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An Optimality Theory Account of Phonological Adaptations of English Loanwords to Ng'aturukana (Turkana) Language

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Abstract:
Borrowed words get to the system of the recipient language with foreign structures. The borrowed words may feature different sets of phonotactics and alien phonemes in the view of the borrowing language. These new phonotactics and phonemes must, however, be adapted through various phonological adaptation processes to befit the borrowing language rules. This paper sought to analyze how Optimality Theory accounts for how English words are phonologically adapted to fit them into the structure of Ng'aturukana (Turkana), the borrowing language. The paper sought to answer two questions:

- *What phonological adaptation processes do the English loanwords undergo when borrowed to Ng'aturukana?*
- *How does the principle of constraint ranking account for the observed phonological adaptations?*

*Theoretically, the paper relied on Optimality Theory to account for the adaptation processes. The study collected thirty (30) English loanwords borrowed into Ng'aturukana. These were drawn from the researcher's MA thesis, the researchers' intuition and common radio station discourses in Turkana County (radio Akicha and Sayari). These data were subjected to validation through two adult speakers of Ng'aturukana. The researcher employed a purposive sampling technique in identifying eighteen (18) loanwords that were analyzed to answer the two research questions. The following were some of the key findings: one, insertion, resyllabification, monopthongization, and spirantisation processes are key in adaptation of English words in Ng'aturukana, and two, the OT constraints that facilitate adaptation of loanwords in Ng'aturukana are *DIPH, *[LAB-DENT], *[ə]V, *[a]V, [*DR], *OBSTRUENT-LIQUID, and DEP-IO. The findings are expected to contribute to the credibility of OT as a universal and typological theory and to issues in cross-linguistic loanword phonology.*

Keywords: *Turkana, ng'aturukana, phonological adaptations, insertion, monopthongization, resyllabification, spirantisation, optimality theory*

1. Introduction

This paper investigated the phenomenon of phonological adaptation of English loanwords to Ng'aturukana. Ng'aturukana is the language spoken by the Turkana ethnic community of Kenya. Ng'aturukana's anthropolinguistics distinguishes between the terminology used to refer to the community and its language. Apparently, Turkana is the name of the ethnic community, while Ng'aturukana is used to refer to the language.

In particular, the paper aims to explain how the phonological adaptations (processes) are necessitated by Optimality Theory's constraints ranking scale in Ng'aturukana language. Loanwords are words borrowed into a foreign language either in their original or adapted forms (Tioko, 2021). According to Tioko et al. (2021), the borrowing of words to Ng'aturukana from English is motivated by the intense linguistic contact involving the two languages. As such, there is constant contact between the two languages in the semantic fields of education, sports and entertainment, trade, agriculture, science and technology, and religion, among others.

In a linguistic environment where languages are in constant contact and interaction, new concepts are shared. This sharing may be motivated by the fact that the native cultures that give birth to languages differ, first, in proto-language families and other sub-divisions even within the same branch. Therefore, the farther the family distances, the more the differences. Therefore, any new object encountered by a foreign language may acquire a name either through coinage of new terms or loanwords adaptation. What languages do with these new shared terms is subject to linguistic and theoretical scrutiny because the results often intrigue linguists. This paper focused on discussing how the possible phonological adaptations noted in Ngaturukana-English interaction are explainable within the frames of Optimality Theory.

Generally, the phonological adjustments targeting borrowed words are necessitated by the existing language's particular rules. In this paper, the rules are referred to as language-particular constraints. The term is generated from Prince and Smolensky's Optimality Theory (1993). The main concern of this paper, therefore, was to explain how the constraints matter in adapting the new words to Ng'aturukana.

The paper begins by explaining the loanword phenomenon in both Ng'aturukana and English, followed by a brief account of the phonological processes in Ng'aturukana. Subsequently, an Optimality Theory precise discussion and

overview of related literature and the methodology are explained. Next, the study's findings and discussions are presented. The last section features the study's conclusions, recommendations, and references.

1.1. Emergence of Loanwords: English and Ng'aturukana

One main result of a multi-cultural and multi-lingual environment is loanword sharing (Tioko, 2021). A loanword is a term borrowed into the system of another to represent an already existing term or a new term for a non-existent object/concept and/or activity (Tioko et al., 2020). The essence of borrowing is to facilitate communication among the speakers when referring to particular objects. In addition, languages encounter linguistic deficiencies because a concept must be known by its speakers prior. When the speakers are unable to get a native word to refer to a new concept, the foreign term is readjusted to suit the needs of the borrowing language. The readjustments in the borrowing language are viewed positively in the recipient language but negatively in the donor language. Although the term appears alien in the borrowing one, it facilitates the communication exchange. Over time, it ends up as part of its morphological inventory.

It is worth noting that borrowing words is guaranteed by the fact that culture and all its embodiments define what should be present and be lacking in a language. The cosmopolitan new societies that have arisen due to multi-culturalism and multilingualism have borne new linguistic structures, often through the loaning of words. English and Ng'aturukana are not exceptional to this new trend and, hence, are under focus here.

English, now a global language, is an Indo-European Germanic language with its routes in England and the present day, the United Kingdom. Historically, its influence on many nations and across the world was propelled by the ambitious nature of the British people to conquer, explore, and change the world through missionary activities and education. It is through these activities that Ng'aturukana got into contact with English. Ng'aturukana, an Eastern Sudanic Language belonging to the Teso-Turkana group, is spoken by the Turkana people, largely occupying the northwestern part of Kenya (Tioko, 2021).

