

# Analysis of Yoruba Numeral Multiplicands; Optimality-based account: A Linguistic and Cultural Perspective

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## Abstract

This paper examines the structure, formation, and cultural significance of Yoruba numeral multiplicands through the lens of Optimality Theory (OT), providing a comprehensive analysis of the linguistic principles that shape Yoruba numerical expressions. The study categorizes Yoruba multiplicands into two primary groups—basic and derived types and explores the intricate interaction of phonological, morphological, and semantic constraints that govern their optimal forms. Through detailed OT tableaux, the study demonstrates how constraint rankings resolve competing linguistic demands, revealing a nuanced interplay between grammatical rules and cultural context in Yoruba numeration. Findings show that Yoruba numerals achieve a dynamic equilibrium between efficiency, clarity, and cultural integrity, embodying cognitive patterns and sociocultural values deeply embedded in Yoruba traditions. This highlights the significance of numeration systems as more than linguistic constructs but as cultural artifacts that encapsulate historical knowledge and

societal norms. The implications of this study extend beyond Yoruba

linguistics, offering a framework for analyzing numeral systems across diverse languages and cultures using OT. By bridging linguistic theory and cultural insights, the study contributes to a deeper appreciation of the diversity and complexity of human expression. The study advocates further investigation into the diachronic evolution of Yoruba numeral multiplicands, exploring their historical transformations and potential for revitalization in modern contexts. Additionally, it recommends incorporating Yoruba numerical systems into multilingual educational curricula and assessing the effects of globalization on their continued use. By addressing these aspects, the study aims to advance the understanding of the intersection between language, culture, and cognition while promoting the preservation and appreciation of linguistic diversity.

## 1. Introduction

The Yoruba numeral system is a remarkable demonstration of linguistic ingenuity and cultural resilience, embodying centuries of evolution and adaptation. As one of the most widely spoken African languages, Yoruba reflects the rich intellectual traditions and societal frameworks of its speakers. Its numerical expressions are especially noteworthy for their intricate structure and cultural depth, blending linguistic, mathematical, and cultural elements to form a robust and versatile numeration system. Central to this system are numeral multiplicands, whose complexity underscores the interplay between form, function, and cultural meaning.

Over the years, scholars such as Bamgbose (1966), Ekundayo (1977), Ajiboye (2013), Fakinlede (2013), Alaba (2012), Babarinde (2013), and Longe (2016) have made significant strides in uncovering the phonological, morphological, and semantic dimensions of Yoruba numerals. These studies have enriched our understanding of this complex system, yet gaps remain in exploring its formation through contemporary theoretical frameworks. One such framework, Optimality Theory (OT), introduced by Prince and Smolensky (1993), offers a powerful tool for analyzing how languages navigate competing linguistic constraints to select the most optimal outputs. Despite its potential, OT has seen limited application to Yoruba numerals, particularly in the study of multiplicands.

This research addresses this gap by categorizing Yoruba numeral multiplicands into two primary groups—basic and derived types—and applying OT to uncover the hierarchical constraints and ranking systems that govern their formation. Beyond structural analysis, this study also delves into the cultural significance of Yoruba numerals, exploring how their forms reflect societal values, historical narratives, and cognitive frameworks. By combining linguistic theory with cultural analysis, the research reveals the depth and adaptability of Yoruba numeration.

The implications of this study extend across linguistic and cultural domains. On a theoretical level, it demonstrates the versatility of OT in analyzing non-Indo-European languages, highlighting its utility in uncovering universal and language-specific patterns. On a cultural level, the study positions Yoruba numerals as more than functional tools, recognizing them as cultural artifacts that preserve heritage, encode identity, and foster a sense of community. Furthermore, this study advocates for the pedagogical integration of Yoruba numerals into multilingual education, promoting both linguistic diversity and cultural awareness.

