

## The Yoruba Numeral System - Functions and Realities

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**A**bstr**act**  
This paper focuses on the language of enumeration in Yoruba, in both the traditional and the newly-proposed decimal systems, not with the intention of justifying one above the other, given that the decimal system represents the sure future in the technological age, but essentially to unravel the creative resourcefulness of the Yoruba language in efficiently sustaining the two systems. We will examine the numerals in the two systems in certain identifiable contexts of functions and their associated forms. We will show what numeral formations are to be handled in the morphological component, and what to assign to the open syntax, of the language. In doing this, we have proposed adjustments that must be made to the decimal system of Longe (2009b) by streamlining and blending the /gbára/ concept, and by eliminating /ẹwá/ 'ten', as a digit/unit in the decimal computation. Expressing large and long numerals in prose is a daunting task for the morphology of the language, since this will impact learnability, pronunciation, and coherence, but despite such challenges, the Yoruba language has handled them pretty well. Only the future will tell for how long the language can keep the two systems.

### Introduction

That the numerals across languages are used for enumeration, in some form or another, is a generally accepted fact. That the systems of enumeration across languages are, for some inexplicable reasons, of varying degrees of efficiency, simplicity and/or complexity, is also not in doubt. Each language, or each unit of languages, usually chooses, as in universal grammar, its systems or parameters, from the universal system of enumeration, for whatever functions that may be considered necessary and appropriate for their varying daily needs. Despite this freedom to choose individual parameters of enumeration however, there are exigencies that may compel such individual parameters to be modified and refined for the greater good. The language of enumeration belongs in the universal realm of mathematics so this places additional demands on whatever individual parameters a language may choose for its enumeration system. Therefore it is not enough for an enumeration system to appear to be efficient for the local needs of a language and a culture, rather it now must be measured against the benchmark of modern mathematical calculation, which is now controlled by both the human mind and machines. Thus the Yoruba language now has two competing systems of enumeration – traditional and decimal. Virtually all Yoruba scholars have recognized all along that the traditional system of enumeration is becoming inefficient for the needs of the contemporary

technological age, yet the solution has become very hard to find. A lot has been written on the Yoruba traditional system of enumeration (cf. Abiyamo (2013), Abraham, R.C. (1958), Armstrong, R.C. and A. Bamgbose (1965), Awoyale, Y. (2013), Delano, I.O. (1958), Ekundayo, S.A. (1977), Fabunmi, F. A. (n.d.), Johnson, Samuel (1897/1921/1966), Longe, O. (2009a), Mann, A. (1887), Rowlands, E.C. (1969), Ward, I.C. (1952), Zaslavsky, C. (1970), among many others). These efforts have concentrated on the status quo, despite its glaring limitations. On the other hand, Longe, O. (2009b), coming from the angle of computer science and mathematics, has provided a very powerful tool by presenting a full-blown description and analysis of the decimal system. His tool has taken us beyond our wildest imagination, but yet that is where we have always wanted to go. Its language may not appear fully coherent for now, but the attempt is bold and systematic. The metalanguage may appear cumbersome in prose, but it is learnable once one becomes familiar with the concepts of counting the decimal points/places forward, or of moving the decimal point to the right. The claims of reading off the surface decimal points/places, for whatever number, no matter how large, appear to be testable, provable, verifiable and comprehensible.

This paper will focus on the language of enumeration in the two systems, not with the intention of justifying one above the other, given that the decimal system represents the sure future in a technological age, but essentially to unravel the richness of the Yoruba language in maintaining the two systems. We will concentrate on the contexts of functions that these numbers are used in, and how these contexts of functions affect the mechanisms of forms of the numbers in the two systems, and help us to put some order into our analyses and perceptions of the numerals. We will divide the contexts of functions into two broad categories – macrostructure and microstructure – in order to gain clearly both a global view of these numerals as well as on the inner workings of the numbers within the spaces of the higher tenths/decades (cf. Mann (1887)), the higher hundredths or centuries, the higher two hundredths, and the higher thousandths/millennia. Going through the morphology, we will start with the macrostructure which controls the global view of the enumeration and then go on to the inner details in the microstructure. This will lead us to the open syntax to see how the language uses phrases and sentences to reduce enumeration to structural prose.

### Macrostructure

The macrostructure gives us the global view of the system of enumeration. On the one hand of the macrostructure are the two mechanisms/strategies that drive the macrostructure: (1) the specific contexts of functions (i.e. free/independent cardinal, sequential cardinal, 'each' numeral, re-iterative numeral, quantitative ordinal, and positional/place ordinal), that the

numerals are engaged in; and, (2) the 'booster' numerals that drive up the numerals to higher and higher heights. On the other hand of the macrostructure are the loose operations of free multiplication, free subtraction, free division, and free addition, which are controlled by the open syntax of the language.

### Specific Contexts of Functions

Seven contexts of functions (i.e. independent; sequential; quantitative; each; all-inclusion; re-iterative; positional/place) can be clearly identified for these numerals, and they cut across the system of enumeration. Each function has its unique forms for the specified contexts as shown in the following chart. We will illustrate these unique forms with the core numbers from 0 to 10, which can generalize to other higher numbers. Both the traditional and the decimal systems accept the numbers from zero (0) to ten (10) as the core.

Chart i: The Core

Independ ent	Sequential	Quantitative	Each	All- Inclusion	Re-iteration	Positional/place
00 òdo	òdo	òdo	òdòdòdo	òdòdòdo	òdòdòdo	òdo
01 oókan	ení/iní	kan/méni	òkòòkan	òkan	òòkan	ìkínní; èkínní; kínní
02. eéjì	èjì	méjì	èjèèjì	méjèèjì	èèméjì	ìkéjì; èkéjì; kéjì
03. eéta	éta	méta	ètèèta	métèèta	èèméta	ìkéta; èkéta; kéta
04. eérin	érin	mérin	èrèèrin	mérèèrin	èèmérin	ìkérin; èkérin; kérin
05. aárùn-ún	àrùn/érùn	márùn-ún	àrààrùn	màrààrùn	èèmárùn-ún	ìkárùn-ún; èkárùn-ún; kárùn-ún
06. eéfà	éfà	méfà	èfèèfà	méfèèfà	èèméfà	ìkéfà; èkéfà; kéfà
07. eéje	èje	méje	èjèèje	méjèèje	èèméje	ìkéje; èkéje; kéje
08. eéjo	éjo	méjo	èjèèjo	méjèèjo	èèméjo	ìkéjo; èkéjo; kéjo
09. eésàn-án	ésán	mésàn-án	èsèèsán	mésèèsán	èèmésàn-án	ìkésàn-án; èkésàn-án; késàn-án
10 eéwàá	èwá	méwàá	èwèèwá	méwèèwá	èèméwàá	ìkéwàá; èkéwàá; kéwàá

### Word-Internal operations

As powerful and promising a computational tool as Longe (2009b) is, there are certain pronunciation and learnability challenges which the morphological formations will definitely pose. Certain adjustments will have to be made for the sake of consistency and systematicity to streamline the decimal system with the traditional system. Adesola (p.c.) has pointed out both the difficulty of interpreting /gbára/ in the decimal system as 'to the power/exponent of' a digit, and the crucial omission of /gbáròkan/ 'one decimal place' in the sequence of /gbàrèjì/, /gbàrèta/, /gbàrèrin/, and so forth, in Longe (2009b). We think it will be safer to interpret /gbára/ simply as the number of digit/decimal positions after a numeral, counting from left

to right. Also, we suggest that, unlike in Longe (2009b), /èwá/ 'ten/10', should be removed as a single unit under the decimal system, such that we are left with just 1 to 9 in the decimal computation. This will enable us to be very strict and systematic in computing the figures, such that the initial digit will figure visually and prominently in the computation. Hopefully such steps will minimize the learnability and pronunciation challenges that one may assume during a first encounter with the decimal system as we will see further below. Because we take the sequential cardinals to represent the core of the Yoruba enumeration system, we will adopt it in this explication, rather than the independent cardinals. Doing that will make the rather lengthy pronunciation much smoother and comprehensive. For lack of space, we are going to cut the charts to the barest minimum and hope that our readers will interpret accordingly.

We regard the operations that produce forms such as sequential cardinals, free/independent cardinals, quantitative ordinals, 'each' numerals, all-inclusion numerals, re-iteration numerals, and the positional/place numerals, mentioned above, as word-internal, and these are controlled by the morphological component of the grammar of the language. Such word-internal operations are evident in the broad categories of functions below.