2. Literature Review and Theoretical Framework

2.1. Literature Review

Generally, loanwords may be adapted both phonologically and morphologically to befit the system of the borrowing language (Cohen, 2009). As regards the former, a borrowed word is altered to phonologically fit the phonological inventory of the language in question.

Several researchers, like Tadmor (2012), Mwaniki (2013), Muriira (2017), and Tioko (2021), postulate that most phonological adaptations are necessitated by phonemic inventory discrepancy and syllable differences. Substitution, a phonological process whereby a phoneme is replaced by another, occurs due to some limitations of the borrowing language phonemic inventory (Tioko, 2021). Substitution often targets replacing one phoneme with another that is present or close to that of the borrowing language. Substitution generally affects both consonants and vowels. Mwikali (2018) also agrees with this argument by positing that most borrowed words in African languages undergo insertion, resyllabification, monopthong'ization, and spirantization, among others, during loanwords adaptation.

Both Dimmendaal (1983) and Tioko (2021) agree that Ng'aturukana language phonemic inventory may present problems to both new learners of Ng'aturukana, especially if they are speakers of other mother languages. Dimmendaal and Tioko acknowledge that Ng'aturukana has 17 consonants that include eight plosives, /p/, /b/, /t/, /d/, /k/, /ɡ/, /c/, /ɟ/, four nasals /m/, /n/, /ɲ/, /ŋ/, two approximants /l/, /r/, one fricative /s/, and two semi-vowels /ɹ/, /w/, and 18 vowels: Voiced- /i/, /ɪ/, /e/, /ɛ/, /a/, /ɔ/, /o/, /ʊ/, /u/, devoiced //i̥/, /ɪ̥/, /e̥/, /ɛ̥/, /ḁ/, /ɔ̥/, /o̥/, /ʊ̥/, /u̥/. Comparatively, English, on the other hand, has 24 consonants and 26 vowels, including the complex ones (Roach, 2010).

In addition, Tioko et al. (2020) and Tioko et al. (2021) confirm that ATR Harmony, one of the phonological processes that affect English loanwords borrowed to Ng'aturukana, is a key adaptation strategy of loanwords. This claim agrees with Barasa (2018) about Ateso language on both its native and borrowed words from English and Kiswahili. Both views affirm that loanwords from English, a language that is ATR harmony deficit, must be earmarked for [ATR] Harmony in Ng'aturukana. In particular, the Teso-Turkana group of languages is unmarked for [ATR harmony]. Tioko et al (2021) proposed that [ATR] harmony in Ng'aturukana is modelled by OT constraints ranking scale ALIGN [–/+ATR] L >> $IDENT_{ROOT\ [ATR]}$ >> $IDENT\text{-}IO_{[ATR]}$ and IDENT[SUFFIX] [ATR], ALIGN [+ATR] L>> ALIGN [ŋi] L, ALIGN [i] R >> IDENTROOT [ATR] for progressive and regressive [ATR] harmony respectively.

2.2. Optimality Theory

This paper utilized Optimality Theory (OT) by Prince and Smolensky (1993), Kager (1999), and McCarthy (2002, 2004, and 2008). OT is a typological theory that relies on hierarchical constraints ranking languages in determining optimal candidates. A constraint is a language-specific structural requirement that can either be satisfied or violated by the generated output forms (Prince & Smolensky, 1993; Tioko, 2021). All constraints are universal. Universal constraints are of two types. First, there are markedness constraints that are assessed mainly through a focus on the output well-formedness (McCarthy, 2004; Nandelenga, 2013). They often lead to the well-formedness of the output form, hence forbidding the prohibited structures in a particular language. Secondly, there are faithfulness constraints. These are assessed by gauging the levels of congruence between the input form and the output form (McCarthy, 2004). These constraints demand that the outputs must maintain the basic features of the basic lexical (input) forms. However, a margin of similarity between the input and the outputs must exist (Kager, 1999).

Constraints are ranked on a scale beginning with the high ranked to the low ranked. A strict ranking between two constraints is shown by a single continuous line, while dotted lines indicate non-crucial ranking. OT also uses two other components: the generator that gives several possible candidates from an input form and the evaluator that assesses all the candidates on the basis of incurred violations denoted by violation marks. An asterisk (*) means a violation, an asterisk plus an exclamation (*!) means a fatal violation, while a pointing finger (☞) means the selected candidate.

In addition to the morphological and phonological constraints, Kager (1999) and Hyde (2012) introduced the idea of ALIGN constraints that require that the right or the left margins of an output form must coincide with the left or right edges of the prosodic words, respectively. Through this, ALIGN [ATR] constraints and ALIGN [AFFIXES] LEFT OR RIGHT of the prosodic words observed in loanwords adaptation in Ng'aturukana are addressed.

The findings of this paper established that Ng'aturukana uses constraints such as * DIPH (disallow any candidate occurring with a diphthong vowel), *[LAB-DENT] (disregard a labio-dental fricative of any kind (/f/ or /v/) in a phonological word in Ng'aturukana, and *OBSTRUENT-OBSTRUENT (no two obstruents should co-occur in an Ng'aturukana syllable). Moreover, it also employs [*DR] (disband a delayed release), *OBSTRUENT-LIQUID (disallow structures that occur with an obstruent and a liquid cluster), and DEP-IO (disallow insertion), among others.

