern Mande), and they compare it with Bisa *zol / zo* ‘100’. However, Bisa seems to be the only South-Eastern Mande language where this root is attested.

²⁷ The vowel *i* in the first syllable of the numeral ‘9’ can be explained by a regressive assimilation, **sɔ́-síé > sīsí*.

Besides *sɔwà* (which is used as a simple form), there is an alternative form for ‘8’, *kēṇēsíéḡ*, which appears in compound numerals (e.g. *bū kēṇēsíéḡ* ‘80’, *kēṇēsíéḡ-kēṇēsíéḡ* ‘eight by eight, in eights’, a distributive meaning). Evidently, the final element of this form, *síéḡ*, stems from *síéḡ* ‘4’, and *kēṇēsíéḡ* might be a multiplicative form, 4x2. However, the etymology of the initial element, *kēṇē-*, remains obscure.

The form *èbū* ‘10’ appears in counting, otherwise, the shorter form *bū* is used.

Numerals for the second and the third tens display an optional tendency towards fusion: *būwlāḡ ~ būplāḡ* ‘20’, *būāḡ ~ būṇāḡ* ‘30’.

An alternative form for ‘1000’ is attested, *là bū* (100x10); it is used in the “forest dialect” of Beng.

3.15. GBAN: The numerals 6 through 8 have an initial element *sě-* which probably results from a merger of the numeral ‘5’ *súú* with an undetermined locative postposition. The irregular consonant *t-* in the numeral *tízìě* ‘9’ can probably be explained through regressive consonantal dissimilation (accompanied by a regressive assimilation of the vowel): **sě-zìě > títìě*.

In complex numerals ending in ‘10’, the numeral ‘10’ appears in the “heavy” form *vùcè*, e.g.: *lú dò vùcè* ‘110’. The meaning and etymology of the element *cè* is unclear (it is perhaps a multiplier ‘1’).

According to Maxim Fedotov (2017: 917), the word for ‘100’ may go back to *lú* ‘mouth’; if so, this may be another manifestation of extended bodypart counting.

3.16. GURO: The numerals 3 and 4 have “heavy” forms, *yāáká ~ yāāká* and *zìèkè*, used in isolation or in the final position of compound numerals, which seem to express an emotional evaluation of the quantity: “as many as 3 (4)” (Kuznetsova 2008: 413). Comparison with other Southern and Eastern Mande languages suggests that the “heavy” form for ‘3’, *yāáká*, may be the original one (in which case *yāá* should be regarded as a shortened form), but for *zìèkè* ‘4’ this is less probable (cf. however the Eastern Mande forms from the Boko-Busa cluster: Boko *sííḡ*, Bokobaru *síígḡ*).

Wúlù ‘200’ seems to be a Manding loan. The semantic shift for *wúlù* (1000 > 200) may be explained either in terms of the discrepancy between the Jula decimal model and the Guro vigesimal model (i.e., its status as a numeral base has been maintained, but with a change to its numerical value), or through a confusion between money count (where the basic unit is 5 Fr) and object count; cf. (Zepp 1983: 149–150) on similar cases of confusion between 200 and 1000 in different languages of Côte d’Ivoire. *Bàà* ‘2000’ is homonymous with the word for a basket made of palm leaves (supposedly used in earlier times for

carrying cola nuts). *Yō* ‘20’ might go back to *yō* ‘oil palm’, although it is not quite clear which components of the oil palm were counted.

Noun precedes numeral. In compound numerals, the noun can be repeated before each order (in which case the connective element *é tã lē* can be omitted), although it is rarely repeated before the number for the lowest order (units).

The plural marker *lū* is most often absent from the numerative, however, it can be present following either the noun or the numeral. It marks focus.

3.17. YAURE: This language is the closest relative of Guro, so the forms and meanings of the numerals up to 20 are very similar to those found in Guro. The divergence concerns the numeral system after 20: it is consistently vigesimal in Guro and consequently decimal in Yaure. The word for ‘1000’ *kpì* (in other sources, *kpì*) is of unknown origin (cf. however *kpě* ‘10,000’ in Gban which could be cognate with *kpì*).

Yaure seems to be the only Mande language to make use of a connector (*pá*, most probably from the verb *pá* ‘take’) marking multiplication for tens: *fù pá yààgá* ‘30’, *fù pá šálàsìè* ‘90’. In the higher orders, multiplication is expressed by simple juxtaposition: *yàà fíílí* ‘200’, *kpì fíílí* ‘2000’.

The plural marker *lū* can appear after the noun or after the numeral; it may also be absent.

3.18. KLA-DAN: The Kla-Dan system is very close to that of Dan-Gwɛɛtaa, there is only one tangible divergence which concerns the word for 1000, *wáá*, borrowed in Kla-Dan from Manding. At the same time, the word *gblú* (whose cognate yielded the term for ‘1000’ in Dan-Gwɛɛtaa) exists in Kla-Dan with the meaning of ‘temporary bag made of a palm leaf’.