### Sequential Cardinals

Morphologically, the sequential cardinals appear to be the core/base of both the traditional and the decimal number systems for three reasons. First, their words, that is, for [0] to [10], cannot be claimed to be derived from any source; second, they are bisyllabic, which is the minimum form; and third, both the traditional and the decimal systems retain them as the base. All the other instantiations of the Yoruba numerals are morphologically traceable to them in one form or another, as we shall soon show. The words for sequential numerals, except for the number 'one/1', are generally characterized by a low tone on their initial vowel. Because they function predominantly in sequential counting, the forms are generally context-sensitive. Whenever the sum total of entities needs to be established, the sequential cardinals come handy to use; and the order of the sequentials cannot be disrupted. They generally feed the quantitative numerals.

Chart ii: The Sequentials

	Traditional	Decimal (longe (2009b:10))	Sequential numeral
0	Òdo	Ófo	'zero/0'
1	ení/iní	ení/iní	'one/1'
2	Èjì	Èjì	'two/2'
3	ẹta	ẹta	'three/3'
4	ẹrin	ẹrin	'four/4'
5	Àrún	Àrún	'five/5'
6	ẹfà	ẹfà	'six/6'
7	Èje	Èje	'seven/7'
8	ẹjọ	ẹjọ	'eight/8'
9	ẹsán	ẹsán	'nine/9'
10	ẹwá	ẹwá	'ten/10'

We have chosen the examples of words for 20 to 30 below and elsewhere, in the two systems for illustrative purposes only, as in the chart below. Given that /gbàrọkan/ has lost its initial vowel, it ought to be written together with the preceding numeral in order to blend.

Traditional	Decimal	Revised decimal
	(Longe (2009b:15))	
10 ẹwá (10)	ẹwá (10)	ọkangbàrọkan
20 ogún (20)	20 ẹjìwá (20)	ẹjìgbàrọkan (20)
21 ọkànlélógún (1+20)	21 ẹjìwálékan (20+1)	ẹjìgbàrọkan-lékan (20+1)
22 ẹjìlélógún (2+20)	22 ẹjìwáléjì (2X10+2)	ẹjìgbàrọkan-léjì (20+2)
23 ẹtálélógún (3+20)	23 ẹjìwáléta (20+3)	ẹjìgbàrọkan-léta (20+3)
24 ẹrinlélógún (4+20)	24 ẹjìwálérin (20+4)	ẹjìgbàrọkan-lérin (20+4)
25 àrúndíngbọn (5-30)	25 ẹjìwálárún-ún (20+5)	ẹjìgbàrọkan-lárún-ún (20+5)
26 ẹrindínlógbọn (4-30)	26 ẹjìwáléfa (20+6)	ẹjìgbàrọkan-léfa (20+6)
27 ẹtádínlógbọn (3-30)	27 ẹjìwáléje (20+7)	ẹjìgbàrọkan-léje (20+7)
28 ẹjídínlógbọn (2-30)	28 ẹjìwáléjọ (20+8)	ẹjìgbàrọkan-léjọ (20+8)
29 ọkàndínlógbọn (1-30)	29 ẹjìwáléṣàń-án (20+9)	ẹjìgbàrọkan-léṣàń-án (20+9)
30 ọgbọn (30)	30 ẹtawá (10X3)	ẹtagbàrọkan (30)

## Three digits will give us the following

210 igba	ẹjì gbàrẹ̀jì lẹ̀wàá	ẹjìgbàrẹ̀jì-lẹ̀kangbàrọkan (200+10)
221 ọkànlélógúnlénigba	ẹjì gbàrẹ̀jì ẹ̀jìwá lékan	ẹjìgbàrẹ̀jì-lẹ̀jìgbàrọkan-lékan (200+20+1)
232 ẹjìlélógbọnlénigba	ẹjì gbàrẹ̀jì ẹ̀tawá léjì	ẹjìgbàrẹ̀jì-lẹ̀tagbàrọkan-léjì (200+30+2)
243 ẹtálélógójìlénigba	ẹjì gbàrẹ̀jì ẹ̀rinwá létá	ẹjìgbàrẹ̀jì-lẹ̀ringbàrọkan-létá (200+40+3)
500 ẹ̀ẹ̀dẹ̀gbẹ̀ta (500)	àrún gbàrẹ̀jì	àrúngbàrẹ̀jì (500)

For four digits we have:

5210 ẹ̀ẹ̀bẹ̀rindínlógbọnlémẹ̀wàá	àrún gbàrẹ̀ta ẹ̀jì gbàrẹ̀jì lẹ̀wàá	àrúngbàrẹ̀ta-lẹ̀jìgbàrẹ̀jì-lẹ̀kangbàrọkan (5000+200+10)
6221 ẹ̀ẹ̀gbọ̀kànlélógbọnlẹ̀kànlélógún	ẹ̀fà gbàrẹ̀ta ẹ̀jì gbàrẹ̀jì ẹ̀jìwálékan	ẹ̀fagbàrẹ̀ta-lẹ̀jìgbàrẹ̀jì-lẹ̀jìgbàrọkan-lékan (6000+200+20+1)
7232 ẹ̀ẹ̀bẹ̀rindínlógójìlẹ̀jìlélógbọn	ẹ̀je gbàrẹ̀ta ẹ̀jì gbàrẹ̀jì ẹ̀tawá léjì	ẹ̀jegbàrẹ̀ta-lẹ̀jìgbàrẹ̀jì-lẹ̀tagbàrọkan-léjì (7000+200+30+2)
8243 ẹ̀ẹ̀gbọ̀kànlélógójìlẹ̀tálélógójì	ẹ̀jọ gbàrẹ̀ta ẹ̀jì gbàrẹ̀jì ẹ̀rinwá létá	ẹ̀jogbàrẹ̀ta-lẹ̀jìgbàrẹ̀jì-lẹ̀ringbàrọkan-létá (8000+200+40+3)
9500 ẹ̀ẹ̀dẹ̀gbẹ̀jìdínlẹ̀ááádọta	ẹ̀sán gbàrẹ̀ta àrún gbàrẹ̀jì	ẹ̀sángbàrẹ̀ta-lárún-úngbàrẹ̀jì (9000+500)

## Independent/Free Cardinals

With the exception of /òdo/ 'zero', these independent cardinals are generally characterized by a mid-high tone sequence on their identical initial vowels. They are context-free; and the single-digit ones among them (òdo/0 - ẹ̀ṣàń-án/9), are regularly the obvious exclusive choice for reciting serial numbers, index numbers, telephone numbers, social security numbers, and all varieties of identification numbers. They are also used in free citation of simple addition, subtraction, division or multiplication of random numbers. We consider them to be cardinal in function despite the fact that their formation does seem to reflect some derivation of compounding. The mid-high tone sequence on the initial vowels has been rightly attributed (cf. Johnson, S. (1921:li), Abraham (1958:xxxii) to [owó] 'money', as in [owó-ọkan -> oókan]. In the chart below, where the interplay of both vowel assimilation and vowel harmony produces the variant forms of the initial vowels, we, again, list only the words for 0 to 10 for illustrative purposes, which can generalize to the words for higher numbers.

Chart iii: The Independent Numerals

Traditional	Decimal	Independent or free standing numeral
0 òdo (no change)	òdo (no change)	'zero/0'
1 oókan <owó-ọkan	oókan <owó-ọkan	'one/1'
2 eéjì <owó-ẹ̀jì	eéjì <owó-ẹ̀jì	'two/2'
3 ẹ́ẹ́ta <owó-ẹ̀ta	ẹ́ẹ́ta <owó-ẹ̀ta	'three/3'
4 ẹ́ẹ́rin <owó-ẹ̀rin	ẹ́ẹ́rin <owó-ẹ̀rin	'four/4'
5 aárún-ún <owó-àrún	aárún-ún <owó-àrún	'five/5'
6 ẹ́ẹ́fà <owó-ẹ̀fà	ẹ́ẹ́fà <owó-ẹ̀fà	'six/6'
7 eéje <owó-ẹ̀je	eéje <owó-ẹ̀je	'seven/7'
8 ẹ́ẹ́jọ <owó-ẹ̀jọ	ẹ́ẹ́jọ <owó-ẹ̀jọ	'eight/8'
9 ẹ́ẹ́sán-án <owó-ẹ̀sán	ẹ́ẹ́sán-án <owó-ẹ̀sán-án	'nine/9'
10 ẹ́ẹ́wáá <owó-ẹ̀wá	ẹ́ẹ́wáá <owó-ẹ̀wá	'ten/10'