3. Methodology

The study targeted to collect 30 (thirty) loanwords from common discourse exchanges undertaken in Ng'aturukana native radio stations, the researcher's Master of Art thesis and intuition. During analyses, 18 (eighteen) words were sampled and selected from the 30 words collected for discussion. Particularly, the local Turkana County radio stations broadcasting in Ng'aturukana: Radio Akicha and Sayari and Frequency Modulations (FMs) were the main sources for the study's data. The contexts of broadcasts upon which the ideal discussions were sourced were education and trade, especially on school preparation items to purchase as students prepared to report to school in May 2023. Parents would call the hosts of the radio program to inquire, register complaints and seek advice from other parents. Eight (8) radio shows of the first week of May, from Tuesday to Friday from 9:00 a.m. to 10:00 a.m., were recorded, transcribed, translated and given glosses. The actual loanwords were then isolated from the main discourse. Also, the researcher, being a native speaker of Ng'aturukana, generated some words. All the generated data were later given to two native speakers of Ng'aturukana to verify and validate. To isolate the adaptation processes taking place, both English and Ng'aturukana words were given. The observed structures and processes were checked with Optimality Theory (OT) main tenets. The constraints' ranking scales for each of the adaptation processes were presented before the main tableau and a discussion of the issue in question was given.

4. Results, Analyses and Discussion

An examination of the obtained data on English words borrowed from Ng'aturukana established the following phonological processes as the most prevalent in loanword adaptation in Ng'aturukana.

4.1. Insertion: Epenthesis

Insertion is a phonological process whereby a new phoneme is inserted into the structure of a word (Mallya, 2018). The commonest form of insertion noted among Ng'aturukana loanwords adaptation was epenthesis. This process, in the nativisation of loanwords, is often motivated by the need to readjust the structure of the borrowed words to conform to the syllabic constraints of the borrowing language phonology (Tioko, 2021). Generally, the new word that originates after epenthesis features more syllables than the borrowed word. Therefore, they are less alien than the borrowed English word without any alterations. The analyses of the collected data featured two forms of epenthesis: prosthesis (the insertion of a vowel word-initially) and anaptyxis (insertion of a vowel between a cluster of two consonants). Data set 1 below shows some examples of epenthesis.

- Data set 1: Insertion in Ng'aturukana Borrowed Words

	English Word	**Ng'aturukana Borrowed Word**	**Gloss**
A	[glæs]	[ɛgɪlasɪ̰]	glass
B	[bɒks]	[abɔkɪs]	box
C	[ɔɪl]	[awoɟil]	oil
D	[faɪl]	[apaɟɪl]	file

Table 1: Insertion in Ng'aturukana Borrowed Words

First, epenthesis from data set 1 above was observed to occur in both words initially, hence, prosthesis, and in between consonants, thus anaptyxis. As such, prosthesis was observed to be an unmarked insertion process in all English loanwords existing in Ng'aturukana. This form of insertion is morpho-phonologically instigated. Morphologically, prosthesis of vowels /a/, and /e/ or /ɛ/ is affixed to the words initially to assign it either the feminine or masculine gender in a singular number. The former is applied to the feminine gender, while the latter is to the masculine gender. This phenomenon is natural to Ng'aturukana because all nouns, whether animate or inanimate, are gender-defined (Dimmendaal, 1983; Tioko et al., 2020). Phonologically, however, the insertion of the vowel left of the words or words initially makes the word begin with an open syllable. This is a characteristic of all nouns in Ng'aturukana. As a result, grammatical gender markers have both morphological and phonological importance. Each of the words in data set 1 applies prosthesis.

In addition to prosthesis, other forms of epenthesis occur at words medial and ultimate syllables in borrowed words. If a medial syllable features a cluster of disallowed consonant clusters in Ng'aturukana, an adjustment is imposed by adding a vowel in between them. This is called anaptyxis. Ng'uturukana, in its entirety, bans a sequence of both Obstruent-Obstruent (OO) and Obstruent-Liquid (OL) in its words. Nevertheless, it allows a sequence of a nasal and a plosive, as in the case of prenasalised consonants and an Obstruent-Glide (OG). As regards the ultimate syllables, a voiced or a devoiced vowel may be added to a borrowed word. Evidence from Tioko (2021) shows that very few syllables occur with closed syllables in Ng'uturukana. Such include words' final syllables ending with a lateral sound /l/ and a nasals sound /n/, /ŋ/ and /ɲ/.

Theoretically, Optimality Theory (OT) accounts for the application of epenthesis noted in all the borrowed words given. Notwithstanding, epenthesis occurs due to the existence of both the well-formedness and faithfulness constraints. In consideration of the input /glæs/, which is adopted by Ng'aturukana as [ɛgɪlasɪ̥] (output) 'glass,' for instance, the following paragraph spells out some proposed constraints.