To build on these findings, the study recommends future research into the diachronic evolution of Yoruba numeral multiplicands, tracing their historical shifts and transformations. Additionally, it highlights the need to examine the impact of globalization and technological advances on the preservation and usage of Yoruba numerals in

contemporary society. By addressing these critical areas, this research aims to deepen the understanding of the intersections between language, culture, and cognition while championing the preservation of linguistic diversity as an integral part of human heritage.

## 2. Literature Review

Foundational studies in Yoruba numeration, such as those by Gaye and Beecroft (1923), Bamgbose (1966), and Ekundayo (1977), classified Yoruba numerals based on structural and cultural properties. Ajiboye (2013) further advanced understanding by analyzing additive, subtractive, and multiplicative mechanisms in Yoruba numerals.

Several researchers have examined the Yoruba numeral system, contributing valuable insights into its structure, classifications, and sociolinguistic implications:

- **Gaye and Beecroft (1923)** provided one of the earliest classifications of Yoruba numerals, categorizing them into cardinal, ordinal, distributive, and adverbial forms. They described how each type functions within the language but did not extensively analyze the construction of derived forms.
- **Bamgbose (1966)** expanded upon this classification by exploring Yoruba numerals' role within nominal groups, describing their morphological features and syntactic arrangements. He identified that numerals could extend beyond mere

counting and be used structurally within sentences. However, his analysis focused more on surface forms and lacked depth in exploring numeral derivations.

- **Ekundayo (1977)** introduced the concept of complex numerals within Yoruba, describing how Yoruba numerals exhibit creativity and variability through operations such as addition, subtraction, and multiplication. He classified Yoruba numerals into basic and complex forms and discussed how the derived forms allow for intricate expressions. Ekundayo highlighted Yoruba's unique ability to represent complex numbers through its multiplicative structure, though he did not delve into the morphological analysis of each multiplicand.
- **Ajiboye (2013)** provided a morphological analysis of Yoruba numerals, dividing them into basic and derived forms and categorizing derivations into additive, subtractive, and multiplicative processes. Ajiboye's work emphasized the combination of basic numerals to generate complex ones, yet his study did not provide extensive examples of higher-order multiplicands.
- **Olubode-Sawe (2013)** supported the division of Yoruba numerals into basic and derived forms, emphasizing the importance of addition, subtraction, and multiplication in their formation. She acknowledged the

influence of phonological patterns in the formation of complex numerals but did not examine the multiplicands systematically, which this paper seeks to address.

These contributions emphasize Yoruba numeration's unique morphological and syntactical flexibility, yet they lack an OT-focused analysis. This paper seeks to build on these insights by applying OT to Yoruba multiplicands, revealing optimal candidates within a system that reflects Yoruba cultural integrity.

### 3. Statement of Problem

The Yoruba numeral system, a significant aspect of linguistic and cultural heritage, remains relatively underexplored regarding its systematic structure and functional dynamics, especially from the perspective of Optimality Theory. Although foundational studies have offered insights into basic numeral classifications and constructions, they often overlook the complex constraints and interactions that influence the formation of Yoruba numeral multiplicands.

This oversight hinders a comprehensive understanding of how Yoruba numerals exhibit remarkable adaptability and internal coherence within linguistic and cultural contexts. In particular, the processes involved in optimizing both basic and derived multiplicands, as well as their essential roles in expressing extensive numerical values—ranging from millions to billions—have not been sufficiently explored. Furthermore, the growing impact of external factors, such as loanwords, poses

challenges to the linguistic integrity of the Yoruba numeral system. Investigating how the language manages these influences through high-ranking constraints can shed light on its mechanisms of resilience and systematic evolution.

This study seeks to bridge these gaps by applying Optimality Theory to analyze Yoruba numeral multiplicands. By examining their structure, formation, and the interplay of constraints, the research aims to uncover the hierarchical principles that guide their optimal realization. In doing so, it contributes to a deeper understanding of both linguistic theory and the cultural richness embedded within the Yoruba numeral system.

