

**Phonological and perceptual factor symbiosis in loanword  
adaptation: A case study of Kirundi**

**Simbiose de fatores fonológicos e perceptivos na adaptação de  
empréstimo linguístico: um estudo de caso da língua Kirundi**

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**ABSTRACT:** This paper examines the two-way interaction of perceptual and production factors in the light of resolving French and English loan structures in Kirundi. The investigation is framed within the view that loanword adaptation results from attempts to match the non-native perception of the L2 input within the confines of the L1 grammar. Neither a purely perceptual nor a purely grammatical account can explain the facts. Based on a collection of 239 French loans and 44 English corpora of loans, this study examines loanword adaptation at both the phonemic and the phonotactic levels. We prove how the constraint-ranking Optimality Theory (OT) can account for the phonological adaptations of loans, but with limitations. The adaptation cannot be fully understood unless perceptual similarity and auditory factors are integrated in the grammar. This study enriches our understanding of the role of perceptual similarity and perceptual salience in phonology and their relationship to constraint ranking.

**KEYWORDS:** Perception. Production. Loanword.

**RESUMO:** Este artigo examina a interação bidirecional de fatores de percepção e produção à luz da formação de estruturas de empréstimos linguísticos do francês e do inglês no Kirundi. A investigação está pautada na visão de que a adaptação do empréstimo linguístico resulta de tentativas de corresponder à percepção não nativa do input da L2 dentro dos limites da gramática da L1. Nem um relato puramente perceptivo ou puramente gramatical pode explicar esses fatos. Com base em uma coleção de 239 empréstimos da língua francesa e 44 corpora de empréstimos da língua inglesa, este estudo examina a adaptação do empréstimo linguístico nos níveis fonêmico e fonotático. Provamos como a hierarquia de restrições da Teoria da Otimalidade (OT) pode explicar as adaptações fonológicas dos empréstimos linguísticos, mas com limitações, pois a adaptação não pode ser totalmente

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compreendida, a menos que a similaridade perceptiva e os fatores auditivos estejam integrados na gramática. Este estudo enriquece nossa compreensão do papel da semelhança perceptiva e do relevo perceptivo na fonologia e sua relação com a hierarquia de restrições.

**PALAVRAS-CHAVE** : Percepção. Produção. Empréstimo linguístico.

## **Introduction**

In recent years, a long standing debate in the field of loanword phonology has re-emerged granting due credence to approaches that stress phonology over phonetics approaches in the nativisation of foreign structures (Rose, 1995; Paradis & LaCharité, 1997, 2001; Ulrich, 1997; Uffmann, 2001, 2004). On the other hand, Peperkamp and Dupoux (2003) adopt a more radical perspective. They propose that loanword adaptation actually takes place outside the phonological component of the grammar, that is, at the level of the perception, which is independent of the rules and constraints of the borrowing language. Silverman (1992) and Yip (1993) give credit to both the perceptual and the phonological components of the grammar.

The purpose of the present study is to shed light on this debate through a consideration of both the phonological and perceptual factors in explaining the incorporation of English and French words into Kirundi language. In fact, Kirundi has hundreds of English and French loanwords (Niyonkuru, 1986). In line with the adaptation of foreign words, some adjustments and choices are made as to what information needs to be preserved and which ones to sacrifice.

The present work is therefore a contribution to an understanding of the adaptation processes of Kirundi loanwords borrowed from those two languages. We will examine the syllable structure and the segmental modifications in the recipient language (Kirundi) of the donor languages' inputs (English and French) and proposing a unified account at both the operative and perceptual levels based on the segmental, phonotactic characteristics and inventories of the languages involved.

## **1 Background to the study**

Kirundi language —or Ikiruúndi— is a Bantu language spoken mainly in Burundi. It is assigned a D 62 index in M. Guthrie's classification (Guthrie, 1948:

76). The language is spoken countrywide in Burundi. There are, however, some slight regional variations within the language, which in turn form a dialect continuum with Kinyarwanda (Ikinyarwaanda, D 61 or J 61) spoken in Rwanda and Giha (D 66 or J 66) spoken in Tanzania.