To assign the noun the grammatical gender (feminine), the morphological constraint Align [a] L (align the affix for the feminine gender left of the word) is proposed. Although this is an inviolable morphological constraint, it must rank lower than the phonological markedness constraints (Kager, 1999). In addition, because a cluster of an obstruent and a liquid in a syllable onset position is banned in Ng'aturukana, the markedness constraint *OL$_{ONS}$ is proposed. Phonemically, vowel /æ/ is absent in Ng'aturuka vowels inventory. The language, in its own specifications, substitutes it with phoneme /a/. In this view, therefore, the constraint *[æ]V is proposed (Tioko, 2021). This is an inviolable constraint in Ng'aturukana and, hence, high ranked. This vowel must, however, be replaced by a warranted vowel /a/ in the language. To address this, the constraint IDENT[æ]V, a low-ranked constraint, is proposed. This constraint requires that the features of vowel /æ/ must not be changed in the output. Lastly, in order to account for all forms of insertions, including that of the last syllable in the output [ɛgɪlas*ɪ̥*], the constraint DEP-IO$_V$ is proposed. This constraint disallows any insertion of a vowel in the structure of the syllable.

In terms of the ranking scale, the above constraints were ranked as follows:
OBSTRUENT-LIQUID $_{ONSET}$ (OLONS), *[æ]V>> ALIGN [ɛ]L >> IDENT[æ]$_V$, DEP-IO$_V$.

On the basis of the tableau, the output [[ɛgɪlasɪ̥] 'glass' was adopted as shown below.

/glæs/	OL$_{ONS}$	*[æ]V	ALIGN [ɛ]L	IDENT[æ]$_V$	DEP-IO$_V$
a. ☞ [ɛgɪlasɪ̥]				*	***
b. [glasɪ̥]	*!		*	*	*
c. [glæs]	*!	*	*		
d. [gɪlasɪ̥]			*!	*	**

Table 2: /glæs/ ⟶ [ɛgɪlasɪ̥] '⍰lass'

On the one hand, table 2 presents candidate (a) as the winning candidate. It conforms to the requirements of the principle of minimal violations. This principle states that a candidate may become optimal by incurring the least fatal violations from various competing constraints. From the ranking scale preceding the tableau, it is evident that the constraint IDENT[æ]$_V$ and DEP-IO$_V$ are low-ranked because they appear last on the ranking scale. Overtly, these are the only violations that the candidate incurs.

On the other hand, candidates (b), (c), and (d) are banned. Candidate (b) is violated based on its fatal violation of the constraints *[æ]V and ALIGN [ɛ]L. The same candidate incurs violations of the low-ranked constraints IDENT[æ]V and DEP-IOV, but these violations are inconsequential because they are low-ranked. Next, candidate (d) is barred from being optimal. Although it conforms to the requirements of OL$_{ONS}$ and *[æ]V, it is ruled out because it is morphologically maladapted. This candidate violates the high-ranked general alignment constraint, ALIGN [ɛ]L. Every noun in Ng'aturukana must be marked for a particular grammatical gender. Moreover, the latter violations are anticipated to occur in order to adapt the word fully to Ng'aturukana. Candidate (c) is the most maladapted candidate. This candidate disobeys the demands of all the three high-ranked constraints: OL$_{ONS}$, *[æ]V and ALIGN [ɛ]L, thus eliminated.

4.1.1. Monophthongization

This phonological process refers to the case whereby a complex vowel is simplified and reduced to a pure (simple) vowel in a prosodic word. Because Ng'aturukana does not have any complex vowel, all diphthongs that appear on English borrowed words are reduced to monophthongs. Consider data set 2 given below.

- Data set 2: Monophthongization of Diphthongs

	English Word	Ng'aturukana Borrowed Word	Gloss
i.	[ɔɪl]	[awɔjɪl]	oil
ii.	[Faɪl]	[apajɪl]	file
iii.	[kəʊntə]	[aɣawunta]	counter
iv.	[kəʊt]	[ɛɣɔtɨ]	coat
v.	[pləʊ]	[ɛpɪlɔ]	pillow
vi.	[səʊlə]	[asola]	solar
vii.	[meleərɪə]	[emalerɪ.a]	malaria
viii.	[trəʊzəz]	[etʊrɔsa]	trouser

Table 3: Monopthongization of Diphthongs

From data set 2, Ng'aturukana applies three strategies in achieving monophthongization. First, excrescence, which entails the insertion of a consonant to the structure of a prosodic word, is employed in examples (i), (ii), and (iii). In dealing with disallowed diphthongs, Ng'aturukana inserts the semi-vowel consonants in between the two vowels, making up a diphthong. This scenario mainly occurs when a homorganic high vowel is part of the diphthong. This is exemplified by vowels /ɪ/ and /ʊ/. The glide /ɲ/ is added to discontinue a sequence of /aɪ/ or /ɔɪ/ while /w/ is added to discontinue a sequence of /aʊ/. The end products of the procedure are monophthongs, which belong to different syllables.

Second, Ng'aturukana applies the substitution of diphthongs with monophthongs when adapting loanwords from English into its system (as in examples iv, v, vi). In iv, v and vi, for instance, the closing diphthong/əʊ/ is replaced with the monophthong /ɔ/ vowel. This observation is attributed to the perceptual nature of this diphthong in Kenyan English (KE), a regional variety of English common among the speeches of Kenyans. Spoken Kenyan English does not differentiate between vowel /ɔ/ and the diphthong /əʊ/ (Itumo, 2018). According to Itumo, KE has significant effects on the Received Pronunciation.

