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Liquid/glide zero alternation in Chitonga: an optimality analysis*

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Introduction

This paper examines the problem of liquid/glide/zero (∅) alternation in Chitonga, a Malawian Bantu language classified as Guthrie's N15. It will be shown that a liquid is always realized as a glide in final syllable position when preceded by a non-mid vowel. And it is realized as nothing after a long vowel (usually mid vowel). It will also be shown that with respect to certain class of glides, there are no alternations with a liquid or zero, even when the structural description warrants their appearance. The insights of Optimality Theory (OT), as developed by Prince and Smolensky (1991, 1993) and extended by Goedmans, 1996; Downing, 1996; McCarthy and Prince 1999, among others, are used to show that liquid/glide/zero alternation straightforwardly stems from the ranking of relevant constraints in Chitonga.

The problem

The data in (1) show the formation of the applicative and the reciprocal in Chitonga. Special attention should be drawn towards alternation of glide/zero and liquid of the applied allomorphs in columns 2 and 4.

(1) **The applicative and the reciprocal**

Basic verb	Applicative	Reciprocal	Appl+rec
a. bika-a 'cook'	bik-iy-a	bik-an-a	bik-il-an-a
b. suk-a 'clean'	suk-iy-a	suk-an-a	suk-il-an-a
c. lang-a 'punish'	lang-iy-a	lang-an-a	lang-il-an-a
d. pum-a 'hit'	pum-iy-a	pum-an-a	pum-il-ana
e. mang-a 'tie'	mang-iy-a	mang-an-a	mang-il-an-a
f. lemb-a 'write'	lemb-e:	lemb-an-a	lemb-el-an-a
g. lot-a 'dream'	lot-e:	lot-an-a	lot-el-ana
h. tem-a 'cut'	tem-e:	tem-an-a	tem-el-an-a
i. seng-a 'shave'	seng-e:	seng-an-a	seng-el-an-a
j. omb-a 'clap'	omb-e:	omb-an-a	omb-el-an-a
k. pemb-a 'make fire'	pemb-e:	pemb-an-a	pemb-el-an-a

The applicative marker is either of the following: *-il-*, *el*, *-iy-* or *-e*: depending on vowel harmony. *–il-* and *–iy-* are used when the root vowel is non-mid, where as *–e*: and *–el-* are used when the root vowel is mid. A liquid of the applied morpheme is found in non-final syllable position as shown in column 4 where as its glide counterpart is always found in final syllable position and after a [+high] vowel (compare columns 2 and 4). Before explaining where the morpheme *e*:, without a glide or a liquid, is found, the data in (2), showing the behavior of monosyllabic words when followed by vowel initial extension, is presented to confirm the positions occupied by the applicative glide and liquid:

(2) **Monosyllabic verbs and extensions**

Basic verb	**Applicative**	**Appl+recip**
a. -fw-a 'die'	fw-iy-a	fw-il-an-a
b. -ly-a 'eat'	ly-iy-a	ly-il-an-a
c. -w-a 'fall'	w-iy-a	w-il-an-a
d. -sw-a 'break'	sw-iy-a	sw-il-an-a
e. -b-a 'steal'	b-iy-a	b-il-an-a
f. -mb-a 'sing'	mb-iy-a	mb-il-an-a
g. -vw-a 'hear'	vw-iy-a	vw-il-an-a
h. -mw-a 'drink'	mw-iy-a	mw-il-an-a
i. -lw-a 'fight a war'	lw-iy-a	lw-il-an-a

The data confirm earlier observation that a glide is consistently found in the final syllable position and after a [+high] vowel where as the liquid is found in the non-final syllable position.

Going back to (1), the allomorph *–e*: is found in the final syllable position when the root vowel is [-low -high]. When it is extended, for example, if a reciprocal is attached, it assumes an *-el-* form. In this case, there seem to be an alternation of a liquid and zero after a [-high] in final syllable position while a liquid is found in a non-final syllable position.