According to Niyonkuru (1986), the main factors which influenced and shaped contemporary Kirundi to a certain extent are: i) the regional trade, ii) the missionary and colonial phenomena with their impact on the political, economic and socio-cultural institutions of Burundi, iii) the educational system and its linguistic consequences ("francophonie"), and iv) the urban and the international political and economic contexts, of which migrants and refugees are a central part. Consequently, Kirundi language has integrated into its lexicon a number of loans imported mainly from English, French, German, Kiswahili, ecclesiastical Latin, Lingala (mostly spoken in neighboring Democratic Republic of the Congo), and Luganda, (spoken in Uganda). Many of those terms were introduced in the nineteenth and twentieth century (Niyonkuru, 1986).

Presently, many Burundians speak French, which is also the official language, as a result of the colonial legacy. It is the medium of instruction from the first grade of primary school. On the other hand, from being the language of a handful of expatriates and pockets of other Africans settled in Burundi, English is today a powerful force that bears with it prospects of international success, given the employment avenues in NGOs (Nizonkiza, 2002). In line with the new dynamics in Burundi sociolinguistics, especially its adhesion in the East-African Community which is mostly Anglophone, there is an immense load of English importations, and the use of English in Burundi is becoming mandatory. Despite the upsurge of a particular linguistic heterogeneity, Kirundi still enjoys the privilege of being the only native national language that has official status in the country.

Researchers on Kirundi language have held an interest in Kirundi loanword adaptations, i.e. in the transformations that apply to words when they are borrowed from a foreign language (Niyonkuru, 1986; Hakizimana, 1986; Nsabimana, 1988; Nzisabira, 2002). All researchers investigating the phonological processes in Kirundi loanword adaptation have based their assumptions on Hyman (1970) and Chomsky et al. (1968). They hypothesize that the input to loanword adaptation is constituted by the surface form of the source language and that the adaptations are computed by the phonological grammar of the borrowing language. All the results conclusively

reiterate an elaboration of phonological rules and hypothesize that there are Kirundi loanword-specific rules. It is worth mentioning, however, that apart from Niyonkuru's plausible research, others are unauthoritative investigations of BA students that are left unexplored and cannot therefore be assigned considerable scientific credence.

The analyses made by our predecessors leave a lot to be desired as to the ways of handling the different adaptation processes observed in loanwords in a unified grammar. For instance, the rule-based analysis fails to explain why the vowel epenthesis rule applies to some segments and not to others. Besides, not all the rules accounted for fit in the existing grammar.

Following Yip (1993) and Paradis & La Charite (1997), we surmise an output-oriented framework in line with the Optimality Theory, a constraint-based formalism. We propose that the transformations of underlying forms during the mapping onto surface forms (markedness constraints) is held in order to comply with the surface phonological structure of the borrowing language (faithfulness constraints).

OT can propose too many rankings, but there is no evidence in the native phonology for explaining the kind of adjustments that have taken place. Loanword adaptations appear to be unlearnable within a purely phonological account. In the words of Steriade (2002), the answer to the Too-Many solutions conundrum is to be found in the perception and salience segments over others. This is outlined in the Perceptibility-Map (P-Map) Hypothesis (Steriade, 2002). The present study is an undertaking to investigate the interplay between perception and production in the analysis of the adaptation processes of Kirundi loanwords in the light of OT and P-Map.

We hypothesize that:

- Production-only or perception-only analyses cannot each explain all the adaptation processes of Kirundi loanwords; and
- Kirundi loanword adaptation processes are both production-based and perception-based.

## **2 Literature Review**

Our problem cannot be articulated except within a conceptual system. This section establishes a vantage point, a set of lenses through which we view the problem. One central issue in loanword phonology concerns what linguistic

mechanism governs the adaptation of foreign pronunciation. A particularly thorny issue is whether loan adaptations are a function of perception or production, or both at the same time. Regarding this issue, various adaptation and diverging theories have been proposed in the literature.