Lastly, the deletion of one of the vowels making up the diphthong is also applied in achieving monophthongization. In most cases, Ng'aturukana drops the mid-central vowels in the diphthong (s) when dealing with borrowed words (Consider examples vii & viii). The observation above agrees with Tioko's (2021) position that Ng'aturukana lacks most of the central vowels and thus applies substitution or deletion when adapting loanwords featuring unattested central vowels. As a result of the language-imposed deletion, what features in the source language word as a diphthong becomes a monophthong when borrowed into Ng'aturukana.

Theoretically, the observations established above can be articulated within the frames of OT theory. In the adaptation of the input /kəʊntə/ to output [aɣawunta] 'counter' the following constraints can be proposed. First, Ng'aturukana specifically disallows the occurrence of diphthongs in the structures of its prosodic words. In this regard, therefore, the language particular constraint *DIPH is proposed. This constraint prohibits any occurrence of a diphthong in the language that none of the diphthongs is attested. Secondly, although English has the schwa /ə/ vowel in its phonetic system, Ng'aturukana does not. So, the language particular constraint, *[ə]V (disallow occurrence of /ə/ in a prosodic word), is proposed. Moreover, any noun word must be marked for grammatical gender in Ng'aturukana. Thus, proposing a constraint that will motivate a violation or obedience to General Alignment constraint is prudent. In this regard, the constraint ALIGN [a]L is proposed. This constraint calls for the affixation of the feminine gender to the left of the prosodic word. All the above constraints are high-ranked and, therefore, inviolable.

In addition to the above constraints, it is apparent that there is a need to propose more constraints, especially the faithfulness ones. This is permissible because all loanwords must incur some adjustments when adopted into Ng'aturukana. In that regard, the constraint IDENT[ə]V, which forbids change of schwa /ə/ vowel features in the output, is proposed. Moreover, to prohibit the insertion of any segments that may lead to a lack of correspondence between the input and the output, the constraint DEP-IO$_{SEG}$ is included in the analyses. This constraint disregards any inclusion of a segment into the structure of a prosodic word.

The above-proposed constraints can be placed on a scale of competing constraints. The following is the proposed ranking scale for the input /kəʊntə/ and the output [akawunta] 'counter.'

*DIPH, *[ə]V >> ALIGN [a]L >> DEP-IO$_{SEG}$, IDENT[ə]V.

		*DIPH	*[ə]V	ALIGN [a]L	DEP-IO$_{SEG}$	IDENT[ə]V.
a.	[kəʊntə]			*!		
b.	[akawʊntə]		*!		**	*
c.	☞ [akawʊnta]				**	**
d.	[akəʊntə]	*!	*		*	

Table 4: /kəʊntə/ ⟶ [akawʊnta] 'counter'

Tableau 4 presents candidate (d) as the most disharmonic one. This candidate fails to keep to the demands of constraints *DIPH and *[ə]V, both of which are inviolable constraints. Due to these fatal violations, it is eliminated. Candidate (b) follows as the next candidate, which incurs a fatal violation in the fatality index continuum. This candidate retained a prohibited schwa /ə/ sound in Ng'aturukana. It is, therefore, dropped. In the same manner, candidate (a) is also ruled out based on its violation of the ALIGN[a] left constraint. No noun in Ng'aturukana should be a deficit of grammatical gender (Tioko et al., 2020; Tioko, 2021). Since the evaluator has eliminated three of the four candidates, the only one

remaining so far is candidate (c). This is considered the optimal candidate because it kept to the demands of the high-ranked constraints and is also well-adapted to befit Ng'aturukana prosodic composition. The violations incurred by this candidate are inconsequential and, hence, do not lead to the disqualification of the candidate. So far, none of its syllables occurs with a banned diphthong.

4.1.2. Resyllabification

Resyllabification refers to the process whereby the syllables are expanded and adjusted to agree with that of the borrowing language. Every language has modalities in which its syllables are built and structured. A syllable is the minimal realizable unit during the articulation of a prosodic word (Anyanwu, 2008). How these syllables are constituted depends on the existing constraints in a particular language. As such, many languages differ in how their prosodic words and syllables are constituted.

In borrowing, if the proto-language families are distant, the syllables may portray several differences. English and Ng'aturukana languages have different common ancestries. Characteristically, English language allows consonant clusters (CC) words initially, medially and finally, while Ng'aturukana disregards all Obstruent-Obstruent and Obstruent-Liquid constructions. Ng'aturukana only permits the prenasalised consonants (^{N}C) and Obstruents-Glides (OG). Since Ng'aturukana aligns grammatical gender to the left of a word, each of Ng'aturukana nouns must minimally be bimoraic or bisyllabic. Therefore, any borrowed English word must add a syllable or more depending on its complexity. In the case of long vowels or complex ones, Ng'aturukana will reduplicate the vowel and shorten it or separate the two vowels so that they belong to separate syllables. In most cases, borrowed words whose syllables are dissimilar to those of the borrowing language undergo readjustment, hence resyllabification. Consider data set 3 given below.

- Data set 3: Resyllabification of Ng'aturukana Borrowed Words.