Examples of words for 20 to 30 in the two systems are in the chart below:

Traditional	Decimal	Revised independent
20 ogún (no change)	eéjìwá <owó-2X10	eéjìgbàròkan (20)
21 ọ̀kànlélogún <owó-1+20	eéjìwá-lékan <owó-2X10+1	eéjìgbàròkan-lékan (20+1)
22 eéjìlélogún <owó-2+20	eéjìwá-léjì <owó-2X10+2	eéjìgbàròkan-léjì (20+2)
23 ẹ̀tálélogún <owó-3+20	eéjìwá-lẹ̀ta <owó-2X10+3	eéjìgbàròkan-lẹ̀ta (20+3)
24 ẹ̀rínlélogún <owó-4+20	eéjìwá-lẹ̀rin <owó-2X10+4	eéjìgbàròkan-lẹ̀rin (20+4)
25 ẹ̀dòlogbòn <owó-5-30	eéjìwá-làrùn-ún <owó-2X10+5	eéjìgbàròkan-làrùn-ún (20+5)
26 ẹ̀rínḍínlogbòn <owó-4-30	eéjìwá-lẹ̀fà <owó-2X10+6	eéjìgbàròkan-lẹ̀fà (20+6)
27 ẹ̀táḍínlogbòn <owó-3-30	eéjìwá-lẹ̀je <owó-2X10+7	eéjìgbàròkan-lẹ̀je (20+7)
28 eéjìḍínlogbòn <owó-2-30	eéjìwá-lẹ̀jo <owó-2X10+8	eéjìgbàrèkan-lẹ̀jo (20+8)
29 ọ̀kàḍínlogbòn <owó-1-30	eéjìwá-lẹ̀sàn-án <owó-2X10+9	eéjìgbàròkan-lẹ̀sàn-án (20+9)
30 ogbòn (no change)	ẹ̀tawá <owó-3X10	ẹ̀tagbàròkan (30)

### Quantitative Ordinals

These words are built on fossilized imperative structures to give the sum total of the sequential enumeration. The words can be context-sensitive. Where they function context-sensitively, this function can overlap with sequential enumeration, where /kan/ 'one' will be replaced with /méní/ 'one in counting'. Where they function non-context-sensitively, which seems to be their primary function, they simply indicate the sum total of entities of sequential enumeration. The quantitative numerals are generally characterized by an initial /m-/ , which has been traced to either /mú/ 'take' (cf. Abraham (1958)) or /mọ́/ 'connect with' (Fabunmi (n.d.)). Morphologically, their fossilized imperative formation takes the form in sequential enumeration in (2.1.1.) as their stem. There is always a high tone on the initial /m-syllable/. Examples of words for 0 to 10, are in the chart below:

Chart iv: Quantitative Numerals

Quantitative	Sequential
00 òdò (no change) 'sum of 'zero/0'	òdò (no change) 'zero/0 in counting'
01 kan <òkan 'sum of 'one/1'	méní <mú-ení 'one/1 in counting'
02. méjì <mú-èjì 'sum of 'two/2'	méjì <mú-èjì 'two/2 in counting'
03. méta <mú-ẹ̀ta 'sum of 'three/3'	méta <mú-ẹ̀ta 'three/3 in counting'
04. mẹ̀rin <mú-ẹ̀rin 'sum of 'four/4'	mẹ̀rin <mú-ẹ̀rin 'four/4 in counting'
05. márùn-ún <mú-àrún 'sum of 'five/5'	márùn-ún <mú-àrún 'five/5 in counting'
06. mẹ̀fà <mú-ẹ̀fà 'sum of 'six/6'	mẹ̀fà <mú-ẹ̀fà 'six/6 in counting'
07. méje <mú-ẹ̀je 'sum of 'seven/7'	méje <mú-ẹ̀je 'seven/7 in counting'
08. méjọ <mú-ẹ̀jo 'sum of 'eight/8'	méjọ <mú-ẹ̀jo 'eight/8 in counting'
09. mẹ̀sàn-án <mú-ẹ̀sán 'sum of 'nine/9'	mẹ̀sàn-án <mú-ẹ̀sán 'nine/9 in counting'
10 mẹ̀wàá <mú-ẹ̀wá 'sum of 'ten/10'	mẹ̀wàá <mú-ẹ̀wá 'ten/10 in counting'

Examples of words for 20 to 30 in the two systems, are in the chart below:

Traditional	Decimal	Quant and seq
Quant & seq	Quant & Seq	Revised
20 ogún (no change)	méjìwá <mú-10X2	méjìgbàròkan (20)
21 mọ̀kànlélogún <mú-1+20	méjìwálékan <mú-10X2+1	méjìgbàròkan-lékan (20+1)
22 méjìlélogún <mú-2+20	méjìwáléjì <mú-10X2+2	méjìgbàròkan-léjì (20+2)
23 mẹ̀tálélogún <mú-3+20	méjìwálẹ̀ta <mú-10X2+3	méjìgbàròkan-lẹ̀ta (20+3)
24 mẹ̀rínlélogún <mú-4+20	méjìwálẹ̀rin <mú-10X2+4	méjìgbàròkan-lẹ̀rin (20+4)
25 mẹ̀ḍélogbòn <mú-5-30	méjìwálàrùn-ún <mú-10X2+5	méjìgbàròkan-làrùn-ún (20+5)
26 mẹ̀rínḍínlogbòn <mú-4-30	méjìwálẹ̀fà <mú-10X2+6	méjìgbàròkan-lẹ̀fà (20+6)
27 mẹ̀táḍínlogbòn <mú-3-30	méjìwálẹ̀je <mú-10X2+7	méjìgbàròkan-lẹ̀je (20+7)
28 méjìḍínlogbòn <mú-2-30	méjìwálẹ̀jo <mú-10X2+8	méjìgbàròkan-lẹ̀jo (20+8)
29 mọ̀kàḍínlogbòn <mú-1-30	méjìwálẹ̀sàn-án <mú-10X2+9	méjìgbàròkan-lẹ̀sàn-án (20+9)
30 ogbòn (no change)	mẹ̀tawá <mú-10X3	mẹ̀tagbàròkan (30)

### 'Each' Numerals

The formation of the words for the 'each' numerals appears to involve some reduplication of only the initial two syllables of the words for sequential enumeration, as the examples of 'each' numeral 'eleven/11', and 21 to 29, appear to show below. The words for these numerals display an unusual interplay of forward application of vowel assimilation and tone harmony, as well as vowel elision, across consonant segments in their morpho-phonemics.

Chart v: Each Numerals

Traditional and Decimal	Reduplicants	'Each' Token
00 Òdòdò	<òdò-òdò	'each zero/0 or in zeroes'
01 ọ̀kọ̀ọ̀kan	<òkan-òkan	'each one/1 entity or in ones'
02. Èjèèjì	<èjì-èjì	'each two/2 entities or in twos'
03. ẹ̀tẹ̀ẹ̀ta	<ẹ̀ta-ẹ̀ta	'each three/3 entities or in threes'
04. ẹ̀rẹ̀ẹ̀rin	<ẹ̀rin-ẹ̀rin	'each four/4 entities or in fours'
05. Àrààrún	<àrún-àrún	'each five/5 entities or in fives'
06. ẹ̀fẹ̀ẹ̀fà	<ẹ̀fà-ẹ̀fà	'each six/6 entities or in sixes'
07. Èjẹ̀ẹ̀je	<ẹ̀je-ẹ̀je	'each seven/7 entities or in sevens'
08. ẹ̀jẹ̀ẹ̀jo	<ẹ̀jo-ẹ̀jo	'each eight/8 entities or in eights'
09. ẹ̀sẹ̀ẹ̀sán	<ẹ̀sán-ẹ̀sán	'each nine/9 entities or in nines'
10 ẹ̀wẹ̀ẹ̀wá	<ẹ̀wá-ẹ̀wá	'each ten/10 entities or in tens'
11 ọ̀kọ̀ọ̀kànlá	<òkàn-òkànlá	'each eleven/11 entities or in elevens'



Examples of words for 20 to 30 in the two systems are in the chart below:

	Traditional	Decimal	Revised Decimal	
20	ogoogún	èjèèjìwá	èjèèjìgbàròkan	(20)
21	òkòòkànlélogún	èjèèjìwálékan	èjèèjìgbàròkan-lékan	(20+1)
22	èjèèjìlélógún	èjèèjìwáléjì	èjèèjìgbàròkan-léjì	(20+2)
23	ètètètálélógún	èjèèjìwáléta	èjèèjìgbàròkan-léta	(20+3)
24	èrètèrinlélogún	èjèèjìwálérin	èjèèjìgbàròkan-lérin	(20+4)
25	àrààrùndíngbò	èjèèjìwálàrùn-ún	èjèèjìgbàròkan-làrùn-ún	(20+5)
26	èrètèrindínlógbò	èjèèjìwáléfà	èjèèjìgbàròkan-léfà	(20+6)
27	ètètètàdínlogbò	èjèèjìwáléje	èjèèjìgbàròkan-léje	(20+7)
28	èjèèjìdínlogbò	èjèèjìwáléjò	èjèèjìgbàròkan-léjò	(20+8)
29	òkòòkàndínlogbò	èjèèjìwálésàn-án	èjèèjìgbàròkan-lésàn-án	(20+9)
30	ogboogbò	ètètètawá	ètètètàgbàròkan	(30)

### All-Inclusion

The all-inclusion numerals, with the exception of /òdo/ 'zero', can also be traced morphologically to the fossilized imperative forms in sequential enumeration, which here, again, serve as the stems. Forward application of both vowel and tone assimilation will explain the resultant forms in the chart below:

Chart vi: All-Inclusion Numerals

	Traditional and Decimal	Formation	All-Inclusive
0	Òdòdòdo	òdo-òdo	'all zero/0'
1	òkan, 7mókòòkan	òkan, 7<mú-òkan-òkan	'one/1'
2	Méjèèjì	<mú-èjì-èjì	'all two/2'
3	métètètà	<mú-èta-èta	'all three/3'
4	mérètèrin	<mú-èrin-èrin	'all four/4'
5	Màrààrùn	<mú-àrùn-àrùn	'all five/5'
6	méfètètà	<mú-èfà-èfà	'all six/6'
7	Méjèèje	<mú-èje-èje	'all seven/7'
8	méjèèjò	<mú-èjò-èjò	'all eight/8'
9	mésètèsán	<mú-èsán-èsán	'all nine/9'
10	méwètewá	<mú-èwá-èwá	'all ten/10'

Examples of words for 20 to 30 in the two systems are in the chart below:

	Traditional	Decimal	Revised decimal	
20	ogoogún	méjèèjìwá	méjèèjìgbàròkan	(20)
21	mókòòkànlélogún	méjèèjìwálékan	méjèèjìgbàròkan-lékan	(20+1)
22	méjèèjìlélógún	méjèèjìwáléjì	méjèèjìgbàròkan-léjì	(20+2)
23	métètètálélógún	méjèèjìwáléta	méjèèjìgbàròkan-léta	(20+3)
24	mérètèrinlélogún	méjèèjìwálérin	méjèèjìgbàròkan-lérin	(20+4)
25	màrààrùndíngbò	méjèèjìwálàrùn-ún	méjèèjìgbàròkan-làrùn-ún	(20+5)
26	mérètèrindínlógbò	méjèèjìwáléfà	méjèèjìgbàròkan-léfà	(20+6)
27	métètètàdínlogbò	méjèèjìwáléje	méjèèjìgbàròkan-léje	(20+7)
28	méjèèjìdínlogbò	méjèèjìwáléjò	méjèèjìgbàròkan-léjò	(20+8)
29	mókòòkàndínlogbò	méjèèjìwálésàn-án	méjèèjìgbàròkan-lésàn-án	(20+9)
30	ogboogbò	métètètawá	métètètàgbàròkan	(30)

### Re-iteration

The words for re-iterative numerals are characterized by an initial double /èè-/ which has been claimed very rightly (cf. Johnson (1921:liii), Abraham (1958)), to come from /i-rin-/ 'walking, shuttling' after the application of vowel harmony. The /m-/ segment, with the exception of /èèkan/ 'once, one time/attempt or previous time', is the remnant of the fossilized quantitative numeral, which again involves the sequential numeral, as in the chart below:

Chart vii: Re-Iteration Numerals

	Traditional	Decimal (Same)	Re-Iterative
0	òdo (not participating)	Òdo	(non-participating)
1	èèkan <è-rin-òkan	èèkan <è-rin-òkan	'one time/attempt; previously'
2	èéméjì <è-rin-mú-èjì	èéméjì <è-rin-mú-èjì	'two times/attempts'
3	èémétà <è-rin-mú-èta	èémétà <è-rin-mú-èta	'three times/attempts'
4	èémérin <è-rin-mú-èrin	èémérin <è-rin-mú-èrin	'four times/attempts'
5	èémàrùn-ún <è-rin-mú-àrùn	èémàrùn-ún <è-rin-mú-àrùn	'five times/attempts'
6	èéméfà <è-rin-mú-èfà	èéméfà <è-rin-mú-èfà	'six times/attempts'
7	èéméje <è-rin-mú-èje	èéméje <è-rin-mú-èje	'seven times/attempts'
8	èéméjò <è-rin-mú-èjò	èéméjò <è-rin-mú-èjò	'eight times/attempts'
9	èémésàn-án <è-rin-mú-èsán	èémésàn-án <è-rin-mú-èsán	'nine times/attempts'
10	èéméwáá <è-rin-mú-èwá	èéméwáá <è-rin-mú-èwá	'ten times/attempts'

Examples of words for 20 to 30 in the two systems are in the chart below:

	Traditional	Decimal	Revised Decimal	
20	ìgbà ogún	ẹ̀mẹ̀jìwá	ẹ̀mẹ̀jìgbàrọ̀kan	20)
21	ẹ̀mẹ̀kànlélógún	ẹ̀mẹ̀jìwálékan	ẹ̀mẹ̀jìgbàrọ̀kan-lékan	(20+1)
22	ẹ̀mẹ̀jìlélógún	ẹ̀mẹ̀jìwáléjì	ẹ̀mẹ̀jìgbàrọ̀kan-léjì	(20+2)
23	ẹ̀mẹ̀tálélógún	ẹ̀mẹ̀jìwálétà	ẹ̀mẹ̀jìgbàrọ̀kan-létà	(20+3)
24	ẹ̀mẹ̀rìnlélógún	ẹ̀mẹ̀jìwálérin	ẹ̀mẹ̀jìgbàrọ̀kan-lérin	(20+4)
25	ẹ̀mẹ̀márùn-úndíngbọ̀n	ẹ̀mẹ̀jìwálárùn-ún	ẹ̀mẹ̀jìgbàrọ̀kan-lárùn-ún	(20+5)
26	ẹ̀mẹ̀rìndínlógbọ̀n	ẹ̀mẹ̀jìwáléfà	ẹ̀mẹ̀jìgbàrọ̀kan-léfà	(20+6)
27	ẹ̀mẹ̀tádínlógbọ̀n	ẹ̀mẹ̀jìwáléje	ẹ̀mẹ̀jìgbàrọ̀kan-léje	(20+7)
28	ẹ̀mẹ̀jìdínlógbọ̀n	ẹ̀mẹ̀jìwáléjo	ẹ̀mẹ̀jìgbàrọ̀kan-léjo	(20+8)
29	ẹ̀mẹ̀kàndínlógbọ̀n	ẹ̀mẹ̀jìwálésàn-án	ẹ̀mẹ̀jìgbàrọ̀kan-lésàn-án	(20+9)
30	ìgbà ogbọ̀n	ẹ̀mẹ̀tawá	ẹ̀mẹ̀tagbàrọ̀kan	(30)

### Positional/Place Ordinals

The words for the positional/place numerals are generally context-sensitive and they can appear in structure in three variant forms. Given the regularity with which the initial /ì-/ can occur, as in the chart below, it may be safe to take it as the underlying form for the other two variants. And given that, the alternation between the initial /è-/ and /ẹ-/ can be explained by the application of vowel harmony. Syncopation, which is a regular process in Yoruba morphology can explain why the commonest /k-/ variant emerges, such that we can designate the positional/place numerals as the /k-series/ for convenience. The /k-/ comes from /kó/ 'grab, collect, pack off', which serves as a fossilized imperative root. And once again, the words for the sequential numerals serve as a key part of the stems for the formation of the positional/place numerals.