3.19. MANO: In the numerals ‘6-8’, the *a*-vocalization of initial syllables indicates the presence of a postposition (most probably, *là* ‘on’) as a connector between two simple numeral stems. In ‘9’, the change **a > ε* is due to regressive assimilation.

The numeral *ɣwū* ‘100’ is homonymous with the noun for ‘head’ and may stem from an extended body-part counting system. Cf. above for Looma and Kpelle where words for ‘100’ and ‘head’ are quasi-homonymous and differ tonally.²⁸

²⁸ The formal similarity of the words for ‘head’ in Mano, a South Mande language, and Kpelle-Looma, South-Western Mande languages, is not fortuitous and is not due to borrowing: in both groups, the forms for ‘head’ go back to the same Proto-Mande stem. However, the etymological link between *ɣwū* ‘100’ and *ɣwū* ‘head’ seems not to be perceived by speakers of Mano (Maria Khachaturyan, p.c.).

3.20. TURA: There are three forms for ‘10’: *bùù* is used as an augend in the numerals from 10 through 19; *kúà* is a multiplicand ‘10’ in the numerals from 20 through 90; *kòò* is a multiplicand ‘10’ in compound numerals above 100. Both *kúà* and *kòò* go back, undoubtedly, to the noun *kòò* ‘hand, pair of hands’. The compound numeral for ‘100’ is *kàí òò* instead of the expected *kàí dó*. *Òò* is, to use Idiatov's (2005: 54) term, a “specified noun” meaning generally ‘the other (of two)’.

3.21. GOO: Numerals 1 to 8 have different forms when used in the attributive construction (in Table 10 they are given before the slash), and in counting (after the slash). ‘10’ also has two forms: *gòòdó* in the attributive construction, *gòòdò* in counting (this fact can be regarded as an argument for an interpretation of these forms as monolexemic in synchrony, rather than as a combination of two lexemes ‘10’ and ‘1’).

As in Tura, here we observe two different stems for ‘10’ in the numerals divisible by ten: those which do not exceed 100 (10 *gòòdó*, 30 *gò yààká*, etc.), and those which exceed 100 (110 *kèìñfì kòò dó*, etc.). This distribution between two stems for ‘10’ might be more complex (and is yet to be verified in more detail); cf. example (14) where the form *gò* appears in a context where one would expect *kòò*. *Gòò/gò* is probably etymologically related to *gòò* ‘cola nut’²⁹ (one could speculate that it originally designated a small package of cola), and *kòò* goes back to the noun *kòò* ‘hand, pair of hands’.

One would expect the word for ‘1000’ *gbíí* to stem from the noun for ‘cola basket’ (as in Dan-Gweetaa), however the name for ‘cola basket’ in Goo has a different form, *gbli* ~ *gbì* (although its lexical tone is yet to be verified). One cannot exclude the possibility that *gbíí* ‘1000’ in Goo has been borrowed from Dan.

In compound numerals, the counted noun is repeated before each order, except for the units, where the numerative word *wéé* ‘bone, grain’ appears instead:

- (14) *kwèè gbíí dó kwèè kèìñ sèèsÁ kwèè gò sèèsÁ wéé sáládó*
 year 1000 1 year 100 9 year 10 9 bone 6
 ‘the year 1996’

3.22. WAN: Forms for the numerals ‘6–10’ display strategies which are very unusual for Mande languages. Only *sólásíyá* ‘9’ is formed according to the pan-Mande quinary

²⁹ Related forms are attested in Dan-Blo (a western Ivoirian dialect of Dan) where ‘10’ in compound numerals is expressed by a form *gɔ̀ɔ̀* whose etymology is not clear, although a link with the word *gɔ̀* ‘cola’ cannot be excluded.

model “5+4” (*sɔ̌ɔ̌lɔ̌*³⁰ ‘5’ + *siiyá* ‘4’, with a connector postposition in-between, probably **tā* ‘on’).

The pair numerals (6, 8, 10) seem to be archaic plurals (or duals) formed through suffixation or infixation of a nasal syllabic (probably accompanied by an undetermined vowel; in any case, this derivation is accompanied by irregular modifications of the stems):

- ‘3’ *ā̌* — ‘6’ *wāāñ*,
 ‘4’ *siiyá* — ‘8’ *sényā̌*,
 ‘5’ *sɔ̌ɔ̌lɔ̌* — ‘10’ *sónyɔ̌lɔ̌*.

Infixation is an extremely untypical procedure in Mande, although transfixation as a marker of superintensive form of adjectives is attested in Dan-Gwæetaa (Vydrine 2007:84ff). If this infixation were present in only one pair of numerals (especially in the pair ‘3 — 6’ where infixation is not evident, because of the monosyllabic character of the numeral ‘3’), it would be appropriate to discard it as a fortuitous resemblance; however, its appearance in three pairs of numerals makes the assumption of a fortuitous resemblance rather improbable.