In search of the two-way interaction of phonetics and phonology in the explanation of the adaptation processes of Kirundi loanwords, this study is undergirded by OT and P-Map theories.

## 2.1 Optimality Theory (OT)

Proponents of this theory (Paradis, 1996; Paradis & La Charite, 1997; Ito & Mester, 1995; Jacobs & Gussenhoven, 2000) posit that loan adaptation is phonological in nature and is solely a function of the production grammar.

In OT, the grammar of a language consists of a set of universal constraints which are hierarchically ranked. The ranking of constraints arises from the interaction between well-formedness constraints, which define universal and language-specific unmarked structures, and faithfulness or correspondence constraints, which require the preservation of input structures and, hence, the identity between the input and the output.

The central idea within OT is that surface forms in languages are the result of a tug-of-war between competing grammatical principles, called *constraints*. In this way, OT differs from traditional grammar, which uses rewriting or transformational rules. In traditional grammar, one form is derived from another with rules. In OT, representations are eliminated when they violate a constraint until one candidate remains, the winning or *optimal* candidate. OT thus concentrates on the interaction between grammatical principles.

An optimality theoretic description of a linguistic phenomenon consists of an input form, a grammar (sometimes called GEN) that generates all possible output candidates from the input, and a set of constraints (CON or LEXICON) that decide the outcome of the grammar. The constraints are ranked, i.e., they are applied in a specified sequential order. The constraints are also universal, i.e., they are valid for all human languages. Structural differences between languages depend on different rankings from one language to another. The mechanism that evaluates the grammar is sometimes called EVAL, or H-EVAL, where H stands for 'harmonic', which in this

case means that the candidate that is most harmonic in relation to the constraints, is preferred. This evaluation is shown in tables. The constraints are arranged in the columns, and the forms to be evaluated are arranged in the rows. The input form to be evaluated is given in the top left corner. A '\*' in a cell indicates that the form of that row breaks the constraint in that column, and \*! indicates that such a violation eliminates that form from further consideration: the violation is fatal. The optimal form, or the winner, is marked. Since the constraints eliminate candidates as they are applied, the final remaining candidate is the winning or optimal candidate. In order to win or to become the optimal candidate, then, a candidate thus does not need to satisfy all constraints in order to be grammatical, it suffices that it is better than all the competing candidates (for the same underlying input form). This is perhaps the greatest difference between OT and traditional grammar.

McCarthy and Prince (1995) propose three important constraints to express faithfulness; MAX I-O, DEP I-O, IDENT (F) elaborated below:

MAX-IO requires that each segment in the input form ('I') has a corresponding segment in the output form ('O'). That is, the input is 'maximally' represented in the output, and the constraint is therefore violated if a segment is deleted.

DEP-IO requires that each segment in the output form has a corresponding segment in the input form. That is, the output must be entirely 'dependent' on the input, and the constraint is violated by any inserted segment.

IDENT (F) requires that every feature ('F') of the input segment is 'identical' to every feature in the output segment. That is this constraint is violated if a segment changes from one feature to another.

However, OT fails to explain all the patterns of loan adaptation. For instance, Brasington (1997) states that OT fails to account for Marshallese adaptations of English words, where the choice between vowel epenthesis and consonant deletion in resolving English consonant clusters depends on the position, as well as the cluster type.

## 2.2 The Perceptual-similarity Approach: P-Map Hypothesis

A recent direction in general phonology is to integrate perceptual similarity into the production grammar (STERIADE, 2002; FLEISCHHACKER, 2001; YIP, 2004).