The data in (3) confirm further our observation that zero alternates with a liquid after a [-high] in final syllable position:

(3) **Zero/liquid alternation**

Basic verb	**applicative**	**Reciprocal**	**Appl+Rec**
a. to: 'take'	tol-e:	tol-an-a	tol-el-an-a
b. Me: 'grow'	mel-e:	mel-an-a	mel-el-an-a
c. ko: 'catch'	kol-e:	kol-an-a	kol-el-an-a
d. pe: get subdued'	pel-e:	pel-an-a	pel-el-an-a
e. po: 'get cool'	pol-e:	pol-an-a	pol-el-an-a
f. jowo: 'abandon'	jowol-e:	jowol-ana	jowol-el-an-a
g. domo: 'disconnect'	domol-e:	domol-an-a	domol-el-an-a
h. pend-e: 'be lame'	pendel-e:		
i. gong'o: 'hit'	gong'ol-e:	gong'ol-an-a	gong'ol-el-an-a
j. sotopo: 'extract'	sotopol-e:	sotopol-an-a	sotopol-el-an-a
k. ja: 'sit'	jal-iy-a		jal-il-an-a

Columns 1 and 2 have zero and liquid alternation, respectively. Since the root vowel is mid, the applied vowel, which is in the final syllable, is *e:*. Columns 3 and 4 show that a liquid consistently occurs in the non-final syllable position. Another important observation to be made is that, unlike the previous data, column 2 shows a liquid can appear in the final syllable position when it is long. Our generalization about the context in which a liquid appears should be revised as follows: There must be no liquid in the final syllable unless it is long. The presence of the liquid in this final syllable, in this case, could not be attributed to 'opacity', if we assume the idea that a long syllable is bimoraic. Our generalization about the distribution of a liquid should be further revised as follows: There must be no liquid before the final mora.

The behavior of certain glides also points to the fact that a liquid is part of the input while a glide and zero are 'derived' (not in the sense of derivational theories!). Some root final glides do alternate with a liquid when extended, whereas others do not. The data in (4) exemplify this.

(4) Some glides do not alternate with a liquid

Basic verb	Applicative	Passive	Causative	Reciprocal	Appl+rec
a. bay-a "kill"	bay-iy-a	bay-ik-a	bay-isk-a	bay-an-a	bay-il-an-a
b. luw-a "forget"	luw-iy-a	luw-ik-a	luw-isk-a	luw-an-a	luw-il-an-a
c. kwiy-a "get angry"	kwiy-iy-a	NA	kwiy-isk-a		kwiy-il-an-a
d. chay-a "hit"	chay-iy-a	chay-ik-a	chay-isk-a	chay-an-a	chay-il-ana
e. zay-a 'show off'	zay-iy-a		zay-isk-a		zay-il-an-a
f. tow-a 'be beautiful	tow-e:	tow-ek-a	tow-esk-a	tow-an-a	tow-el-an-a
g. low-a 'bewitch'	low-e:	low-ek-a	low-esk-a	low-an-a	low-el-ana
h. few-a 'get soft'	few-e:		few-esk-a		few-el-an-a
i. pey-a 'sweep'	pey-e:	pey-ek-a	pey-esk-a	pey-an-a	pey-el-an-a
j. βěy-a 'belch'	βey-e:	βey-ek-a	βey-esk-a	βey-an-a	bey-el-an-a
k. gěy-a 'belch'	gey-e:	gey-ek-a	gey-esk-a	gey-an-a	gey-el-an-a
l. zuw-a "undress"	Zul-iy-a	Zul-ik-a	Zul-isk-a	zul-an-a	zul-il-an-a
m. saniy-a "find"	sanil-iy-a	Sanil-ik-a	Sanil-isk-a	Sanil-an-a	sanil-il-an-a
n. liy-a "cry"	lil-iy-a	Lil-ik-a	Lil-isk-a	Lil-an-a	lil-il-an-a
o. siy-a "leave"	sil-iy-a	Sil-ik-a	sil-isk-a	sil-an-a	sil-il-an-a
p. puw-a "pound"	pu-l-i-y-a	Pul-ik-a	Pul-isk-a	Pul-an-a	pul-il-an-a
q. Chimbiy-a 'run'	Chimbil-i-y-a	Chimbil-ik-a	Chimbil-isk-a		chimbil-il-an-a

A glide in (a-k) does not alternate with a liquid because it is lexical. The root-final glide in (l-q), on the other hand, alternates with the liquid when the verb is extended. This glide in column 1 (l-q), therefore, occupies that position because of the condition that restricts liquids from appearing before the final mora position. The liquid in this case must be the input segment. The basic form of the applicative allomorph, therefore, is *–il-/-el-*, the form being determined by vowel harmony.