Finally, *sīāā̌* ‘7’ looks like a combination of ‘4’, *siiyá*, and ‘3’, *ā̌*. The model “7 = 4+3” is not only exceptional in Mande, but is also rare in Niger-Congo as a whole (Pozdniakov 2018: 282).

To sum up, the counting system of Wan for the second five looks (etymologically) as follows:

6=3x2; 7=4+3; 8=4x2; 9=5+4; 10=5x2.

The even numerals are formed through multiplication by two, and the odd numerals through addition of the largest possible items. Although very unusual for the Mande family, this system is not exceptional among the languages of the world. In fact, it is close to Type II of Seidenberg’s “Neo-2” system (Hurford 1987: 250–251; Hanke 2010: 71–72), with the sole difference that the even numerals are derived by multiplication by two (expressed though infixation), rather than reduplication.

The term for ‘20’, *mlīñ*, can be compared with *mlītī* ‘people’ ((Nikitina ms.); cf. *mī* ‘human being’); as in many other Mande languages, it may stem from the noun for ‘human being’.

³⁰ The “upper ring” symbol is used by Tatiana Nikitina for the “neutral high” tone, an underlying toneme whose superficial realization (high, mid or low) depends on contextual rules, see (Nikitina 2017: 1036; Nikitina 2018).

4. Major characteristic features of Mande numeral systems

4.1. Classification of numerical systems into types

If we proceed from the principle formulated in 1.3 (“the multiplicand of the lower order, i.e., the radix, defines the type of the numerical system”), the following numerical systems exist in the Mande family:

- decimal (Modern Bamana, Mandinka, Kakabe, Susu, Kpelle, Soninke, Beng, Gban, Yaure, Dan-Gwɛɛtaa, Kla-Dan, Mano, Tura, Goo),
- pure vigesimal (Seenku, Jalkunan, Jowulu, Guro, Boko),
- mixed decimal and vigesimal (Vai, Jogo, Ligbi, Bozo-Tigemaxo, Bobo, Mwan, Wan),
- octogesimal (Old Bamana, Dzuungoo),
- mixed decimal and octogesimal (San-Maka).

By “mixed decimal and vigesimal”, we mean systems where “the numbers up to 99 are expressed vigesimally, but the system then shifts to being decimal for the expression of the hundreds, so that one ends up with expressions of the type $x100 + y20 + z$ ” (Comrie 2005). In the mixed decimal and octogesimal system of San-Maka, counting is decimal up to 79, and then switches to octogesimal ($x80 + y10 + z$).

The Bozo-Tigemaxo system is peculiar: it is decimal up to 39 and from 100 on, but it is “heteroradical vigesimal” in the intermediate span ($x + 10 + y$, where x is divisible by 20). The same “heteroradical vigesimal” component is also present in both octogesimal systems (Old Bamana, Dzuungoo).

Vigesimal models (pure or mixed with decimal ones) do not predominate in Mande, but they are well represented; they are characteristic of more than a third of the languages in our sample. It is interesting that vigesimal models are dispersed over diverse genetic groups and are not concentrated in one or two closely related ones. At the same time, nearly all Mande languages where vigesimal systems are attested (with the exception of Vai) are in close contact with Kru, Gur and/or Senufo languages (or such contact can be supposed at an earlier stage). This serves a crucial point in favor of the argument that the vigesimal model in Mande is contact-induced.

The octogesimal models represented in the Old Bamana system, in Dzuungoo and in San-Maka seem to be an areal innovation, perhaps resulting from the evolution of a vigesimal system during the development of inter-African commerce (the word for ‘80’ may be traced back either to the term for a package of cola, or to a string of cowrie shells).

On the other hand, the substratum influence of the Senufo languages (where octogesimal systems are also present) is highly probable.³¹

In two languages, Jogo-Ligbi and Boko, elements of a pentadecimal system (built on base 15) have been identified: the word for 15 is not compound (at least in synchrony), it appears as an augend for the numerals from 16 through 19, and in Boko it also acts as a diminuend for 14. Pentadecimal systems are very rare in the languages of the world.

4.2. Elements of the quinary model and other models within the first ten

No Mande numerical system is quinary in the strictest sense, given that a numeral for ‘5’ does not serve as a multiplicand in any language. However, it is very frequent as an augend, and there are reasons to think that this situation can be reconstructed at the Proto-Mande level. Quinary models never extended beyond the first ten, and in many languages the quinary eventually faded away altogether: original components have often fused and lost their distinctiveness, and some numerals from 6 through 9 have lost their quinary nature. Remnants of this model are found in 25 out of 30 systems of our sample, and are missing only in Dzuungoo, Seenku, Bozo-Tegemaxo and Soninke (Wan, with its idiosyncratic model for the numerals of the second five, stands apart).