	English Word		Ng'aturukana	L.Word	Gloss
i.	[kɑd]	CVC	[aɣaad]	V.CV.VC	card
ii.	[tɜm]	CVC	[a.ta.am]	V.CV.CV	book
iii.	[gləʊb]	CCVC	[ɛ.gɪ.lɔ.bǫ]	V.CV.CV.CV	globe
iv.	[keɪbl]	CV.CC	[a.kɛ.bɔ.lɔ]	V.CV.CV.CV	cable
v.	[spɪkə]	CCV.CV	[a.sɪ.pɪ.ka]	V.CV.CV.CV	speaker
vi.	[frɪdʒ]	CCVC	[a.pɪ.rɪɟ]	V.CV.CVC	fridge

Table 5: Resyllabification of Ng'aturukana Borrowed Words

From data set 3, we can confirm one main similarity between English and Ng'aturukana. They are both open and closed-syllable languages. Both types are attested in their syllabic structures. However, there are a number of differences that are a result of resyllabification and OT-imposed constraints. Examples (i) and (ii) show that the monosyllabic word is adapted as a trisyllabic word. What has taken place is that, first, the OT constraint ALIGN[a]L motivated the addition of an open syllable to the left of both words. Secondly, the two unattested long vowels /ɑ/ and /ɜ/ are replaced by short /a/ vowels in Ng'aturukana. Reduplication is done on the vowels such that each is pegged to the different syllables. The motivating constraints here are [*ɑ]V and [*ɜ]V, which block the occurrence of /ɑ/ and /ɜ/ vowels in Ng'aturukana, respectively. Resyllabification of the two examples is a result of two faithfulness constraints: MINWD (A noun must be bisyllabic) (Musa & Alqahtani, 2015) and DEP-IO$_V$ (disallow epenthesis in words). The former is a crucial constraint in Ng'aturukana. All these constraints lead to an increase in syllables, thus resyllabification.

Moreover, examples iii, iv, v & vi feature loanwords that occur with CC structures and so must be readjusted. Example (iii) occurs with an OL (gl) structure at the syllable onset, while example (iv) occurs with an OL (bl) at the syllable coda position. Ng'aturukana disallows this and, therefore, introduces epenthesis between /gl/ and /bl/. By discontinuing the CC structures, the prosodic word grows bigger and heavier because another syllable has been added. Theoretically, the markedness constraints OL$_{ONS}$ and OL$_{CO}$ are the ones deemed responsible for these resyllabifications. The former militates against an OL structure at the onset position of a syllable, while the former disallows an OL structure in the syllable coda position. The two impose epenthesis. Likewise, examples (v) and (vi) occur with disallowed consonant clusters. Example (v) has an OO structure at the syllable onset position, while example (vi) chances with a banned Continuant-Continuant structure at words onset positions. Just as for examples (iii) and (iv), Ng'aturukana applies OT constraints OO$_{ONS}$ (forbids an obstruent and obstruent cluster at the syllable onset) and CONT-CONT$_{ONS}$ (prohibit a cluster of a continuant and a continuant at the syllable onset position). The two constraints, therefore, make it possible for the /sp/ and /fr/ clusters to employ epenthesis. Generally, epenthesis is necessitated by the low-ranked DEP-IO constraint, while ALIGN [affix for gender] L is responsible for the open syllable in all the borrowed words (see data set 3 above).

In a constraints competition tableau, for instance, the input /frɪdʒ/ is realized as [a.pɪ.rɪɟ] 'fridge' as the optimal output results because of the existence of the following constraints. First, since there is a + [Cont-Cont] structure in the input, the constraint *[CONT-CONT$_{ONS]}$ is applied. Secondly, because Ng'aturukana does not have delayed released (affricates) consonants, it substitutes /c/ and /ɟ/ in place of /tʃ/ and /dʒ/, respectively. The phoneme /dʒ/ appearing in the input must be dealt with. In this regard, the constraint *DR is proposed. This constraint demands that a delayed release consonant should not occur in the language where it is unattested (Tioko, 2021).

Besides, Ng'aturukana lacks the two labio-dental fricatives phonemes (/f/ & /v/). As a result, the constraint *[LAB-DENT] is proposed. This constraint militates against the occurrence of a labio-dental fricative in languages that they are not attested. In addition, the crucial faithfulness constraint MINWD is proposed to disband any candidate occurring without an onset syllable and is not bimoraic or more. Also, the constraint ALIGN [a]L is proposed because the concept is assigned the feminine gender when borrowed to Ng'aturukana. To cater to the feature changes and the insertions, the constraints $IDENT_{-[DR],}$ $IDENT_{[LAB-DENT]}$ and $DEP\text{-}IO_V$. $IDENT_{[DR]}$ forbids changes in the DR features in the output, while $IDENT_{[LAB-DENT]}$ prohibits changes in labiodental fricative features in the output. These three constraints are low and non-crucial.

The above-proposed constraints can be ranked as follows:

*[DR], *[CONT-CONT]$_{ONS}$, *[LAB-DENT]>>MINWD>>ALIGN[a]L>>$IDENT_{[DR],}$ $IDENT_{[LAB-DENT]}$ and $DEP\text{-}IO_V$.