Chart viii: Positional/Place Numerals

Traditional	Decimal (Same)	Positional/Place
00 òdò (non-participating)	òdò (non-participating)	'zero' (neutral)
01 ìkínní; èkínní; kínní <ì-kó-ení	ìkínní; èkínní; kínní	'first'
02. ìkéjì; èkéjì; kejì <ì-kó-èjì	ìkéjì; èkéjì; kejì	'second'
03. ìkétà; èkétà; keta <ì-kó-éta	ìkétà; èkétà; keta	'third'
04. ìkérin; èkérin; kèrin <ì-kó-èrin	ìkérin; èkérin; kèrin	'fourth'
05. ìkárùn-ún; èkárùn-ún; kárùn-ún	ìkárùn-ún; èkárùn-ún; kárùn-ún	'fifth'
06. ìkéfà; èkéfà; kẹfà <ì-kó-ẹfà	ìkéfà; èkéfà; kẹfà	'sixth'
07. ìkéje; èkéje; kéje <ì-kó-èje	ìkéje; èkéje; kéje	'seventh'
08. ìkéjo; èkéjo; kéjo <ì-kó-ẹjo	ìkéjo; èkéjo; kéjo	'eighth'
09. ìkésàn-án; èkésàn-án; késàn-án	ìkésàn-án; èkésàn-án; késàn-án	'ninth'
10. ìkẹwàá; èkẹwàá; kẹwàá <ì-kó-ẹwà>	ìkẹwàá; èkẹwàá; kẹwàá	'tenth'

Examples of words for 20 to 30 in the two systems, are in the chart below:

	Traditional	Decimal	Revised Decimal	
20	ogún (no change)	ìkéjìwá [l-/è-/k-]	ìkéjìgbàrọ̀kan	(20th)
21	ìkòkànlélógún [l-/è-/k-]	ìkéjìwálékan [l-/è-/k-]	ìkéjìgbàrọ̀kan-lékan	(20+1st)
22	ìkéjìlélógún [l-/è-/k-]	ìkéjìwáléjì [l-/è-/k-]	ìkéjìgbàrọ̀kan-léjì	(20+2nd)
23	ìkétàlélógún [l-/è-/k-]	ìkéjìwálétà [l-/è-/k-]	ìkéjìgbàrọ̀kan-létà	(20+3rd)
24	ìkérìnlélógún [l-/è-/k-]	ìkéjìwálérin [l-/è-/k-]	ìkéjìgbàrọ̀kan-lérin	(20+4th)
25	ìkárùndíngbọ̀n [l-/è-/k-]	ìkéjìwálárùn-ún [l-/è-/k-]	ìkéjìgbàrọ̀kan-lárùn-ún	(20+5th)
26	ìkérìndínlógbọ̀n [l-/è-/k-]	ìkéjìwáléfà [l-/è-/k-]	ìkéjìgbàrọ̀kan-léfà	(20+6th)
27	ìkétádínlógbọ̀n [l-/è-/k-]	ìkéjìwáléje [l-/è-/k-]	ìkéjìgbàrọ̀kan-léje	(20+7th)
28	ìkéjìdínlógbọ̀n [l-/è-/k-]	ìkéjìwáléjo [l-/è-/k-]	ìkéjìgbàrọ̀kan-léjo	(20+8th)
29	ìkòkàndínlógbọ̀n [l-/è-/k-]	ìkéjìwálésàn-án [l-/è-/k-]	ìkéjìgbàrọ̀kan-lésàn-án	(20+9th)
30	ogbón (no change)	ìkétawá [l-/è-/k-]	ìkétagbàrọ̀kan	(30th)

### Booster Numerals

We now come to the second part of the global view of the enumeration system. This concerns the role of what we refer to as the 'booster' numerals. On the decimal side, what we can consider as a booster numeral is the surface decimal point which can be expanded ad infinitum. On the traditional side, there are five booster numerals – 10, 20, 200, 1000, and 2000, in the enumeration system. These numerals, in addition to their own individual meanings, run up the other numbers, and like rockets, take them to greater heights.

As we will show under the microstructure, the numeral 10 demarcates across the board, the numerals into tens, which coincidentally marks the distance of a decade in time. Inexplicably in Yoruba though, numbers in time and space have been divided into tens, such that numbers up to infinities, are built upon layers upon layers of tens. Yoruba legend (cf. Longe (2009a)) would relate the numeral 10 to the number of our fingers or our toes. Primarily the numeral 10 controls the foundation of the core.

The word /ogún/ for the traditional booster numeral 20, controls the domain between 20 and 200. It takes over from numeral 10 and powers the enumeration system all the way through /ogórùn-ún/, (the numeral 100 (century)), to /igba/, the numeral 200, as in the following multiples of 20, but the delimitation by /ẹwá/, 10, also runs through as an undercurrent:

Chart ix: Booster Numerals

Trad.	Decimal	Revised	Trad.	Decimal	Revised
20 ogún	èjìwá	jìgbàròkan	30 ogbò/àádóji	ètawá	ètagbàròkan
40 ogóji	èrinwá	ringbàròkan	50 àádóta	àrúnwá	àrúgbàròkan
60 ogóta	èfàwá	fàgbàròkan	70 àádòrin	èjewá	èjegbàròkan
80 ogórin	èjowá	jogbàròkan	90 àádòrùn-ún	èsánwá	èsángbàròkan
100 ogórùn-ún	òkan gbàrèjì	kangbàrèjì	110 àádófà	òkan gbàrèjì	òkangbàrèjì
120 ogófa	èjìwá	lèjìgbàròkan	130 àádóje	òkan gbàrèjì	òkangbàrèjì
140 ogóje	òkan gbàrèjì	kangbàrèjì	150 àádójo	ètawá	lèttagbàròkan
160 ogójo	èrinwá	lèringbàròkan	òkan gbàrèjì	àrúnwá	lárùn- úgbàròkan
	èfàwá	lèfàgbàròkan			
180 ogósàn-án	òkan gbàrèjì	kangbàrèjì	170 àádósàn-án	òkan gbàrèjì	òkangbàrèjì
	èjowá	lèjogbàròkan	èjewá	lèjegbàròkan	
200 ogówàá/ igba	èjì gbàrèjì	jìgbàrèjì	190 àádówàá	òkan gbàrèjì	òkangbàrèjì
			èsánwá	lèsàn- ángbàròkan	

### Traditional Booster Numeral 200 all the Way to the first Thousandth / Millennium

The boosting power of the traditional /igba/ 200 then takes over and powers the enumeration all the way to the first thousandth/millennium as in the chart below:

Chart x: Booster Numerals

Trad Multiples of 200	Decimal (Longe (2009b))		Trad Multiples of 200 minus 100	Decimal (Longe (2009))	
Trad.	Decimal	Revised	Trad.	Decimal	Revised
200 igba	èjì gbàrèjì	èjìgbàrèjì			
400 irinwó	èrin gbàrèjì	èringbàrèjì	300 oódúnrún	èta gbàrèjì	ètagbàrèjì
600 egbèta	èfà gbàrèjì	èfàgbàrèjì	500 èdéggbèta	àrún gbàrèjì	àrúgbàrèjì
800 egbèrin	èjo gbàrèjì	èjogbàrèjì	700 èdéggbèrin	èje gbàrèjì	èjegbàrèjì
1000 egbèrún	òkan gbàrèta	òkangbàrèta	900 èdéggbèrún	èsán gbàrèjì	èsángbàrèjì
1200 egbèfa	òkàn gbàrèta	lèjìgbàrèjì	1100 èdéggbèfà	òkan gbàrèta	òkangbàrèta
	gbàrèjì	lèjìgbàrèjì		lòkan gbàrèjì	lòkangbàrèjì
1400 egbèje	òkan gbàrèta	lèrin òkangbàrèta	300 èdéggbèje	òkan gbàrèta	lèttagbàrèjì
	gbàrèjì	lèringbàrèjì		gbàrèjì	lèttagbàrèjì
1600 egbèjo	òkan gbàrèta	lèfà òkangbàrèta	500 èdéggbèjo	òkan gbàrèta	òkangbàrèta
	gbàrèjì	lèfàgbàrèjì		lárùn-ún gbàrèjì	lárùn-ún- gbàrèjì
1800 egbèsán	òkan gbàrèta	òkangbàrèta	700 èdéggbèsàn-án	òkan gbàrèta	lèje òkangbàrèta
	lèjogbàrèjì	lèjogbàrèjì		gbàrèjì	lèje- gbàrèjì
2000 egbèwá	èjì gbàrèta	èjìgbàrèta	900 èdéggbèwá	òkan gbàrèta	òkangbàrèta
/egbàá	(2000)			lèsàn-án gbàrèjì	lèsàn-án- gbàrèjì

While the boosting energy of traditional /igba/ 'two hundred' powers the enumeration to traditional /egbàá/ 'one thousand/millennium',

the undercurrent of subtraction, like checks and balances, has now shifted from /èwá/ 'ten', to /ogórùn-ún/ 'one hundred/century'.