Exceptional in Mande are the remnants of models with multiplicand 4: the form for ‘8’ used in compound numerals in Beng, *kēñēsíéñ*, presumably ‘4x2’ by origin, see 3.14; ‘8’ in San-Maka, *kíwísí*, probably also ‘4x2’ by origin, see 2.6; the Wan form for ‘8’, and also for ‘6’ and ‘10’, see 3.22. However, these remnants of “Neo-2” structures are not so rare in Niger-Congo; in particular, this model (mainly for $4 \times 2 = 8$) is attested in some Gur languages (Natorio, Wara, Viemo, some Grusi languages), in numerous Adamawa languages, in Ijo, in the Ka-Togo and Na-Togo groups of the Kwa family, etc. (Pozdniakov 2018: 282–288), in Ekoi (Bantoid) (Hanke 2010: 71).

Beng and Wan are Southern Mande languages which stand apart from the rest of the group; according to glottochronological analysis, their separation from the Proto-Southern Mande languages took place some 23-25 centuries ago, and the separation of San from its closest relative Bisa lies within the same temporal range (Vydrin 2009). The presence of non-quinary models in these languages might be interpreted as evidence for the lack of stability of count systems, even within the first ten, at that temporal distance.

³¹ The areal character of this phenomenon is mentioned, in particular, in (Hammarström 2010: 32).

4.3. Different forms for bases and corresponding numerals

A phenomenon that often disguises the presence of quinary (both for speakers and for researchers) is a mismatch between the forms for the numeral ‘5’ and the element referring to 5 in the numerals 6 through 9. In many languages (Vai, Susu, Looma, Bobo, Beng, Gban, Guro, Yaure, Mwan, Dan-Gwæetaa, Kla-Dan, Mano, Tura, Goo, Wan, Boko, San-Maka) such formal differences result from assimilative processes accompanying the fusion of the elements and do not represent a great problem. There are however cases where we are undoubtedly dealing with different stems, see Table 11.

Table 11. Different stems for ‘5’ as a numeral and as an augend

	Bamana	Mandinka	Kakabe	Jogo-Ton	Jogo-Ligbi	Jalkunan	Loko	Kpelle
5	<i>dúuru</i>	<i>lúulu</i>	<i>lólolu</i>	<i>sōolò</i>	<i>sóoló</i>	<i>sóóló</i>	<i>ndó(ŋ)</i>	<i>lólí</i>
5 in compounds	<i>wóron-</i> , <i>wóo-</i>	<i>wóro-</i> , <i>wóo-</i>	<i>wórɔ-</i> , <i>wóo-</i>	<i>māā-</i> , <i>màà-</i>	<i>mòɔ-</i> , <i>màú-</i> , <i>mà-</i>	<i>ma-</i> , <i>mi-</i>	<i>ngɔ-</i>	<i>mèí-</i> , <i>mèi-</i>

Stems for ‘5’ in compounds are of two types: *GO-/WO*-³² (Bamana, Mandinka, Kakabe, Loko) and *MA-* (Jogo, Ligbi, Jalkunan, Kpelle).

The stem *MA-* likely goes back to the superessive postposition broadly represented in the languages of the Mande family and reconstructible at the Proto-Mande level as **bā̃*; the use of superessive adpositions as linkers in compound numerals is a well-attested phenomenon in Mande and elsewhere. If so, the original form of the numerals for 6-9 in Jogo, Ligbi, Jalkunan, Kpelle could be built on the model of “5 *MA* N”, with the subsequent truncation of the initial element.

Variability of forms with one and the same numerical value is also attested for higher numerals. Most often, a numeral has one form when it appears alone or as an augend, and another form when it functions as a multiplicand. Sometimes (Table 12), both forms are

³² The element *-rO-* in Manding (and in Kakabe) probably goes back to the locative postposition **dó* (as a counterpoint, however, it should be mentioned that this postposition has inessive meaning, while everywhere else connectors go back to superessive postpositions). On the other hand, it cannot be altogether excluded that the stem **GO-* (or **GORO* ?) could be related to the stem of the type *KORO* attested in Soninke-Bozo and Bobo; in that case, the element *-rO-* can be regarded as an integral part of the root. In this case, **GORO* is a good candidate for reconstruction at the Proto-Western Mande level, in addition to **dǒdǒú*. See also the discussion in 2.1.

evidently variants of the same root (or, rather, one of the variants is derived from the other by affixation or compounding). There are however numerous cases (Table 13) where the stems belong to different roots.³³

Table 12. Variability in stems formed from the same roots

Language	10		20		80		100	
	sole or augend	multipli- cand	sole or augend	multipli- cand	sole or augend	multipli- cand	sole or augend	multipli- cand
Jogo			<i>kēlē</i>	<i>kēlḕmò</i>				
Ligbi			<i>kèlēmó</i>	<i>cēlē</i>				
Jalkunan			<i>jálámà</i>	<i>jááʔ, jén</i>				
Looma	<i>pù(g)</i>	<i>pùgò</i>						
Loko	<i>pubu</i>	<i>pùù(ŋ)</i>						
Bozo- Tigemaxo							<i>silambe- kierima</i>	<i>keme</i>
Soninke	<i>tánmú</i>	<i>tán</i>						
Dzuungoo					<i>cààn</i>	<i>cèèn</i>		
Bobo			<i>kìē</i>	<i>kiòrō</i>			<i>zò, zòḡ</i>	<i>zòlō</i>
Goo	<i>gǒǒ</i>	<i>gǒ < 100</i>						