/frɪdʒ/	*[DR]	*[CONT-CONT]$_{ONS}$	*[LAB-DENT]	MINWD	ALIGN[a]L	IDENT $_{[DR]}$	IDENT [LAB-DENT]	DEP-IO$_V$
a. [frɪdʒ]	*!	*	*	*	*			
b. [afrɪɟ]		*!				*		**
c. [afɪrɪɟ]			*!			*		**
d.☞ [a.pɪ.rɪɟ]						*	*	**

Table 6: Input /frɪdʒ/⟶ output [a.pɪ.rɪɟ] 'fridge'

Tableau 6 portrays candidate (a) as the most disharmonic. In fact, it not only violates the demands of the three undominated constraints, *[DR], *[CONT-CONT]$_{ONS}$, *[LAB-DENT] but also the other two crucial constraints: MINWD and ALIGN[a]L. Due to this unconformity to the requirement of Ng'aturukana language, it is ruled out. This candidate did not employ resyllabification. Similarly, candidate b is also eliminated by the evaluator. This candidate applies partial resyllabification by only adding the V (open) syllable leftwards. However, the cont-cont structure /fr/ is still unattended. Due to this, the undominated constraint *[CONT-CONT]$_{ONS}$ is violated. If this candidate discontinued the /fr/ structure, it would be considered fully structured. For this failure, therefore, it is ruled out. Next, candidate (c), although conforming to the syllable requirements of Ng'aturukana, is also maladapted. This candidate occurs with a labio-dental fricative, which Ng'aturukana's phonemic inventory is devoid of. It, thus, violates the crucial constraint *[LAB-DENT]. It is also eliminated.
So far, the only remaining candidate is (d). This candidate obeys all the demands of the five crucial constraints but incurs violations of the three low-ranked ones. It is, thus, adopted as the winning candidate. In OT, a violation of low-ranked constraints does not impose fatal repercussions on the candidate (McCarthy, 2008). Otherwise, if the candidate incurs minimal violations, it is well adapted. In fact, for a process like resyllabification to occur, some adjustments have to take place. These adjustments normally affect the low-ranked constraints as portrayed by this candidate.

4.1.3. Spirantisation

Spirantisation is another phonological process that was employed by Ng'aturukana when borrowing words from English. This is a lenition process that results when stops are assimilated to become fricatives in specific environments of the syllables and morphemes. It is regarded as a lenition process because it weakens the stop consonants. Fricatives are phonologically weaker than stops. In the case of Ng'aturukana, the data showed that when velar stops neighbour [mid, back] vowels, the velar stop /k/ is produced as a velar fricative /ɣ/ (Dimmendaal, 1983). The vowels noted to be causing spirantisation are /ɔ/ and /o/. Consider data set 4 below.

- Data set 4: Spirantisation

	English word	Ng'aturukana Loanword	Gloss
a.	[kəʊt]	[ɛɣɔtɻ]	coat
b.	[kɔnə]	[ɛɣɔɔna]	corner
c.	[kɒlget]	[ɛɣoligetɻ]	colgate

Table 7: Spirantisation

From the examples given in data set 4, it is evident that phoneme /k/ changes to /ɣ/ in the environment of /ɔ/ and /o/. Both of these vowels are +mid and + back vowels. The articulators, during the production of /k/, tend to be pulled backward in anticipation of these back vowels. Due to this anticipation, the back of the tongue is pushed backward, hence the production of /ɣ/, which is a velar fricative. The observed loanwords share the same features as the native words. In OT, the above observation is attributed to the language's particular crucial faithfulness constraint *[k]-/[+back]V. The constraint requires that the voiceless velar stop /k/ should not occur phonetically when it neighbours + [back] vowel in a prosodic word.

For example, an OT examination of the mapping of the input /kɔnə/ and the output [ɛɣɔɔna] 'corner' indicates a competition of some constraints in Ng'aturukana. In essence, *[ə]V vowel is proposed to disband the occurrence of loanwords with a schwa in Ng'aturukana. Moreover, ALIGN[ɛ]L is proposed to deal with grammatical gender maladaptations. The positional faithfulness constraint *[k]-/[+back]V is proposed to annul any occurrence of /k/ in the

environment of + [back] vowel. Also, the constraint IDENT [ə]V is proposed to bar any features of a schwa from any change. In order to retain the features of the /k/ (velar stop), the constraint MAX-[BACK, -CONT] is proposed. This constraint requires that the features of a velar stop. Lastly, the constraint DEP-IO$_V$ is proposed to bar any insertions from taking place. The first three constraints are all crucial but ranked differently, with the most dominant being *[ə]V followed by ALIGN[ɛ]L and then *[k]-/[+back]V. The last three proposed constraints are all low-ranked.

The ranking scale for the above adaptation is given below:

*[ə]V >> ALIGN [ɛ]L >> *[k]-/[+back]V >> IDENT [ə]V, MAX-$_{[BACK, -CONT]}$, DEP-IO$_V$

/kɔnə/	*[ə]V	ALIGN [ɛ]L	*[k]-/[+back]V	IDENT [ə]V	MAX-$_{[BACK, -CONT]}$	DEP-IO$_V$
[kɔnə]	*!	*	*			
[ɛɣɔɔna]				*	*	**
[ɣɔɔna]		*!		*	*	*
ɛkɔɔna]			*!	*		**

Table 8: Input /kɔnə/ ⟶ the output [ɛɣɔɔna] 'corner'

From the foregoing tableau, candidate (b) is the optimal candidate. It is the most harmonic because it employs spirantisation and other morpho-phonological aspects correctly. This candidate obeys the demands of the dominant well-formedness constraint *[ə]V, the crucial morphological constraint ALIGN [ɛ]L and the crucial positional faithfulness constraint *[k]-/[+back]V. On the flip side, candidates (a), (c) and (d) are all eliminated. As such, candidate (a) is the most disharmonic because it violates the demands of all the crucial constraints, including *[k]-/[+back]V, which is responsible for spirantisation. Candidate (c) fails to align the crucial grammatical gender vowel left. Candidate (d), though well-structured, appears with a prohibited velar stop /k/. It is also eliminated.