Loanword studies that adopt this approach propose that loan processes tend to maximise the perceptual similarity between the adapted form and the foreign input (KANG; 2003, KENSTOWICZ, 2003a). The role of perceptual salience and perceptual similarity in phonology has gained increasing attention. A representative work in this vein is contributed by Steriade (2002), who postulates a P-Map (Perceptibility-Map) hypothesis proposing that phonological processes are governed by native speakers' awareness of the perceptual distinctiveness of different contrasts in different positions.

According to Steriade (2002), there are two properties of the P-Map notably the positional effects and contrast. Positional effect is the notion that the distinctiveness of a segment is affected by the syntagmatic context. Contrast, on the other hand, is the statement such that 'a' is more perceptible than 'b' means, that 'a' is more reliably distinguished from a reference term 'x' than 'b' is distinguished from 'x'. The P-Map knowledge leads the speaker to choose the output form which has relatively minimal modification of the input in terms of perceptual similarity.

P-Map is a set of statements about absolute and relative perceptibility of different contrasts across different contexts where they might occur. For example, the P-Map will be a repository of speakers' knowledge that [p]/[b] contrast is better perceived before vowels (e.g., [apa] vs. [aba]) than before consonants (e.g., [apta] vs. [abta])

In the same line of thought, Kenstowicz (2003a) argues that auditory salience and similarity play a crucial role in Fijian adaptation of English words. Salient segments or structures tend to be preserved in adaptation processes (stress assignment), and when repairs are needed, modifications will be kept as unobtrusive as possible.

The choice of the P-Map hypothesis is motivated by its ability to integrate both phonology and phonetic views. In fact, P-Map is also called the theory of the phonology of perceptibility effects. It is built on OT leftovers and attempts to fill its gaps by addressing its inadequacy of failing to integrate phonetics into phonology and relying only on correspondence and constraints.

This research frames in both theories' strengths and weaknesses to account for the complementarities of phonetics and phonology in the explanation of the nativisation process of Kirundi loanwords borrowed from English and French.

### **3 Methods**

#### **3.1 Data Collection**

Two types of data were collected for the present study, notably primary data (in bold and italics, see appendix 2) and secondary data (unmarked). Data were collected from publications, conversations, newspapers, Bible literature, school text books, commercial posters, and hoardings.

#### **3.2 Data analysis procedures**

The loanwords in the data collected were identified through a systematic comparison of the lexical items occurring in the target language (TL: Kirundi) and the second language input (SL: French or English). In order to analyse the collected data, we transcribed all the loans regarding their perceptual features, especially their segmental features.

With regards to production analysis, we identified the constraints and ranked them in their specified sequential order. The ranking of constraints varied according to the adapted loans. For every case, an appropriate constraint-ranking was proposed. The evaluation was done using O.T tables and principles.

Concerning the analysis of perception, a contrastive analysis between the English and French original forms and their Kirundi adjusted forms was conducted using the Received Pronunciation (R.P) of English and “le Français Standard” as the objective standards of pronunciation of both English and French forms. Further perceptual analyses were done through a comparison of the three languages’ phonological systems.

The data were analysed using constraint rankings and statistical distribution.

### **4 Results**

#### **4.1 Plosives**

Kirundi language has a similar inventory of plosives as the two donor languages, with distinctions in two articulatory places. The English and French /t/ and

/d/ are alveolar plosives, but are realised as dental stops in Kirundi. In all the two donor languages plosives differ in voicing and aspiration, but the only peculiarity is that in Kirundi voicing but not aspiration is contrastive.

Predictions about faithful mappings are attested by the data. From (1), it can be seen that faithful substitutes make up the majority of the observed outputs. For example, in the adaptation of /p/, they contribute to 62/64 of all instances in the onset or in the coda. These patterns occur regardless of the allophonic variations in the source language. For example, English aspirated /p/ is replaced by Kirundi unaspirated /p/.