### 4. Methodology

This study uses a qualitative approach, drawing from primary sources, scholarly articles, and interviews with Yoruba language experts. The analysis is framed within OT, classifying Yoruba multiplicands into basic and derived categories. Constraints are identified and ranked for each multiplicand type, with OT tableaux illustrating candidate evaluations. The optimal form of each multiplicand is determined based on its adherence to high-ranked constraints, providing a structured analysis of Yoruba numerals.

### 5. Analysis of Yoruba Numeral Multiplicands

#### 5.1 Basic Multiplicands

Basic multiplicands are indivisible morphemes fundamental to Yoruba numeration, such as *ogún* (20), *igba* (200), and *òkẹ* (20,000). These multiplicands operate within defined numerical

ranges and have corresponding odd forms, a unique feature that enhances the system’s adaptability. Below, we analyze *Ogún* (20) and *Igba* (200) using OT to illustrate optimal candidate selection.

**Tableau 1: *Ogún* (‘Twenty’)**

**Constraints for *Ogún* (‘Twenty’):**

1. FAITH ỌGỌ: The ỌGỌ in the input must have correspondent in the output
2. \*ỌGỌ: Prohibit ỌGỌ

The constraints above must be ranked in the following ways.

FAITH ỌGỌ >> \*ỌGỌ

TABLEAU 1

Ọgórùn-ún ‘One-hundred’	FAITH ỌGỌ	*ỌGỌ
 Ọgórùn-ún		*
orún	*!	

In Tableau 1, FAITH ỌGỌ is highly ranked, meaning that any optimal candidate must not violate this constraint. Both candidates in (1) violate one constraint each: candidate (a) violates the lowly ranked constraint \*ỌGỌ, while candidate (b) violates the highly ranked constraint FAITH ỌGỌ. Although both candidates violate one constraint

each, candidate (a) emerges as the optimal candidate because it only violates a lower-ranked constraint.

**Tableau 2: *Igba* (‘Two Hundred’)**

**Constraints for *Igba* (‘Two Hundred’):**

1. FAITH ẸGBÈ: The ẸGBÈ in the input must have correspondent in the output
2. \*ỌKÉ: Prohibit ỌKÉ
3. \*ẸGBÈ: Prohibit ẸGBÈ

The constraints above must be ranked in the following ways.

FAITH ẸGBÈ >> \*ỌKÉ >> \*ẸGBÈ

TABLEAU 2

Ẹgbèrún ‘One-thousand’	FAITH ẸGBÈ	*ỌKÉ	*ẸGBÈ
 Ẹgbèrún			*
òké	*!	*	

In Tableau 2, FAITH ẸGBÈ is highly ranked, meaning that any optimal candidate must not violate this constraint. Both candidates in (2) violate one constraint or the other: candidate (a) violates the lowly ranked constraint \*ẸGBÈ, while candidate (b) violates the highly ranked constraint FAITH ẸGBÈ, and a low-ranked constraint \*ỌKÉ. Without any doubt, candidate (a) emerges as the optimal

candidate as it only violates a lower-ranked constraint.

### 5.2 Derived Multiplicands

*Derived multiplicands are constructed by applying multiplication to basic forms, creating values such as Egbègba (200,000), Egbàá (Egbèwá) ‘Two-thousand’ (2,000), Egbègba (‘Two Hundred Thousand’ or 200,000), Egbègbàá (‘Two Million’ or 2,000,000), Egbòkè (‘Twenty Million’ or 20,000,000), Egbègbègbà (‘Two Hundred Million’ or 200,000,000), Egbègbègbàá (‘Two Billion’ or 2,000,000,000), Egbègbòkè (Twenty Billion’ or 20,000,000,000), and Egbègbègbègba (Two Hundred Billion’ or 200,000,000,000). These multiplicands expand Yoruba numeration’s range, adhering to the same constraint hierarchy as basic multiplicands.*

#### Tableau 3: Egbàá (‘Two Thousand’)

##### Constraints for Egbàá ‘Two-thousand’ (2000)

1. FAITH EGBÀÁ: The EGBÈ in the input must have correspondent in the output
2. \*ÒKÉ: Prohibit ÒKÉ
2. \*EGBÀÁ: Prohibit EGBÈ

The constraints above must be ranked in the following ways.