5. Conclusions

This study concludes that English-borrowed words undergo phonological adjustment when borrowed into Ng'aturukana. Key to the adaptations are the phonemic and syllabic discrepancies, which dissimilate the words, hence the need for adjustments. This study also established that insertion (epenthesis), monophthongization, resyllabification and spirantisation are some of the main processes observed in the adaptation of English loanwords in Ng'aturukana.

In addition, Optimality Theory tenet of constraints ranking was observed to be adequate and efficient in accounting for the dominant processes observed above. Generally, the universal markedness and language particular well-formedness constraints were observed to rank higher than the positional faithfulness and the general faithfulness constraints.

Some of the dominant constraints observed to be employed in the adaptations are: OL$_{ONS}$, *[æ]V, *DIPH, *[ə]V, *[DR], *[CONT-CONT]$_{ONS,}$ *[LAB-DENT]. In addition to these, it was also established that General Align (GA) constraints ALIGN[AFFIX]L of the prosodic word is useful in the introduction of an onset vowel, which pegs grammatical gender to a word. The two vital GA constraints used were ALIGN[a]L and ALIGN [ɛ] L. The former was applied to the nouns considered feminine in Ng'aturukana's specifications, while the latter was used for the masculine grammatical gender.

The study also established that the faithfulness constraints play an important role in the adaptation of the loanwords to Ng'aturukana. These include MNWD, *[k]-/[+back]V, IDENT [ə]V, MAX-[BACK,-CONT], IDENT[DR], IDENT [LAB-DENT], IDENT[æ]V, IDENT[ə]V, DEP-IO$_{SEG}$, and DEP-IOV.

6. Implications of the Study

This study has implications for linguistics, especially formal linguistics and Optimality theory studies. The paper mainly centred on the phonological process which occurs when English loanwords are borrowed into Ng'aturukana. Therefore, any researcher working on Ng'aturukana phonology and linguistic contact between English and other African languages can use it.

Moreover, the study can also be employed in comparative studies. Ng'aturukana is basically an eastern Sudanic language; hence, the observations made on the loanwords' adaptations can be tested in another language. This study also used Optimality Theory as the main theoretical framework. Indeed, it established that OT is an efficient theory as it was able to account for the loanwords' adaptations in Ng'aturukana. Through its principle of universal constraints, both the dominant and the dominant constraints have been established. The theory can also be applied to any other aspect of language, including morphology, syntax and tonology.

7. Recommendations for Further Research

This paper is centred on English loanwords only. It was silent on the fact that Kiswahili is the national language of Kenya and has wider usage than English, even among the uneducated citizens. The paper recommends that another study of a similar kind should be undertaken to establish the strategies employed when adapting Kiswahili words into Ng'aturukana.

In addition, the study focused on the phonological phenomenon and avoided the morphological one. Another study is recommended to exhibit the morphological processes employed in Ng'aturukana when dealing with English-borrowed words in its system. This is because it is hypothesized that issues like affixation, compounding and coinage may be utilized in adapting the words morphologically.

8. References

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Appendix

No.	English Word	Ng'aturukana Adapted Word	Gloss
1.	[kɑd]	[aɣaad]	card
2.	[tɜm]	[ataam]	book
3.	[gləʊb]	[ɛgɪlɔbo̱]	globe
4.	[keɪbl]	[akɛbɔlɔ]	cable
5.	[spɪkə]	[asɪpɪka]	speaker
6.	[frɪdʒ]	[apɪrɪɟ]	fridge
7.	[kəʊt]	[ɛɣɔtɪ̱]	coat
8.	[kɔnə]	[ɛɣɔɔna]	corner
9.	[kɒlget]	[eɣoligetɪ̱]	colgate
10.	[ɔɪl]	[awɔjɪl]	oil
11.	[faɪl]	[apajɪl]	file
12.	[kəʊntə]	[aɣawunta]	counter
13.	[pləʊ]	[ɛpɪlɔ]	pillow
14.	[səʊlə]	[asola]	solar
15.	[meleərɪə]	[emalerɪ.a]	malaria
16.	[glæs]	[ɛgɪlasɪ̱]	glass
17.	[bɒks]	[abɔkɪs]	box
18.	[trəʊzəz]	[etʊrɔsa]	trouser
19.	[buts]	[ŋabʊt̪i:]	boots
20.	[pen]	[epɛɛ̀nɪ̱]	Pen
21.	[bɔl]	[ebɔɔ̀l]	ball
22.	[rim]	[arɪ̀mɪ̱]	ream
23.	[bɒks]	[abɔkɪs/abɔkɪð]	box
24.	[fulskap]	[apʊlʊsʊkapʊ̱	foolscap
25.	[redʒɪstə]	[arɛɟɛsɛ̱t̪a]	register
26.	[geɪt]	[ɛgɛtɪ̱]	gate
27.	[tʃeɪndʒ]	[ecenɟɪ̱]	change
28.	[bæləns]	[ɛbalans]	balance
29.	[rɪsɪt]	[arɪcɪt̪/arɪsɪt̪/arɪðɪt̪ɪ̱]	receipt
30.	[sælɒn]	[asalɔnɪ̱]	salon

Table 9: English Loanwords Borrowed to Ng'aturukana