1. Examples of (1a-f) demonstrate faithful plosive outputs:

- |  |   |
|--|---|
| a) 'paroisse' [paRwas] > [paruwasɪ]<br>"parish"        | d) 'brigade' [bRɪgad] > [βɪrɪgade]<br>*[bɪrɪgade] 'brigade' |
| b) 'soupe' [sup] > [ɪsupu] 'soup'<br>*[supɸu]          | e) 'tomate' [tomat] > [ɪtomatɪ]<br>'tomatoe'                |
| c) 'cabaret' [kabaRe] > [akaβare]<br>*[akabare] 'club' | f) "bucket" [bʌkət] > [ɪmbegetɪ]                            |

Deviant mappings of foreign plosives for which it is difficult to find an explanation in OT framework include those instances in (2a-f):

- (2) a. '**Porte**-monnaie' [poRtmone] > [ɪngodomonɪ], [ɪgɪtomonɪ] 'wallet'  
 b. '**Permanganate**' [peRmãganat] > [karimanganya] 'permanganate'  
 c. '**Administrateur**' [administRatoeR] > [musitanteeri] 'governor'  
 d. '**Trompet**' [tRõpet] > [urumbete] 'trumpet'  
 e. '**Pepiniere**' [pepinjer] > [ɪpɪkɪnyeri] 'tree nursery'  
 f. '**Bloc** ciment' [bloksimã] > [ɪkirokosima] 'cement block'

Meanwhile, upon analysis of the above deviations, we find that in all /p/ deviations, the plosive /k/ sharing the same feature (voiceless) and class (plosive) is chosen as a repair. Following Steriade's arguments (2002), who posits that plosives are less perceptible than fricatives, we notice that bilabial plosives are less perceptible, especially when these occur as syllable nuclei in a string of segments. The same holds true for the alveolar plosives [t] and [d]. However, [t] and [d] are not replaced by any other phoneme, but are deleted from the string. The deletions

observed in 2c, 2d, 2f must be accounted for through perceptual factors. Specifically, the segmental deletions observed in these particular contexts are caused by the fact that the segments that are deleted fall under a given threshold of phonetic salience at the perceptual level. These contrasts in the data 2c, 2d, 2f (dm, tr, bl) are hardly perceived due to the minimal distance in perception between the pairs of sounds dm, tr, bl, especially when these occur as nuclei onsets or coda. Since perception of a non-native contrast is blocked by the absence of the relevant feature from the speaker's grammar, Kirundi speakers will be unable to accurately perceive a contrast between the pairs of sounds and, henceforth, delete them.

For this particular case (2), we clearly observe that the input to adaptation is treated at both the perceptual and phonological levels. Saliency and perceptual distance between segments militate to their preservation or deletion. Contrary to previous analyses of Kirundi loans, there is no specific loanword rule deleting the segment /d/ in 2c, /t/ in 2d, or /b/ in 2f. Although those sounds exist in Kirundi, the contrast created in their combination with segments /m/, /r/, /l/ is not easily perceived because of the minimal distance in articulation between the pairs of sounds.

### 5.2.2.2. Fricatives

Foreign fricatives are expected to be replaced by their closest fricative correspondents in Kirundi. Kirundi fricatives (i.e., f, v, s, z, ʃ, ʒ) contrast in place and voice just as English and French do. Faithful substitutions for fricatives are shown in Table 9. The onset fricatives /f, v, s, z, ʃ, ʒ/ surface as the expected output /f, v, s, z, ʃ, ʒ/. Coda fricatives are replaced by their Kirundi correspondents, but resyllabified in respect of the Kirundi markedness constraint **NO-CODA**.

Meanwhile, it is important to recall that the interdental /θ/ and /ð/ are English-specific. The phoneme /ʒ/ is specific to Kirundi and English, and realized in French as /ʒ/. Analysis of the corpus data shows that faithful outputs make up the highest proportion in the adaptation of most phonemes.