### Traditional Booster Numeral 2000 to the First Twenty Thousandth

The mechanism for this formation is a fossilized form of multiplication of /egbàá/ (as head/multiplier) 'two thousand' by a sequential numeral (multiplicand)

Chart xi: Booster Numerals

2000s			2000s minus 1000	
Trad	Decimal (2009b)	Longe	TRAD	Decimal (Longe (2009b))
2000	egbàá	èjì gbárèta		
4000	egbàaji	èrin gbárèta	3000	èdéggbàaji èta gbárèta
6000	egbàata	èfà gbárèta	5000	èdéggbààrún àrún gbárèta
8000	egbàarin	èjọ gbárèta	7000	èdéggbèrin èje gbárèta
10000	egbàarùn-ún	òkan gbàrèrin	9000	èdéggbààrún èsán gbárèta
12000	egbàafa	òkan gbàrèrin èjì gbárèta	11000	èdéggbàafà òkan gbàrèrin òkan gbárèta
14000	egbàaje	òkan gbàrèrin èrin gbárèta	13000	èdéggbàaje òkan gbàrèrin èta gbárèta
16000	egbàajo	òkan gbàrèrin èfà gbárèta	15000	èdéggbàajo òkan gbàrèrin àrún gbárèta
18000	egbàasàn-án	òkan gbàrèrin èjọ gbárèta	17000	èdéggbàasán òkan gbàrèrin èje gbárèta
20000	egbàawáá (òkè)	èjì gbàrèrin	19000	èdéggbàawá òkan gbàrèrin èsán gbárèta

Again, while the boosting energy of traditional /egbàá/ 'two thousand', powers the enumeration to traditional /egbàawáá/ 'twenty thousand', the undercurrent of subtraction, like checks and balances, has now shifted from traditional /ogórùn-ún/ 'one hundred/century', to traditional /egbèrún/ 'one thousand or millennium'. This marks the limit of the global regular morphology of the traditional enumeration system. The two words /apò/ 'bag' for the numeral /ogórùn-ún/ 'one hundred', and /òkè/ 'straw sack', for the figure 'twenty thousand', though excellent candidates as booster numerals, are random; they do not regularize with the system. Nothing morphologically in the system leads up to them, and nothing leads up beyond them. They can only come in at the level of the phrase in the open syntax.

## Traditional Booster Numerals in Functions

The chart below summarizes the traditional booster numerals in their functional domains.

Chart xii: Summary of Booster Numerals in Functions

Independent	Sequential	Quantitative	Each	All-Inclusion	Re-iteration	Positional /fractional
10 ẹwáá	ẹwá	mẹwáá	ẹwẹẹwá	mẹwẹẹwá	ẹẹmẹwáá	lkẹwáá; ẹkẹwáá; kẹwáá
20 ogún	ogún	Ogún	ogún kọọkan	ogoogún	iye lgbà ogún? ogoogún	ogún
100 ọgórùn-ún	ọgórùn-ún	Ogún	ọgórọ̀rùn	ọgọọgórùn-ún	iye lgbà ọgórùn-ún ?ọgọọgórùn-ún	ọgórùn-ún
200 ọgówáá {igba}	ọgówáá {igba}	ọgówáá {igba}	ọgọọgówáá igbiigba	ọgọọgówáá igbiigba	iye lgbà igba ọgọọgówáá? igbiigba	ọgówáá {igba}
1000 ẹgbẹ̀rún	ẹgbẹ̀rún	ẹgbẹ̀rún	ẹgbẹẹgbẹ̀rún	ẹgbẹẹgbẹ̀rún	iye lgbà ẹgbẹ̀rún? ẹgbẹẹgbẹ̀rún	ẹgbẹ̀rún
2000 ẹgbáá	ẹgbáá	ẹgbáá	ẹgbẹẹgbáá {ẹgbáá kọọkan}	ẹgbẹẹgbáá	ẹgbẹẹgbáá {iye lgbà ẹgbáá}	ẹgbẹẹgbáá

## Microstructure

Under the microstructure we will be looking at both the traditional and decimal numerals vertically. For the decimal system, given that, according to Longe (2009b), the digital numbers cannot go beyond zero/0 and ten/10, the strategies for formation are very tight and very limited. There is no subtraction at all. There are extensive applications of multiplication and addition for figures beyond ten/10, based on their surface configuration, despite the fact that 10 consists of two digits with two decimal places. While we agree with Longe (2009b) to take 10 'ẹwá' as a base, but because 10 has two decimal places, we have eliminated it as a reckoning unit, to now give the following:

Chart xiii: Decimal Numerals

Traditional	Decimal (Longe (2009b))	Revised Decimal
10 ẹwá	ẹwá	ọkangbárọkan
11 ọkànlélógún (1+20)	ẹwálékan <ẹwá-lé-òkan	ọkangbárọkan-lékan (10+1)
12 ẹjilélógún (2+20)	ẹwáléjì <ẹwá-lé-ẹjì	ọkangbárọkan-léjì (10+2)
13 ẹtálélógún (3+20)	ẹwálétà <ẹwá-lé-ẹtà	ọkangbárọkan-létà (10+3)
14 ẹrinlélógún (4+20)	ẹwálérin <ẹwá-lé-òrin	ọkangbárọkan-lérin (10+4)
15 àrùndíngbọ̀n (5-30)	ẹwálárùn-ún <ẹwá-lé-àrùn	ọkangbárọkan-lárùn-ún (10+5)
16 ẹrindínlógbọ̀n (4-30)	ẹwáléfà <ẹwá-lé-ẹfà	ọkangbárọkan-léfà (10+6)
17 ẹtádínlógbọ̀n (3-30)	ẹwáléje <ẹwá-lé-ẹje	ọkangbárọkan-léje (10+7)
18 ẹjídínlógbọ̀n (2-30)	ẹwáléjọ <ẹwá-lé-ẹjọ	ọkangbárọkan-léjọ (10+8)
19 ọkàndínlógbọ̀n (1-30)	ẹwálésàn-án <ẹwá-lé-ẹsàn	ọkangbárọkan-lésàn-án (10+9)
20 ogún (20)	ẹwájì (10X2)	ẹjìgbárọkan (20)

Accordingly, the next multiple of 10, will give the following

Traditional	Decimal (Longe (2009b))	Revised Decimal
10 ẹwá (10)	ẹwá (10)	ọkangbárọkan
20 ogún (20)	ẹjìwá (2X10)	ẹjìgbárọkan (20)
21 ọkànlélógún (1+20)	ẹjìwálékan (2X10+1)	ẹjìgbárọkan-lékan (20+1)
22 ẹjilélógún (2+20)	ẹjìwáléjì (2X10+2)	ẹjìgbárọkan-léjì (20+2)
23 ẹtálélógún (3+20)	ẹjìwálétà (2X10+3)	ẹjìgbárọkan-létà (20+3)
24 ẹrinlélógún (4+20)	ẹjìwálérin (2X10+4)	ẹjìgbárọkan-lérin (20+4)
25 àrùndíngbọ̀n (5-30)	ẹjìwálárùn-ún (2X10+5)	ẹjìgbárọkan-lárùn-ún (20+5)
26 ẹrindínlógbọ̀n (4-30)	ẹjìwáléfà (2X10+6)	ẹjìgbárọkan-léfà (20+6)
27 ẹtádínlógbọ̀n (3-30)	ẹjìwáléje (2X10+7)	ẹjìgbárọkan-léje (20+7)
28 ẹjídínlógbọ̀n (2-30)	ẹjìwáléjọ (2X10+8)	ẹjìgbárọkan-léjọ (20+8)
29 ọkàndínlógbọ̀n (1-30)	ẹjìwálésàn-án (2X10+9)	ẹjìgbárọkan-lésàn-án (20+9)
30 ọgbọ̀n (30)	ẹtawá (3X10)	ẹtagbárọkan (30)

For 100 and beyond, the number of decimal places after the first digit all the way to the right, will determine what is to be the power of, that is /agbára-/ 'to the power of'.

Now, on the other hand, the traditional system has the mechanisms/strategies that enable the numbers to expand within the spaces of the higher tenths/decades, the higher hundredths/centuries, and the higher thousandths/millennia. Such mechanisms/strategies are subtraction, addition, division, and multiplication. They are controlled by and within the morphological component of the grammar of the language; and as such, their outcome still yields more words, not sentences or phrases.