Table 13. Different stems in decimal and vigesimal systems

Language	10		20	
	sole or augend	multiplicand	sole or augend	multiplicand
Modern Bamana	<i>tán</i>	<i>bî</i>		
Kakabe	<i>tán</i>	<i>bíí`</i>		
Susu	<i>fùú</i>	<i>tòngó</i>		
Jowulu	<i>byĩ</i>	<i>bù</i>	<i>kònĩ</i>	<i>yàà</i>
Seenku			<i>fũẽ</i>	<i>tégé</i>
Tura	<i>bùù</i>	<i>kúà</i>		
Goo	<i>gǒǒ</i>	<i>kòò (> 100)</i>		

³³ The Jowulu couple ‘10’ *byĩ* — *bù* is unclear in this respect. At the present state of knowledge about this language, it is difficult to say whether these forms are derived from the same root or not.

With the exception of the Samogho languages (Jowulu and Seenku), for which our knowledge is very limited, the use of different roots for the same numerical values can be explained more or less satisfactorily. In Manding and Kakabe, *BI*-forms for ‘10’ most probably go back to the Proto-Mande root **pú*, while *tán* may be a Western Mande innovation going back to the Proto-Niger-Congo stem for ‘5’ (Pozdniakov 2018: 224–226). In Susu, *fùú* is certainly an ancient form, and *tòngó* is a new one, probably resulting from the grammaticalization of the verb *tòngó* ‘take’. In Tura, *bùù* also represents the Proto-Mande root **pú*, and *kúà* is an innovation of the Proto-Dan-Tura level going back to the word for ‘hand, arm; pair of hands’ (in Tura, *kòò*); recall that in Dan, reflexes of **pú* have been replaced by the form derived from “hand” (in Dan-Gwæetaa, *kòò* or *kò*) in all contexts. In Goo, the “hand” form has replaced the original stem for ‘10’ in multiplicand function, but this form is used only in compound numerals above 100. In lower numerals another stem has emerged, which probably has the etymology ‘(small package of) cola nuts’.

4.4. Status of numerical bases

Higher numerical bases tend to be more similar to nouns, and smaller bases behave more as true numerals (in the sense formulated in the general comments preceding Table 10). The only exception is the Goo language (Aplonova & Vydrin 2017: 461) where *gǝǝ* ‘10’ (used in the first hundred) and *kòò* ‘10’ (used in the second hundred and higher) are nouns (15, 16), while *kíǵǵ* ‘100’ is a numeral (16).

- (15) *kwíí gǝǝ dǝ wǛǛ pǝǝlǻ*
 basket 10 1 bone 2
 ‘12 baskets’ (10x1 + 2)

- (16) *kíǵǵ kòò dǝ*
 100 10 1
 ‘110’ (100 + 10x1)

This unusual situation in Goo might be explained by the fact that both words for ‘10’ have etymologies more or less transparent for the speakers of this language (‘cola/package of cola’ and ‘pair of hands’), cf. 3.21, and *kíǵǵ* ‘100’ is most probably a Manding loan, and is etymologically opaque for speakers.

Another peculiar case is represented by Boko where the numeral for ‘15’ probably contains the stem for ‘1’, cf. 2.2, and can thus be regarded as the lowest base displaying nominal characteristics.

According to the criterion “the lowest numerical base which has noun status”, the languages of our sample are distributed as follows:³⁴

10 — Dan-Gwæetaa, Kla-Dan, Mano

20 — Guro, Yaure, Mwan, Wan, Boko

80 — Dzuungoo

100 — Vai, Kpelle, Looma, Loko, Beng, Gban, Tura

800 — Old Bamana, San-Maka

1000 — Modern Bamana, Kakabe, Jogo, Jalkunan, Susu, Bozo-Tigemaxo, Jowulu

> 1000 — Soninke

The situation in Mandinka is ambiguous (*kème* ‘100’ can behave as a numeral or as a noun). In Soninke, all bases, including *wújîné* ‘1000’, behave as numerals.

A correlation emerges: languages of Sahelian communities with historical engagement in long-distance trade and state-building tend to transform counting bases into numerals to a higher degree. In Soninke, the language of the very first great empire of the Western Sudan, even ‘1000’ is a numeral. In Manding and Bozo (but also in other Sahelian languages), ‘100’ is a number, and only ‘1000’ is a noun. In languages spoken in the forest zone by communities which, until the most recent times, abstained from large-scale commerce, the “nominal threshold” is either ‘100’ (Southwestern and some Southern Mande languages) or ‘20’ (most of Southern Mande languages, Boko), or even ‘10’ (Dan, Mano). This correlation is highly natural: the more a language community is exposed to commerce, the more prevalent higher numeral bases are, because their frequent use facilitates their transformation into “true numerals”.