Examples in (3a-i) Provide representative examples of faithful fricative outputs:

- |   |  |
|---|--|
| (3) a. 'fanta' [fa:ta] > [fanta] 'type of lemonade' | c. 'vitamine' [vitamin] > [vitamini] 'vitamin' |
| b. 'photo' [foto] > [foto] 'picture' (+)            | d. 'valise' [vali: z] > [ivarizi] 'suitcase'   |

- e. 'salon' [salõ:] > [isaro] 'sitting-room'      h. 'season' [si: zðn] > [isiizeeni]  
 f. 'sauce' [so: s] > [isoosi] 'sauce'      i. 'shirt' [ʃ:t] > [ishaati]  
 g. 'rose' [ro:z] > [iroza]

Unfaithful outputs of fricatives fall into two types: fricatives differing from the faithful substitutes in place, and fricatives realized as plosives with a deviant place and, of course, mannerfeatures.

For example English interdental fricatives /θ/ and /ð/ are realized in alveolars /s/ and /z/, both deviating from the faithful input in place, French /ʒ/, which is mapped to Kirundi palato-alveolar /dʒ/, therefore deviating in place feature.

Also, the phoneme /v/ behaves differently from other fricatives with its substitutes varying according to position. If in intervocalic position, /v/ is always adapted as /v/ or /f/, while in word-initial prevocalic position, /v/ is rendered as /β/, a bilabial voiced fricative, or /k/, a voiceless velar plosive,

As seen in examples (4a-c):

- (4) a. [viŋet] → [βiŋete] 'label'  
 b. [vidã:ʒ] → [ikidaaɖɕi] 'empty bottle' (+)  
 c. [vites] → [igiteesi] 'speed'

Besides, there are cases of unfaithful mappings of phoneme /s/, especially when preceded or followed by the palatal voiceless fricative /sh/. We posit that convincing explanations of this shift cannot be found in OT framework as it can be seen in Table 1 below:

**Table 1:** OT analysis of a sample of /s/ adaptation in /j/ positions

Input:/sa e/	Consonant Context Colouring	Vowel Context Colouring	IDENT F(Place) Nucleus of σ1 & Nucleus of σ2	MAX- IO	DEP-IO
a. isa e	*	*	*		*
b. isa a	*		*		*
c. → i ja e		*			*
d. i jase	*	*	*		*

Note that each candidate incurs a violation of at least two constraints. The optimal candidate (1c) violates the same constraints as the other candidates except contextual markedness constraints. Featural values of the deviated /s/ phoneme into /ʃ/ depend on neighboring segments by assimilation. Here, assimilatory forces are intrinsically in conflict with contrast-preserving forces: the result depends on interactions between contextual constraints (striving for assimilated outputs), and faithfulness constraints (striving for maximally faithful outputs). Meanwhile, there is little OT can provide as to which selection mechanism has militated for the choice of the optimal candidate, here “/iʃaʃe/”.

Other similar examples include:

- (5) a. /ʃoset/ → /ʃeʃeti/ ‘socks’  
 b. /sakoʃ/ → /ʃakoʃi/ ‘handbag’ (+)

However, while phonological scansion clearly plays a role in L2-to-L1 mapping, this corner of the corpus indicates that a level of phonetic scansion must also be involved. The above case shows /s/ readiness to assimilate before /ʃ/. This phonemic change is only attributable to the combinatory factors of both voicing and energy of articulation when /s/ and /ʃ/ occur in the same stretch of speech: /s/ takes on the features of place of /ʃ/.

### 5.2.2.5 Lateral and Trill

The liquids and trills in the two donor languages have slightly different qualities in relation to Kirundi. In English, the alveolar lateral /l/ found in the coda has a velar allophone (i.e. dark l [ɫ]).

In French, /l/ is pronounced with a smaller degree of velarisation than in English. The /r/ sound is generally alveolar in English and more flexible vis-à-vis Kirundi in terms of place and manner than the French /R/, which is a voiced velar dorsal.