FAITH EGBÀÁ >> \*ÒKÉ >> \*EGBÀÁ

TABLEAU 3

Egbàárùn-ún ‘Ten-thousand’	FAITH EGBÀÁ	*ÒKÉ	*EGBÀÁ
 Egbàárù			*

n-ún			
Òkè Márùn-ún	*!	*	

In Tableau 3, FAITH EGBÀÁ is highly ranked, meaning that any optimal candidate must not violate this constraint. Both candidates in (3) violate one constraint or the other: candidate (a) violates the lowly ranked constraint \*EGBÀÁ, while candidate (b) violates the highly ranked constraint FAITH EGBÀÁ, and a low-ranked constraint \*ÒKÉ. Without any doubt, candidate (a) emerges as the optimal candidate as it only violates a lower-ranked constraint.

#### Constraints for Òkè ‘Twenty-thousand’ (20,000)

1. FAITH ÒKÉ: The ÒKÉ in the input must have correspondent in the output
2. \*ÒKÉ: Prohibit ÒKÉ

The constraints above must be ranked in the following ways.

FAITH ÒKÉ >> \*ÒKÉ

TABLEAU 4

Òkèrùn-ún ‘one-hundred thousand’	FAITH ÒKÉ	*ÒKÉ
 Òkèrùn-ún		*

Egbàá-àádóta	*!	
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In Tableau 4, FAITH ÒKÉ is highly ranked, meaning that any optimal candidate must not violate this constraint. Both candidates in (4) violate one constraint each: candidate (a) violates the lowly ranked constraint \*ÒKÉ, while candidate (b) violates the highly ranked constraint FAITH ÒKÉ. Although both candidates violate one constraint each, candidate (a) emerges as the optimal candidate because it only violates a lower-ranked constraint.

**Constraints for Egbègba ‘Two-hundred Thousand’ (200,000)**

1. FAITH EGBÈGBÈ: The EGBÈGBÈ in the input must have correspondent in the output
2. ÒKÉ: Allow ÒKÉ
3. \*LOAN: Prohibit loan-word
4. \*ODù: Prohibit ODù

The constraints above must be ranked in the following ways.

FAITH EGBÈGBÈ >> \*LOAN >> ÒKÉ >> \*ODù

TABLEAU 5

Egbègbèrún ‘One-billion’	FAITH EGBÈGBÈ	*LOAN	ÒKÉ	*ODù
 Egbègbèrún			*	

Àádóta òké	*!			
Odù kan	*!		*	*
Mílìonú kan	*!	*!	*	
Egbèlégbè kan	*!		*	

In Tableau 5, FAITH EGBÈGBÈ and \*LOAN are highly ranked, meaning that any optimal candidate must not violate any of these constraints. Candidate (a) violates a low ranked constraint ÒKÉ, candidate (b) violates a highly ranked constraint FAITH EGBÈGBÈ, candidate (c) violates a highly ranked constraint FAITH EGBÈGBÈ, and two low-ranked constraint ÒKÉ and \*ODù, candidate (d) violates two highly ranked constraints FAITH EGBÈGBÈ and \*LOAN, and a low-ranked constraint ÒKÉ, while candidate (e) violates a highly ranked constraint EGBÈGBÈ, and a low-ranked constraint ÒKÉ. Although both candidates (a and b) violate one constraint each, candidate (a) emerges as the optimal candidate because it only violates a lowly-ranked constraint.