Having presented the basic issues of glide/liquid/zero alternation in Chitonga, we now proceed to outline the general principles and we show how these and related facts can be accounted for within Optimality Theory.

Optimality theory – general principles

The central idea of Optimality Theory (OT) is that, unlike in derivational theories of the type assumed and argued for in Generative Phonology, phonological outputs are not derived from underlying representations through the interaction of ordered rules. Instead, outputs are freely generated and the actual output for any input within a particular language is the one which is the most optimal given the ranking of relevant constraints in that language. In other words, surface forms of language reflect resolutions of conflicts between competing demands (*constraints*). A surface form is 'optimal' in the sense that it incurs the least serious violations of a set of violable constraints, ranked in a language-specific hierarchy. Constraints are universal and languages differ in their ranking of constraints, giving priorities to some constraints over others. Such rankings are based on 'strict' domination: if one constraint outranks another, the higher-ranked constraint has priority, regardless of violations of the lower-ranked one. However, such violation must be minimal, which predicts the *economy* of grammatical processes.

The crucial principles of OT as outlined by McCarthy and Prince (1993a, b; 1994), Prince and Smolensky (1993), and others, which will be alluded to in this paper are presented immediately below:

Some OT principles

5.(a) **Universality**: Universal Grammar (UG) provides a set CON of constraints which are universal and are universally present in all grammars.
(b) **Violability**: Constraints are violable, but violation is minimal.
(c) **Ranking**: The constraints of CON are ranked on a language-specific basis; the notion of minimal violation is defined in terms of this ranking. Outputs which violate the least ranked constraints are relatively more optimal than those violating highly ranked constraints. A grammar is a ranking of the constraint set.
(d) **Parallelism**: The best satisfaction of the constraint hierarchy is computed over the whole hierarchy and the whole candidate set. There is no serial derivation.

As the foregoing shows, OT is a development of Generative Grammar, a theory sharing its focus on formal description and quest for universal principles, on the basis of empirical research of linguistic typology (and first language acquisition). However, OT radically differs from earlier generative models in various ways.

OT is surface-based in the sense that well-formedness constraints evaluate surface forms only. Structural description and changes must always be evaluated among other possible resolutions of constraint violations. Therefore OT predicts that a markedness constraint (which seeks to change the input to conform to unmarked output forms) may trigger various types of structural changes, depending on its interaction with faithfulness constraints (which seek to maintain the input at all cost). Different languages should, therefore, pursue different 'repair strategies' in attaining identical output goals. In contrast, a rule-based theory fails to make this prediction of the functional unity of processes. Consider the set of rules in (6). All function to avoid the configuration *XAY, yet these rules cannot be formally related:

6. **A set of functionally coherent rules**

a. $A \longrightarrow B / X \_\_ Y$

b. $A \longrightarrow C / X \_\_ Y$

c. $A \longrightarrow \varnothing / \_\_ Y$

d. $Y \longrightarrow Z / XA \_\_$

e. $\varnothing \longrightarrow B / XA \_\_ Y$

f. $X \longrightarrow \varnothing / \_\_ AY$

(Kager 1999:56)

This re-occurrence of a common output factor which guides different rules, without being explicitly stated in the rules, is called a *conspiracy.*

Before OT, phonologists had already realized that output constraints are necessary ingredients of grammatical theory. As a response to rule conspiracies and the 'Duplication Problem' (overlapping functions of rules and constraints), they introduced output constraints to block or trigger the application of rules. Among the first output constraints were the OCP in autosegmental theory ('no identical adjacent autosegments', (Goldsmith 1976), and the No-Clash constraint in metrical theory (Liberman 1975). Such additions resulted in mixed models, containing both rules and output constraints. Various proposals were made for interactions of rules and output constraints, such as the *Theory of Constraints and Repair Strategies* (Paradis 1988), and *Persistent Rule Theory* (Myers 1991).