Inside the block of each multiple of 'ten' on the way up, are the two processes of addition and subtraction, shared into two un-equal parts of 'four' and 'five'. The first four digits after the multiple of 'ten' is governed by addition, while the second half of the multiple after 'ten' is governed by subtraction. Both the onset of the multiple of 'ten' and the endpoint of the multiple are excluded from the two processes given that they mark the two edges. Thus we have 1-4 for addition, and 5-9 for subtraction. Despite this irregularity, it remains a puzzle why it has to be this way. Almost every Yoruba grammarian has wondered why there have to be two processes (addition and subtraction) instead of one process; or why addition has to precede subtraction; and so forth. There are no easy answers.

### Traditional Booster Numeral Ten and First Tenth/Decade

#### 4.1.1. Traditional Additives

The additives add cumulatively to the left edge of the base, up to the fourth consecutive digit as in the following:

Chart xiv: Traditional Additive Numerals

Inde- ndent	Sequential	Quantitati- ve	Each	All- Inclusion	Re-Iteration	Positional /Fractional
10 ẹwàá	ẹwá	mẹwàá	ẹwẹẹwá	mẹwẹẹwá	ẹẹmẹwàá	ikẹwàá; ẹkẹwàá; kẹwàá
11. ọkànlá, ọkànlà	ọkànlà	mọkànlá	ọkọọkànlá	mọkọọkànlá	ẹẹmọkànlá	ikọkànlá; ọkọkànlá; kọkànlá
12. eéjilá	Èjilá	Méjilá	èjèèjilá	méjèèjilá	ẹẹmẹjilá	ikéjilá; èkẹjilá; kéjilá
13. ẹtálá	ètálá	métálá	ètèètálá	mètèètálá	ẹẹmètálá	ikétálá; ẹkétálá; kétálá
14 ẹrínlá	ẹrínlá	mérínlá	ẹrẹẹrínlá	mérẹẹrínlá	ẹẹmérínlá	ikérínlá; ẹkérínlá; kérínlá

While the morphology of addition may appear opaque in the formation between /ọkànlá/ 'eleven' and /ẹrínlá/ 'fourteen' above, it is clearly transparent in the verb /lé/ 'exceed' between /ọkànlélógún/ 'twenty one' and /ẹrínlélógún/ 'twenty four' below:

20 ogún	ogún	Ogún	ogún kọọkan	ogoogún	iyé lgbà ogún	ogún
Independent	Sequential	Quantitative	Each	All-Inclusion	Re-Iteration	Positional/Place
21. ọkànlélógún	ọkànlélógún	mọkànlélógún	ọkọọkànlélógún	mọkọọkànlélógún	ẹẹmọkànlélógún	ikọkànlélógún; ọkọkànlélógún; kọkànlélógún
22. eéjilélógún	èjilélógún	méjilélógún	èjèèjilélógún	méjèèjilélógún	ẹẹmẹjilélógún	ikéjilélógún; èkẹjilélógún; kéjilélógún
23. ẹtálélógún	ètálélógún	métálélógún	ètèètálélógún	mètèètálélógún	ẹẹmètálélógún	ikétálélógún; ẹkétálélógún; kétálélógún
24 ẹrínlélógún	ẹrínlélógún	mérínlélógún	ẹrẹẹrínlélógún	mérẹẹrínlélógún	ẹẹmérínlélógún	ikérínlélógún; ẹkérínlélógún; kérínlélógún

#### 4.1.2. Traditional Subtractives

The traditional subtractives look ahead to the endpoint of the right edge and subtract /dín/ forward to the beginning of the second half of the multiple of ten. The grammar uses a fossilized sentence to state that the lower number is taken away from the higher number, that is, X gets extracted from Y.

Chart xv: Traditional Subtractive Numerals

INDEPENDENT	SEQUENTIAL	QUANTITATIVE	EACH	ALL-INCLUSION	RE-ITERATION	POSITIONAL /PLACE
10. ẹwàá	àrùndínlógún	mẹfẹfẹdógún (màrùndínlógún)	àrààrùndínlógún	màràràrùndínlógún	ẹẹmàràrùndínlógún	ikàràrùndínlógún; ẹkàràrùndínlógún; kàràrùndínlógún
11. ẹrínlélógún	ẹrínlínlógún	mẹrínlínlógún	ẹrẹẹrínlínlógún	mẹrẹẹrínlínlógún	ẹẹmẹrínlínlógún	ikẹrínlínlógún; ẹkẹrínlínlógún; kẹrínlínlógún
12. ẹtálélógún	ètádlínlógún	mètádlínlógún	ètèètádlínlógún	mètèètádlínlógún	ẹẹmètèètádlínlógún	ikètádlínlógún; ẹkètádlínlógún; kètádlínlógún
13. ẹjilélógún	èjilínlógún	mèjilínlógún	èjèèjilínlógún	mèjèèjilínlógún	ẹẹmèjilínlógún	ikèjilínlógún; ẹkèjilínlógún; kèjilínlógún
14. ẹrínlélógún	ẹkàndínlógún	mọkàndínlógún	ọkọkàndínlógún	mọkọkàndínlógún	ẹẹmọkàndínlógún	ikọkàndínlógún; ẹkọkàndínlógún; kọkàndínlógún
20. ogún	ogún	ogún	ọkọkànlélógún	ẹẹmọkànlélógún	ogún	

INDEPENDENT	SEQUENTIAL	QUANTITATIVE	EACH	ALL-INCLUSION	RE-ITERATION	POSITIONAL /PLACE
10. ẹwàá	àrùndínlógún	mẹfẹfẹdógún (màrùndínlógún)	àrààrùndínlógún	màràràrùndínlógún	ẹẹmàràrùndínlógún	ikàràrùndínlógún; ẹkàràrùndínlógún; kàràrùndínlógún
11. ẹrínlélógún	ẹrínlínlógún	mẹrínlínlógún	ẹrẹẹrínlínlógún	mẹrẹẹrínlínlógún	ẹẹmẹrínlínlógún	ikẹrínlínlógún; ẹkẹrínlínlógún; kẹrínlínlógún
12. ẹtálélógún	ètádlínlógún	mètádlínlógún	ètèètádlínlógún	mètèètádlínlógún	ẹẹmètèètádlínlógún	ikètádlínlógún; ẹkètádlínlógún; kètádlínlógún
13. ẹjilélógún	èjilínlógún	mèjilínlógún	èjèèjilínlógún	mèjèèjilínlógún	ẹẹmèjilínlógún	ikèjilínlógún; ẹkèjilínlógún; kèjilínlógún
14. ẹrínlélógún	ẹkàndínlógún	mọkàndínlógún	ọkọkàndínlógún	mọkọkàndínlógún	ẹẹmọkàndínlógún	ikọkàndínlógún; ẹkọkàndínlógún; kọkàndínlógún
20. ogún	ogún	ogún	ọkọkànlélógún	ẹẹmọkànlélógún	ogún	

Both multiplication and subtraction can interplay between multiples of ten (10) up till two hundred as in the following:

Chart xvi: Traditional Multiplicative and Subtractive Numerals

Traditional Multiplication		Traditional Subtractives	
40	ogóji <ogún-èji (20X2)	30	àádóji <èwá-dín-òji (40-10)
60	ogóta <ogún-èta (20X3)	50	àádóta <èwá-dín-òta (60-10)
80	ogórin <ogún-érin (20X4)	70	àádórin <èwá-dín-òrin (80-10)
100	ogórùn-ún <ogún-àrún (20X5)	90	àádórùn-ún <èwá-dín-òrùn (100-10)
120	ogófà <ogún-èfà (20X6)	110	àádófà <èwá-dín-òfà (120-10)
140	ogóje <ogún-èje (20X7)	130	àádóje <èwá-dín-òje (140-10)
160	ogójò <ogún-èjò (20X8)	150	àádójò <èwá-dín-òjò (160-10)
180	ogósàn-án <ogún-èsán (20X9)	170	àádósàn-án <èwá-dín-òsán (180-10)
200	ogówàá <ogún-èwá (20X10)	190	àádówàá <èwá-dín-òwá (200-10)

## 5. Loose Operations

By loose operations we mean instances of free addition, free subtraction, free multiplication, and free division, which are controlled by the open syntax of the language. We see them as word-external. These can be expressed in simple sentential or phrasal prose. They never result in words. There are no particular morphological forms assigned to each of these forms. They are not as morphologically complicated as the numerals in the morphological component, and they come in handy wherever and whenever the numerals prove difficult to state.