The Kirundi phoneme closest to the foreign /l, r, R/ is the voiced alveo-palatal /r/. From the above, it can be predicted that faithful outputs of foreign laterals and trills are going to be mapped to the Kirundi alveo-palatal /r/ with a violation of place and

manner features (IDENT-F (P) and IDENT-F (M)), ranked below MAX-IO, DEP-IO, and IDENT-IO (V). Table (2) below testifies to the truth of the above predictions.

**Table 2:** Adaptation of lateral and trill

Input Phoneme	Output (Kirundi)	English	French	Total (%)
/l/	/r/			100
/r/	/r/		---	100
/R/	/r/	--		100

8. Examples (8a-j) provide instances of the lateral /l/, the trill /r/, and retroflex /R/:

- a. Ring [ri:ŋ] > [iriingi]
- b. In a hurry [inðhʌri] > [inahuri]
- c. E-mail [imeil] > [imeeri/e]
- d. Blue-Band [blubænd] > [βureβa] ‘brand of butter’
- e. Peinture [petyR] > [ipentiire] ‘painting’
- f. Passe [pas] > [ipasi/e] ‘pass’
- g. Litre [litR] > [iritiro] ‘litre’
- h. Laissez-passer [lɛsepase] > [resepase] ‘pass’
- i. Mandarine [mã :daRin] > [mandariini/e] ‘mandarin’
- j. Lieutenant [ljΦtnã] > [rijetena] ‘lieutenant’

From the above, we observe a combination of phonological and perceptual factors in the adaptation of the lateral /l/, and the trill /r/, and retroflex /R/. Both phonemes are realized in one Kirundi /r/. The mapping of the two sounds into one is projected by the perception of those sounds by a Kirundi speaker. We argue following Brown (1998) that native speakers are able to perceive a contrast only if the feature is portrayed in their phonological system. The perception of the contrast between /r/, /l/ and /R/ is blocked by the absence of the feature [lateral] in Kirundi. Kirundi speakers will therefore map the three types of phonemes into one

irrespective of the place feature. The phonological system of Kirundi will funnel the distinct stimuli for /l/, /r/, and /R/ into one perceptual category. Consequently, Kirundi speakers will perceive instances of /l/, and /r/, and /R/ as the same sound.

## 5 Discussion

The lack of a maximal applicability of OT in Kirundi loanword adaptation has been observed in our analysis and this leads us to question OT basic concepts, i.e., GEN, LEXICON, and EVAL.

GEN was mainly challenged when we had to deal with output forms that could not be easily generated unless one has knowledge of the language. These include forms such as **[karaβansaansi]** from **crepissage**, **[musitanteeri]** from **administrateur**, **[urumbeeti]** from trumpet, **[agashwankara]** from **chancre**, and many more. There is no provision in GEN that the input-output mechanism could generate a set of candidates including the above forms. This leads us to posit that there is another mechanism unknown to GEN which has contributed to setting candidates including ones which can hardly be predicted from the surface input forms. This 'output-input opacity' phenomenon escapes GEN principle. In other words, Kirundi loanword adaptation cannot be solely catered for at the surface level.

LEXICON is another OT concept concerned with providing the input specifications likely to be submitted to the Generator. This principle presupposes that grammatical realizations are expressed as interactions of constraints at the level of the output (Kager, 1999). Whether or not a form is contrastive in a language depends on the interaction of output-input oriented markedness and faithfulness constraints. This principle has been challenged in the analysis of Kirundi loanword adaptations. In many cases, it appeared that the output-input analysis provided little cues as to the understanding of the preserved or the deleted segments in the adaptation process. A case in point is the adaptation of foreign vocalic segments and behaviour of [s] in [ʃ] environments. Neither faithfulness nor markedness constraints could provide us with a justification of the adapted forms.

With regards to the third OT principle (EVAL), which is the central component of the grammar since it is burdened with the responsibility of accounting for all observed irregularities of surface forms, the principle could in some instances provide

cues to the understanding of loanword adaptation, but in some others could not be reliable.