Problems of mixed models involve an extremely complicated interaction of rules and constraints. A rule may apply in violation of a constraint, which violation is later 'repaired' by some subsequent rule. Therefore a mixed model must not only stipulate structural descriptions of the rules and the linear ordering of the rules, but also interactions of rules and output constraints, defining the conditions under which output constraints can be temporarily violated. OT avoids such interactional complexity by limiting grammatical interactions to constraints. This *unification of interaction* makes OT, both conceptually and computationally, a much simpler theory than any mixed model.

The major strength of OT is captured when we consider the following problem in syntax where the constraints are assumed to be inviolable:

> The inviolable principles of syntax have proved themselves to be problematic in that inviolability has been purchased at the cost of a variety of types of hedges (....) some principles are parameterized, holding in one way in one language and in another way in another language. (...) the prevailing belief about constraints - that they are inviolable -resulted in a continuing frustration with their role in grammar, for it is exceedingly difficult to find a constraint that is never violated (Archangeli 1997: 26-27).

OT analysis

Since a liquid is the most basic form, we should be able to explain the following observations:

- A liquid is always realized as a glide before the final mora position and after high vowels.
- A liquid is realized as zero after a [-high] and in the final syllable position, unless the final syllable is long.
- Vowel coalescence in long final syllables where a liquid alternates with zero.

The relevant markedness and faithfulness constraints governing glide/zero and liquid alternation in this paper are outlined in (7):

7. a. No l (fin. μ): A liquid must not be before the final mora.
   b. MAX μ: Every mora in the input must have a correspondent in the output.
   c. DEP C: Every consonant in the output has a correspondent in the input.
   d. MAX (liquid): Every liquid in the input has a correspondent in the output.
   e. *[-high] δ marg: A [-high] vowel must not be re-syllabified in the syllable margins.

f. MAX V: A vowel in the input must have a correspondent in the output.
g. ONSET: A syllable must have onset.

The tableau (8) explains why a liquid alternates with a glide rather than ∅ or other possible forms after a high vowel. The constraints are ranked across the top, going from highest ranked on the left to lowest ranked on the right. The top left-hand cell shows the input representation (e.g. *zul-a* and *bik-il-a*) for which candidates are being considered. Candidates show up in the leftmost column, with the optimal candidate indicated by the symbol '⇒'. Violations are indicated by asterisks (*), and an exclamation mark highlights each "fatal" violation, i.e., the violation that eliminates a candidate completely.[1]

8 A liquid alternating with a glide and not zero

zul-a	No l (fin. μ)	ONSET	MAX μ	MAX V	MAX (liquid)
a. zula	*!				
b. zuwa ⇒					*
c. zu:				*!	*
d. zu			*!	*	*
e. zu.a		*!			*
bik-il-a					
a. bikila	*!				
b. bikiya⇒					*
c. biki:				*	*
d. biki			*!	*	*
e. biki.a		*!			*

Candidates (a) are not optimal as they violate the highest ranked No l (fin. μ) which disallows liquids before final mora position. Candidates (b) are optimal because they violate only one and low ranked MAX (liquid). Candidates (c) and (d), on the other hand, are not optimal as they have the largest number of violations. In addition, candidates (d) violate another high ranked MAX μ constraint which does not tolerate deletion of moras. Candidates (e) violate a high ranked ONSET which says that every syllable must have an onset.

In our generalizations, we said that a glide is never preceded by a [-high] vowel. We use the principle of sonority to introduce a constraint that disallows [-high] vowel to be syllabified as a glide in the onset position. The nucleus is the most sonorous of all the sounds and as we move out towards the onset or the coda, the lesser the degree of sonority of sounds. Roughly, we will represent the chain of sonority as in (9):

9. **The sonority Principle**

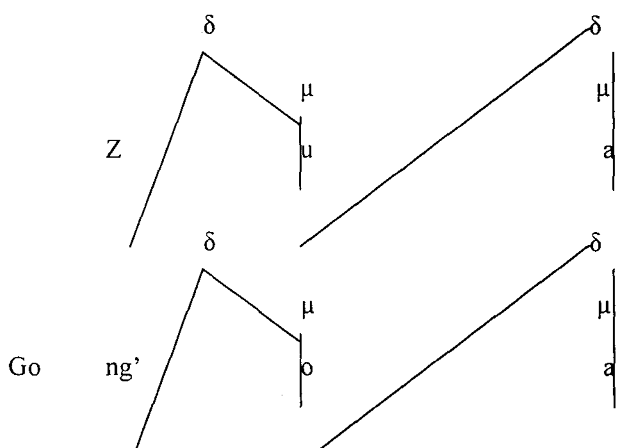
plosive fricative nasal liquid | glide vowel |
high | mid low