**Constraints for Egbègbègbà ‘Two-hundred million’ (200,000,000)**

1. FAITH EGBÈGBÈGBÈ: The EGBÈGBÈGBÈ in the input must have correspondent in the output
2. ÒKÉ: Allow ÒKÉ
3. \*LOAN: Prohibit loan-word
4. \*EERU: Prohibit EERU

The constraints above must be ranked in the following ways:

FAITH

ĘGBĘGBÈGBÈ >> \*LOAN >> ỌKÉ >> \*EERU

TABLEAU 6

Ęgbẹgbẹgbẹ̀rún ‘One-billion’	FAITH ĘGBĘGBÈGBÈ	*LOAN	ỌKÉ	*EERU
 Ęgbẹgbẹ̀rún			*	
Èdọ̀k è̀eta Ọkẹ̀	*!			
Eeru kan	*!		*	*
Bílìọ̀nú kan	*!	*!	*	

In Tableau 6, FAITH ĘGBĘGBÈGBÈ and \*LOAN are highly ranked, meaning that any optimal candidate must not violate any of these constraints. Candidate (a) violates a low ranked constraint ỌKÉ, candidate (b) violates a highly ranked constraint FAITH ĘGBĘGBÈGBÈ, candidate (c) violates a highly ranked constraint FAITH ĘGBĘGBÈGBÈ, and two low-ranked constraint ỌKÉ and \*EERU, while candidate (d) violates two highly ranked constraints FAITH ĘGBĘGBÈGBÈ and \*LOAN, and a low-ranked constraint ỌKÉ. In spite of both candidates (a and b) violate one constraint each,

candidate (a) still emerges as the optimal candidate due to the fact that it only violates a lowly-ranked constraint.

**Constraints for Ęgbẹgbẹ̀gbẹ̀gba Two-hundred Billion (200,000,000,000)**

1. FAITH ĘGBĘGBÈGBÈGBÈ: The ĘGBĘGBÈGBÈ in the input must have correspondent in the output
2. ỌKÉ: Allow ỌKÉ
3. \*LOAN: Prohibit loan-word

The constraints above must be ranked in the following ways.

FAITH ĘGBĘGBÈGBÈ >> \*LOAN >> ỌKÉ >>

TABLEAU 7

Ęgbẹgbẹ̀gbẹ̀rún ‘One-trillion’	FAITH ĘGBĘGBÈGBÈGBÈ	*LOAN	ỌKÉ	*EERU
 Ęgbẹgbẹ̀rún			*	
Ęgbàálélé̀dẹ̀ gbẹ̀ta-ọkẹ̀ Ọkẹ̀	*!			
Trílìọ̀nú kan	*!	*!	*	

In Tableau 7, FAITH EGBÈGBÈGBÈ and \*LOAN are highly ranked, meaning that any optimal candidate must not violate any of these constraints. Candidate (a) violates a low ranked constraint ÒKÉ, candidate (b) violates a highly ranked constraint FAITH EGBÈGBÈGBÈGBÈ, while candidate (d) violates two highly ranked constraints FAITH EGBÈGBÈGBÈ and \*LOAN, and a low-ranked constraint ÒKÉ. In spite of both candidates (a and b) violate one constraint each, candidate (a) still emerges as the optimal candidate because it only violates a lowly-ranked constraint.

## 6. Discussion

This analysis reveals that Yoruba numeral multiplicands achieve structural precision and adaptability through constraint hierarchies. Each constraint ranking respects Yoruba's linguistic integrity, allowing numeral forms to expand from small to large values. The OT-based approach illustrates Yoruba numerals' flexibility and internal coherence, as well as their resistance to external influence through strict constraints against loanwords.

## 7. Conclusion

By applying OT to Yoruba numeral multiplicands, this study underscores the language's complex numeral system and its reliance on constraint interactions. Through FAITH and \*LOAN constraints, Yoruba maintains both linguistic purity and adaptability, expanding to numerals in the trillions without external borrowing. The OT framework clarifies the systematicity of Yoruba

numerals, offering a valuable model for understanding the linguistic richness embedded within Yoruba language.

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