As far as P-Map principles are concerned, i.e., CONTRAST and POSITIONAL EFFECT, these principles could not solely be helpful unless they are merged to the native phonological system. In some specific instances, it appeared that speech perception itself is controlled by the language-specific grammar. Thus, the fact that the Kirundi speaker perceives an auditory [kã:tabl] as the phonological structure /kontabure/ can be directly attributed to the workings of the structural constraint NOCODA in perception. Here, contrast or positional effect or any other perceptual cues cannot explain the adjustment made. This stresses the interrelatedness of both grammar and perception in Kirundi loanword adaptation.

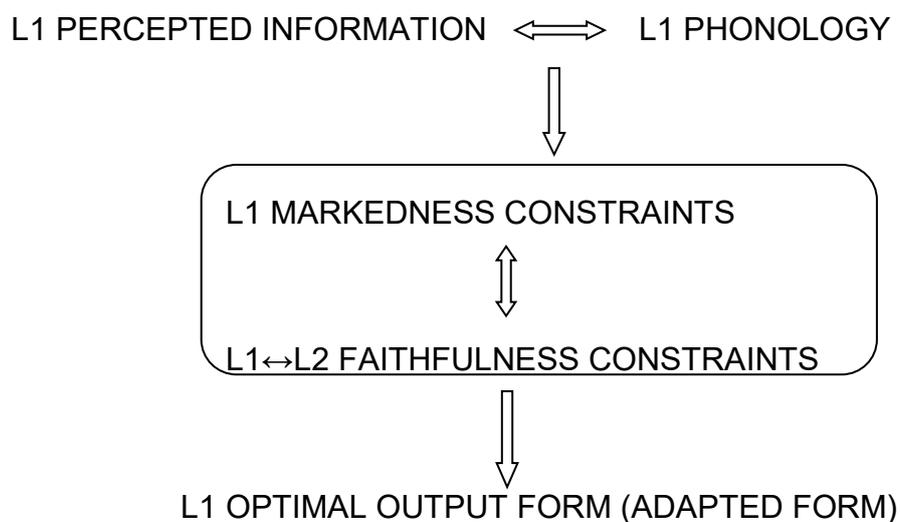
The above results lead us to offer a more comprehensive understanding of the two-way interaction of both perception and phonology in loanword adaptation, a third goal we had laid out in the beginning of our research. This view challenges our U.G. predecessors (Generativists) who believe in Universal Grammar and posit that loanword phonology can be accounted for as a separate grammar with the redundancy of having separate perception and production levels, as posited in Silverman (1992) and other well-known work.

What is more, phonotactic adaptations of illicit syllable structures demonstrate variation between consonant preservation (e.g. through vowel epenthesis) and deletion (very scarce), and the likelihood of retention vs. deletion is related to two main phonological factors (e.g., phoneme category and cluster structure) in interaction with perceptual factors; perceptual salience of segments.

Findings from our analysis reveal that segment preservation overweighs deletion, especially when the segment stands in a perceptually salient content (positional effect), since deletion would result in too distinctive a contrast between the pre- and the post- adaptation forms. On the other hand, deletion was favored when the segment occurs in a non-salient confusability,(or low perceptibility or less contrastive, environment).This application of P-Map principles, notably contrast and positional effect, supported OT principles (GEN, CON and EVAL) in the explanation of phonotactic adaptation.

In line with this bidirectionality of factors, we propose a summarised schema which we lay down as a verified model of Kirundi loanword adaptation of French and English loans.

## L2 INPUT FORM (BOTH PHONOLOGICAL AND PERCEPTUAL DATA)



As a matter of fact, considered that phonology or phonetic-solely based analyses cannot fully explain all the adaptation processes as it was found in the analysis, it can be inferred from this observation that the L1 percept offered ground for the language's constraints to establish a merger between the input segment and the available output segment. In other words, output forms are computerised by the projection of the abstract perceptual input which is checked and adjusted by a group of ranked constraints (faithfulness and markedness) to produce an output that is optimal with respect to those constraints.

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