4.5. Subtraction and division

Subtraction has been attested in nine languages, that is, in almost one third of our sample. However, in only two systems (Old Bamana, see 2.1, and Boko, see 2.2) is this operation productive. As mentioned in 2.2, some violations of the Greenbergian generalizations concerning subtraction are attested in the Boko system.

In Looma and Loko, subtraction is used only for (etymologically opaque) ‘9 = 10-1’, and in Jowulu it is used only for ‘7’ (= 10-3), ‘8’ (= 10-2), ‘9’ (= 10-1). In Bozo and San-Maka the subtractive numeral is ‘70’ (= 80-10), and in Dzuungoo it is ‘140’ (= 80x2 – 20); these cases can be understood in the context of the octogesimal systems, where the

³⁴ For certain languages of the sample, this information is unavailable or irrelevant; these languages are not taken into account.

fundamental base is 80. In Dzuungoo, most probably, a subtractive numeral ‘70 = 80-10’ also existed at an earlier stage, but it has been ousted by a non-subtractive form.

Although subtraction is not particularly rare in Mande counting systems, the internal syntax of subtractive numerals is idiosyncratic for every language, and as such is hardly reconstructible at the proto-level.

Division is found in three numeral systems: Old Bamana, Jogo-Ton, Jogo-Ligbi. All these cases confirm Greenberg's (1990: 280) observations that the denominator of the fraction is always 2 (or a power of 2), and also, that division is usually found in vigesimal systems.

The coexistence of systems with different bases and of various arithmetic operations in one language makes possible different designations for one and the same number. So, in the archaic Bamana system, 70 can be expressed as *màrinkème ní tán* (60+10), as *kème tán nà* (80–10) or as *kème tán ká jè* (80–10). In Dzuungoo, 1000 can be designated by the compound numeral *gúrú-sān kó cànfoōdzyéè* (800x1 + ((80x2) + 40)) or by the Jula loanword *wāākērēn*.

4.6. Inner syntax of complex numerals. Connectors

The order of components in complex numerals formed by means of multiplication and addition is the same in all Mande languages: Base x *a* + *b*, where *a* is a multiplier, and *b* is the addend.

Multiplication is expressed paratactically, with the solitary exception of the Yaure language where we find a multiplication connector *pá* (‘10 *pá* N’ for the numerals from 30 to 90 divisible by 10).

As for addition, it can be expressed by various means in Mande languages. Four models predominate statistically:

— simple juxtaposition, without any morphological marking:³⁵ Vai, Looma,³⁶ Kpelle, Dzuungoo, Bobo, Gban, Yaure, Mwan, Boko. This is a rather infrequent model for addition, and it is never the only model used for addition in a language. Such a marginal position of additive parataxis can be explained by its predominance in multiplication;

³⁵ Languages where only addition in numerals for 6-9 is zero-marked are not taken into account.

³⁶ Data for Loko are missing. It is highly probable that a zero connector is used in Loko in the same way as in Looma.

— a coordinative-comitative construction:³⁷ Modern and Old Bamana, Mandinka, Kakabe, Jogo, Ligbi, Jalkunan, Bozo-Tigemaxo, Soninke, Dzuungoo, Seenku, Jowulu, Beng, Mwan, Dan-Gwɛetaa, Tura, San-Maka, Boko. This model predominates in the languages of the savanna zone, while it is rarer and in fact rather marginal in the forest zone (its expansion in Tura might be explained by Manding influence);

— superessive postpositions or extended expressions with such postpositions (in some of the languages, the postposition is fused): Jalkunan (?), Looma, Loko, Gban, Guro, Yaure, Mwan, Dan-Gwɛetaa, Kla-Dan, Mano, Goo, Wan. The use of superessive adpositions as connectors for numerals (also attested in other languages of the world, although not very frequently) is very well represented in Southern Mande languages and in Southwestern Mande, but practically absent in the rest of the family;

— a noun ‘bone, unit’ (which is also used as a numerative), sometimes ‘3SG/REFL + grain’ (‘its grain’): Kpelle, Gban, Guro, Yaure, Mwan, Dan-Gwɛetaa, Kla-Dan, Mano, Goo, Tura. A connector *kai* going back to the noun for ‘bone, grain’ appears in Liberian dialects of Looma (Vydrin 1987: 46). In most languages, this connector appears only before the terms for units, but in Kpelle it precedes both units and tens, and in Mwan the connector *ḃē* (presumably from *ḃē* ‘grain’) is preceded by *mīā* ‘20’, while *vū* ‘10’ is linked to the units by another connector, *tā* (a superessive postposition). As we have demonstrated, the connector ‘bone, grain, unit’ is very well attested in the Southern Mande group, and its existence in Kpelle and Liberian Looma may result from Southern Mande influence.