The commonest template for two of these loose operations is /X ó lé Y/ 'X it exceeds by Y', for addition; and /X ó dín Y/ 'X it is less by Y', for subtraction. X in both cases represents the higher number while Y is the lower number. The /ó/ co-refers with X. It is more usual for X to be any numeral above the multiples of 20. Some examples of the two operations follow below.

### 5.1. Free Addition

The numbers from 11 – 14 and 21 – 24 can be expressed as free addition in open syntax. The lower numbers can be either independent or quantitative. Again, the pattern is closer to the morphology.

11. /èwàá ó lé oókan/òkan/kan/ 'ten (higher) it exceeds by one (lower)'; 12. /èwàá ó lé eéji/méji/ 'ten (higher) it exceeds by two (lower)'; 13. /èwàá ó lé èta/méta/ 'ten (higher) it exceeds by three (lower)'; 14. /èwàá ó lé èrin/mérin/ 'ten (higher) it exceeds by four (lower)'; 21. /ogún ó lé

oókan/òkan/kan/ 'twenty (higher) it exceeds by one (lower)'; 22. /ogún ó lé eéji/méji/ 'twenty (higher) it exceeds by two (lower)'; 23. /ogún ó lé èta/méta/ 'twenty (higher) it exceeds by three (lower)'; 24. /ogún ó lé èrin/mérin/ 'twenty (higher) it exceeds by four (lower)'.

The second structure of free addition also employs an imperative sentence structure. There are three formats in the open syntax. There seems to be no restrictions on what numbers can be added to each other, and in what order. The imperative structures below do not sound as enumeration at all.

11. /ro oókan pò mó èwàá/ 'add one to ten'; /ro oókan àti èwàá pò/ 'add one and ten'; /fi oókan kún èwàá/ 'join one with ten'; 12. /ro eéji pò mó èwàá/ 'add two to ten'; /ro eéji àti èwàá pò/ 'add two and ten'; /fi eéji kún èwàá/ 'join two with ten'; 13. /ro èta pò mó èwàá/ 'add three to ten'; /ro èta àti èwàá pò/ 'add three and ten'; /fi èta kún èwàá/ 'join three with ten'; 14. /ro èrin pò mó èwàá/ 'add four to ten'; /ro èrin àti èwàá pò/ 'add four and ten'; /fi èrin kún èwàá/ 'join four with ten'.

The third structure (cf. Adesola (p.c.)) is what we call free pairing, usually using either the sequential numeral, or the quantitative numeral, as in /èji èji/ vs. /méji méji/ 'in pairs', /èta èta/ vs. /méta méta/ 'in triples'; /èrin èrin/ vs. /mérin mérin/ 'in quadruples'. These are close to, but are not semantically identical with the 'all-inclusive' numerals. They will be generated by the syntax not in the morphological component.

### 5.2. Free Subtraction

There are two ways of expressing free subtraction. (1) is more usual and it can follow the pattern of subtraction in the morphology. This pattern is closer to the morphology. The lower numerals are quantitative.

15. /ogún ó dín márùn-ún/ 'twenty (higher) it be less by five (lower)'; 16. /ogún ó dín mérin/ 'twenty (higher) it be less by four (lower)'; 17. /ogún ó dín méta/ 'twenty (higher) it be less by three (lower)'; 18. /ogún ó dín méji/ 'twenty (higher) it be less by two (lower)'; 19. /ogún ó dín oókan/ 'twenty (higher) it be less by one (lower)'; 25. /ogbón ó dín márùn-ún/ 'thirty (higher) it be less by five (lower)'; 26. /ogbón ó dín mérin/ 'thirty (higher) it be less by four (lower)'; 27. /ogbón ó dín méta/ 'thirty (higher) it be less by three (lower)'; 28. /ogbón ó dín méji/ 'thirty (higher) it be less by two (lower)'; 29. /ogbón ó dín oókan/ 'thirty (higher) it be less by one (lower)'.

The other way employs an imperative sentence structure. The lower numbers are of the independent class; the quantitative numerals are not quite coherent.

15. /yò aárùn-ún kúrò lára/nínú ogún/ 'remove seven (lower) from twenty (higher)'; 16. /yò èrin kúrò lára/nínú ogún/ 'remove four (lower) from

twenty (higher)'; 17. /yọ ẹ́ẹ́ta kúrò lára/nínú ogún/ 'remove three (lower) from twenty (higher)'; 18. /yọ ẹ́ẹ́ì kúrò lára/nínú ogún/ 'remove two (lower) from twenty (higher)'; 19. /yọ oókan kúrò lára/nínú ogún/ 'remove one (lower) from twenty (higher)'.

### 5.3. Free Multiplication

Unlike the two processes of subtraction and addition which are already embedded in the morphological component to cement the inner workings of the multiples of ten, free multiplication is outside of the realm. There are four patterns for free multiplication in the open syntax.

#### 5.3.1. Independent X Quantitative

This sequence can be ambiguous. It can mean either Independent times Quantitative, or two separate entities of the Independent.

	Free Multiplication	Literal Quantity
òkẹ méjì	forty thousand	two tokens of 'òkẹ
àpò méjì	two hundred in currency	two tokens of 'àpò'
ogórùn-ún méjì	two hundred	two tokens of one hundred
igba méjì	four hundred	two tokens of two hundred

#### 5.3.2. Sequential X Mass Independent

	Free Multiplication	Literal Quantity
igba òkẹ	four million	two hundred tokens of 'òkẹ'
ogórùn-ún òkẹ	two million	one hundred tokens of 'òkẹ'
egbèrún àpò	ten thousand of a currency	one thousand sacks/bags
èjìdínlógbò òkẹ	fifty six thousand	twenty-eight sacks

#### 5.3.3. X in Y Places

Both X and Y are freely interchangeable in the syntax, as in /egbèrún lónà ogún/ [one thousand in twenty places] 'twenty thousand'; /ogún lónà egbèrún/ [twenty in one thousand places] 'twenty thousand'.

#### 5.3.4. Imperative

Free multiplication can also be expressed in an imperative sentence as in the following:

(a) / ẹ́e ogójì ní ilọ́pọ ogun/ [make forty (higher) in many times of twenty (lower)] 'eight hundred'; (b) /fi ogún se ilọ́pọ fun igba/ [make twenty (lower) be many times for two hundred (higher)] 'four thousand'; (c) /fi ààbò se ilọ́pọ fún odidi/ [make half (lower) be many times whole (higher)].

### 5.4. Free Division

Free division takes two formats: (a) what we refer to as free plain fraction, and (b) free imperative division. Plain fraction (cf. Adesola (p.c.)) is always phrasal using /idá/ 'division' with either a quantitative numeral, or a place numeral, as in /idá méjì/ 'two divisions', or /idá keji/ 'second division'. Again it is the syntax that will generate these. On the other hand, there are two restrictions on free imperative division. (a) The place numerals are excluded from such division. It does not make sense to say /\*fi ikérin pín ikárùn-ún/ 'use the fourth to divide the fifth'; or 'divide the fifth by the fourth'. (b) It is also not possible to divide a smaller number by a bigger number. So, we cannot say /\*pín ààbò sí odidi/ 'divide a half into a whole'; nor can we say /\*fi odidi pín ààbò/ 'use the whole to divide the half'. However, it is possible to say /pín odidi sí ààbò tàbí wẹ́wẹ́/ 'divide a whole into halves'; or /fi ààbò pín odidi/ 'use a half to divide a whole'.

### 6. Conclusion

The paper has tested the decimal system in all the traditional seven contexts of functions and it holds firmly. While the focus of Longe (2009b) was essentially to lay out what the language of a decimal system would look like, our own focus has been to stretch the decimal system to all the available contexts and highlight the formational consequences. Our effort has shown that the resources of the Yoruba language are rich enough to handle the two systems of enumeration efficiently, and this may point the way to a robust transition from the traditional to the decimal system to satisfy the demands of the technological age. But is this transition necessary and inevitable? Given the technological advantage of the decimal system, would that lead to the demise of the traditional system? And when can, or will that happen? Can the language afford to retain the two systems, and for how long?

Such questions point to the reality. Given the millions upon millions of Yoruba speakers worldwide who use the traditional enumeration system in speech, education, commerce, industry, religion, literature, etc., and the length of time they have been using it, it is not going to be very soon that they will shift to the decimal system. Unless the decimal system is now incorporated into the educational system officially, especially for the future generation, it may remain in the academic realm for awhile. Just like the struggle for supremacy between the analog and decimal time clocks, we may choose to let the two systems co-exist until one system dies a natural death, if the two systems cannot co-exist.

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