As the illustration above shows, glides and high vowels have so much in common, including height. The fact that a [high] is closer to the glide, it means that it can be re-syllabified in the margins of the syllable as a glide, but not mid and low vowels which are far away from the glide in terms of sonority. Hence a constraint (*[-high]φ marg) that bars non-high vowels from being re-syllabified in the onset. (10) illustrates this observation.

10. **Non-high vowels are nevĕr re-syllabified in syllable margins**

(a)

(b) *



The high vowel /u/ can be re-syllabified into the following onset as a glide /w/ (10a), but the non-high vowel /o/ cannot be re-syllabified into the following onset as a glide /w/. Any attempt to do so yields bad results (10b). Besides introducing the constraint

*[-high]δ marg which disallows non-mid vowels to be re-syllabified in the syllable margins (as glides), the tableau in (11) also introduces another constraint (DEP C) which disallows the possibility of a glide (in bold) being inserted.

11. No l (fin. μ), ONSET, *[-high]δ marg, MAX μ, DEP C >> MAX V, MAX (liquid)

gong'ol-a	No l (fin. μ)	ONSET	*[-high]δ marg	MAX μ	DEP C	MAX V	MAX (liquid)
a. gong'ola	*!						
b. gong'o: ⇒						*	*
c. gong'owa			*!				*
d. gong'o				*!		*	*
e. gong'o.a		*!					*
f. gong'owa					*!		

Candidate (a) is ruled out because it violates a high ranked No l (fin. μ) which does not allow liquids to be found before the final mora. Candidate (b) is optimal as it satisfies the five high ranked constraints No l (fin. μ), ONSET, *[-high]δ marg, MAX μ and DEP C which require that the optimal candidate has no liquid before the final mora, all syllables have onsets, no non-high vowel is re-syllabified in the syllable margin, no mora deletion and that no consonant is inserted, respectively. The constraint No l (fin. μ) ensures that the optimal candidate has no liquid before the final mora. The optimal candidate violates the low ranked MAX V and MAX (liquid) which can be tolerated. Candidate (c) violates a high ranked constraint *[-high]δ marg which does not allow the re-syllabification of [-high] vowels in the syllable margins. Candidate (d) is not optimal because it violates another high ranked MAX μ and it has a highest number of violations. The constraint MAX μ accounts for the coalescence (with the resulting long final syllable) in the optimal candidate. Candidate (f) is unacceptable because it violates another high ranked constraint (DEP C) which constrains abstractness by requiring every segment of the output to also occur in the input. This constraint disallows the insertion of a glide.

The tableau in (12) shows that the optimal candidate has a liquid in the final syllable.

(12) **No l (fin.) μ, ONSET, *[-high] δ marg, MAX μ >> MAX V, MAX (liquid)**

tol-el-a	No l (fin.) μ	ONSET	*[-high] δ marg	MAX μ	MAX V	MAX (liquid)
a. tolela	*!					
b. tole: ⇒					*	*
c. toweya			**!			**
d. toleya			*!			*
e. to.le.a		*!				*

f. to:					*!	**	**

Candidate (a) is not optimal because it violates the high ranked No l (final μ) which disallows liquids before the final mora position. Candidate (b) is optimal as it satisfies the three high ranked No l (final μ), ONSET and *[-high] δ marg, and it violates low ranked MAX V and FAITH (liquid) which can be tolerated. It should be noted that the long syllable (*le*:) is a manifestation that there are two mora positions, hence the liquid is not before the final mora, although it appears in the final syllable. Candidate (c) is not optimal as it violates *[-high] μ marg twice, and it also violates the low ranked MAX (liquid) twice. Candidate (d) also violates the same constraint which rules out candidates that have a [-high] vowel being re-syllabified as a glide. Candidate (e) violates the high ranked ONSET which requires every syllable to have onset. Candidate (f) has only two moras against three in the input. Candidate (f), therefore, is unacceptable because it violates another high ranked constraint MAX μ which prohibits mora deletion.