There are also some models attested only in single languages:

- the nominal expression ‘its child’ (Bobo);
- the expression ‘behind it’ (Vai);
- the reciprocal pronoun (Wan);
- an article-like suffix (Jalkunan);
- the verb ‘add’ (Jowulu);
- the possessive marker (San-Maka; however, possessive markers in Mande languages often go back to locative postpositions).

Some connectors are of unknown origin: *àśíj* in Beng; *wéè* in Seenku, a specialized postposition used only in compound numerals; *lù* in San-Maka.

³⁷ It is typical of Mande languages to express coordinative and comitative meanings by one and the same means. The marker of this construction may be a conjunction/preposition, or, in some languages, coordinative (inclusory) pronoun (Vydrin 2010).

In certain languages, only one additive model is used in all cases. These are: Old and Modern Bamana, Mandinka, Kakabe, Jogo, Ligbi, Susu, Bozo-Tigemaxo, Soninke. In this group we find languages of large communities which have been involved in long-range trade for many centuries. In languages of the forest zone, we find multiple models for addition. Presumably, the presence of such “less standardized” systems correlates with a lower level of involvement in commercial relations and, therefore, less frequent use of higher numerals in the daily life of the communities.

4.7. External morphosyntax of numerals

4.7.1. Word order. The basic word order in the numerative construction in Mande is “Noun + Numeral”. A notable exception from this rule is represented by Soninke where numerals from 20 precede the noun, and in compound numerals, where elements for higher orders (from 20 on) precede the noun, while the elements for smaller numbers follow it (see 2.7).

At the same time, certain elements resembling the Soninke model can also be found in other languages of the family. In particular, in compound numerals in Guinean Kpelle (Maria Konoshenko, p.c.), the noun can be optionally repeated between the orders of thousands and hundreds (17), although, unlike in Soninke, the noun obligatorily appears to the left of the entire compound numeral.

- (17) *pélé wáá hwéélè (pélé) ñùŋ lóólí*
house 1000 2 house 100 5
‘2500 houses’

Repetition of the noun before each order of numerals is also the norm in Dan-Gwæetaa (see 2.5), Goo, Guro and Seenku.

4.7.2. Plural markers. By default, in Mande numerative constructions, neither the noun, nor the numeral carries a plural marker. There are two exceptions in this respect: Soninke, where nouns appear in their plural forms before the numerals from 2 through 9, and Seenku, where nouns are always pluralized before numerals higher than 1.

At the same time, in many languages the plural marker can be added to either the noun or the numeral, and in both cases the semantics of definiteness is expressed. This phenomenon is attested in Bamana (2.1), Mandinka (3.1) and Dzuungoo (2.3), and its existence cannot be excluded for some other languages (for which the necessary evidence may be missing at this time). In Dan-Gwæetaa, a plural marker can be added to any element of the numerative construction, but the semantics of this is different from Bamana or

Dzuungoo; it expresses restrictive meaning ("exactly the indicated number of items"). In Guro, a plural marker in a numerative construction expresses focus.

5. On the historical evolution of Mande counting systems

One can make some suggestions concerning the sequence of emergence of different counting bases in Mande languages (which can probably be extended to other African languages as well).

— The quinary system is based on counting on one's fingers: it is the most archaic model, which emerged before commerce appeared.

— There are also traces of non-quinary models for the numbers of the first ten (in particular, a probable instance of the "Neo-2" strategy in Beng, San-Maka, and especially in Wan). These sporadic non-quinary elements seem to be quite archaic.

— The presumable etymological links of the numerals for '100' with 'mouth' in Gban and with 'head' in Mano, Kpelle and Looma are indicative of the existence, at an earlier stage, of extended body-tallying count systems similar to those described for Haruai by Comrie (1999).

— The decimal model is an extension of the quinary system. In languages of large communities with a long history of state-building and involvement in long-distance trade, quinary systems tend to become blurred or disappear altogether.

— The pentadecimal and vigesimal models can be considered as further extensions of "finger count systems"; more precisely, they can be defined as "finger and toe count systems". In our sample, they are represented in 12 languages (out of 30). In many Mande languages, elements of vigesimal systems are rudimentary: there is a special word for '20' (often going back to a lexeme for 'human being'), while other numerals divisible by 20 belong to the decimal system ($40 = 4 \times 10$, $60 = 6 \times 10$, etc.). Those languages which have more substantial ("extended") vigesimal systems may follow two different models: numerals divisible by 20 are formed through multiplication of the numeral '20' ($40 = 2 \times 20$, $60 = 3 \times 20$, etc., as in Guro, Mwan, Bobo, etc., a "true vigesimal system") or they are represented by different stems (as in the old Bamana system, Dzuungoo, Bozo, a "heteroradical vigesimal system"). The languages with extended vigesimal systems belong to different Mande groups, a fact which makes problematic the reconstruction of such a model for Proto-Mande (and even for the proto-languages of the lower-level groups within Mande). Instead, the geographical distribution of these languages makes plausible the hypothesis that the vigesimal model was borrowed from Senufo and/or Gur languages (where this model is much more widespread); in South Mande languages, the vigesimal

model can also be explained as the result of Kru influence (on the spread of vigesimal systems in Kru, see (Zepp 1983)).