Significance and conclusion

Although Tonga belongs to Zone N in Guthrie's referential classification just like most of the neighboring languages, including Chichewa (Nyanja), Chitumbuka and Chingoni, it is similar to East African languages such as Kiswahili and Kichaga in terms of their prohibition of liquids before final moras. In Kiswahili (Polome 1967:75-76, 84), a liquid alternates with nothing, apparently to be found in the verbal roots ending in a vowel as in (13) (-*e*- and -*i*- mark for the applicative in Swahili).

10. **Swahili**

ach-a 'take'	ach-i-a 'leave to someone'
fik-a 'arrive'	fik-i-a 'reach someone'
po-a 'improve (of health)'	pol-e-a 'improve for'
ja-a 'get full'	jal-i-a 'be full up to'
li-a 'cry'	lil-i-a 'cry to'
o-a 'marry'	ol-e-a 'marry with'
to-a 'lay out'	tol-e-a 'spend on'
kata-a 'refuse'	katal-i-a 'refuse to'
chomo-a 'draw out'	chomol-e-a 'draw out for'
fungu-a 'unfasten'	fungul-i-a 'unfasten for'
twa-a 'take'	twal-i-a 'get hold of'
ochuku-a 'carry'	ochukul-i-a 'carry for someone'
ondo-a 'take away'	ondol-e-a 'deprive of'

Polome mentions that this /l/, alternating with /∅/, however, actually belongs to the relevant root. Just like in Chitonga, he suggests that the basic applicative allomorphs are *–il-* and *–el-* as seen in the reduplicated form of the suffix in:

11. Swahili

acha 'take'	ach-i-a 'leave to someone'	ach-il-i-a	'pardon'
fika 'arrive'	fik-i-a 'reach someone'	fik-il-i-a 'get right here'	

In other analyses for example, Mkochi (2004), liquid, glide and zero alternations have been treated as cases of glide and liquid epenthesis. Mkochi (2004:27) states: "What determines whether it is a liquid that is inserted instead of a glide is nothing but the height of the vowels." The present paper, however, shows that analyses by Mkočhi and Polome miss an important generalization that a liquid is consistently missing before the final mora position. Although Poleme suggests that the liquid is there in the underlying form, he provides no evidence for it.

The most significant non-linguistic statement about liquid and glide/zero alternation is to be found in Turner's (1952: i-ii) where he states:

> The Tonga column gives the words only when they are different from the Tumbuka – the words being in many cases the same. The Tonga folk, being rapid speakers, slur or elide the final syllable of many words: e.g. *kulira* becomes *kuliya*, *kukura* becomes *kukuwa*, *kutora* becomes *kuto'* – the accent in the last example remaining on the final syllable, indicating that the terminal *–ra* has been elided. In further inflections of the verb, however, the elided syllable is first restored, then the final *–ra* is again elided, so that *kutorera* becomes *kutore'*

This paper, however, has independently shown how the problem of liquid and glide/zero alternation are easily accounted for by OT. It has shown that outputs are freely generated and the actual output for any input is the one which is the most optimal given the ranking of relevant constraints in Chitonga. This is quite unlike in derivational theories of the type assumed and argued for in Generative Phonology where phonological outputs are derived from underlying representations through the interaction of ordered rules.

Since *-il-/-el-* seems to be the proto-form of applicative marking in Bantu, retained in the neighboring Chichewa and Chitumbuka, its absence in Chitonga surface forms seems to be a result of re-ranking of the constraints No 1 (fin. μ) and MAX (liquid). The re-ranking of these constraints, which appears to have also taken place in Kiswahili and Kichaga, leaves an issue that requires a separate treatment. It could provide insight into whether Chitonga has its origins partly in Tanzania. The origin of the Tonga people has baffled historians for a long time (see Msosa 1999; Pachai 1973).

Notes

* I am grateful to Laura Downing for teaching me how to make generalizations from given data and "for working through with me on this paper."

1. Unless indicated otherwise, all the verb forms from Chitonga in this paper are of low tone type. The symbol /l/ represents the symbols /l/ and /r/ which occur in free variation.

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