The elements of pentadecimal systems in Jogo-Ligbi and Boko, isolated within the Mande family, may also result from borrowing from Gur languages or Senufo (cf. (Carlson 1994) on the presence of the pentadecimal model in some Senufo languages).

— The octogesimal models (old Bamana, Dzuungoo, San-Maka) stem from the commercial relations of the pre-colonial period: they reflect a count based on bunches of cowrie shells (the predominant pre-colonial currency) or packages of cola nuts (the main item of intra-African trade).

— The consistent decimal systems are the most innovative: they continue to expand and in the process are ousting more archaic systems, cf. the replacement of the old Bamana system by the new one.

The dynamics of the evolution of numerical systems is also reflected in the use of connectors. In languages spoken by communities involved in large-scale trade for many centuries, it is typical to have one universal connector (normally a coordinative/comitative conjunction/preposition), while languages spoken in the forest zone, not used until very recently for large-scale trade, tend to employ various connectors for different orders.

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Numeral systems of Mande languages

In the paper, eight Mande counting systems (Modern and Old Bamana, Boko, Dzuungoo, Mwan, Dan-Gwèetaa, San-Maka, Soninke) are analyzed in detail, followed by the presentation of a summary table for 30 languages representing all the groups of the Mande family. In Mande languages, elements of different models are present: decimal, vigesimal, octogesimal; some elements of a quinary and quidecimal systems are also attested. Certain languages of the family possess subtractive numerals; the subtrahend may be as high as 25. In the old Bamana system, Jogo-Ton and Jogo-Ligbi, division is applied. In money counting, many Mande languages apply the principle of multiplying by five.

It is suggested that the quinary and decimal models should be considered original for Mande languages, while the vigesimal model (as well as rare pentadecimal and octogesimal ones) as a result of recent evolution, quite probably under the influence of Senufo, Gur, and probably also Kru languages.

Keywords: Mande languages, numeral systems, quinary system, decimal system, vigesimal system, octogesimal system, pentadecimal system, subtractive numeral

Systèmes des numéraux dans les langues mandé

L'article présente une analyse détaillée de huit systèmes de compte mandé (bambara traditionnel et bambara moderne, boko, dzuungoo, mwan, dan-gwèetaa, san-maka, soninké), ensuite un tableau synthétique des particularités des systèmes numériques de 30 langues représentant tous les groupes de la famille mandé est présenté. Dans les langues de la famille mandé, on trouve des éléments de différents systèmes numériques : décimal, vigésimal, octogésimal, et quelques éléments des systèmes quinaires et quindécimaux (à base 15) sont également représentés. Dans quelques langues, des numéraux complexes peuvent être formés par soustraction, le nombre soustrait pouvant aller jusqu'à 25. Dans le système traditionnel bambara, jogo-ton et jogo-ligbi, le procédé de division est utilisé, ce qui est extrêmement rare du point de vue typologique. Dans le compte de la monnaie, des nombreuses langues mandé utilisent le procédé de multiplication par cinq.

En guise de conclusion, il est proposé que les systèmes quinaires et décimaux sont originels dans les langues mandé, tandis que les systèmes vigésimaux (de même que quindécimaux et octogésimaux) proviennent d'une évolution récente, probablement sous l'influence (contacts ou substrat) des langues sénoufo, gur, et probablement aussi kru.

Mots-clés: langues mandé, systèmes numériques, système quinaire, système décimal, système vigésimal, système octogésimal, système quindécimal, numeral soustractif

Системы числительных в языках манде

В статье подробно рассматриваются 8 систем счёта манде (боко, дзуун, муан, дан-гуэта, сан-мака, сонинке, традиционная и современная системы бамана), а также даётся сводная таблица особенностей систем исчисления 30 языков манде, представляющих все группы семьи манде. Для языков семьи оказывается достаточно типичным совмещение элементов разных систем — децимальной, вигезимальной, октогезимальной; наблюдаются также некоторые элементы квинарной и квиндецимальной систем. В некоторых языках при образовании сложных числительных применяется вычитание, при этом могут вычитаться числа до 25. В традиционной системе бамана и в джого-тон и джого-лигби применяется даже действие деления, что оказывается крайне необычным с точки зрения типологии. При подсчёте денег во многих языках манде применяется принцип “умножения на пять”, когда базовой единицей оказывается монета с номиналом в 5 единиц.

Делается вывод, что исконными для языков манде следует признать квинарную и децимальную системы, тогда как вигезимальные (а также квиндецимальные и октогезимальные) системы являются результатом поздней эволюции, вполне возможно, под влиянием (субстратным или контактным) языков сенуфо, гур и, возможно, кру.

Ключевые слова: языки манде, система числительных, квинарная система, децимальная система, вигезимальная система, октогезимальная система, квиндецимальная система, вычитательные числительные