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Tone in the infinitive in Kinande: an OT analysis¹

by

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This paper seeks to account for the tonal processes in the infinitive in Kinande, a Bantu language of eastern DRC (Congo), using the Optimality theoretic framework. We postulate lexical tones, phrasal tones and intonational tones in the input, and we derive the output tones from these through universal constraints that mediate between input and output tonal structures. The paper is organized as follows. In §1, we present the basic assumptions of OT. In §2, we deal with the disyllabic verb stems of the infinitive in Kinande, and in §3 we extend the analysis to the monosyllabic stems. We end the paper with an appendix that assembles the central OT constraints relevant for tonal analysis in current work on Bantu languages.

1. Some basic assumptions of OT.

The theoretical framework within which the above facts will be accounted for is Optimality theory (Prince and Smolensky 1993). The version adopted here is the correspondence model of McCarthy and Prince (1995). The summary presented below draws from Yip (in progress), as well as from the original sources.

The central proposal of Optimality theory (OT) is that phonological outputs are not derived by the interaction of ordered rules. The input to each process is associated, via the function GEN, with a set of output candidates which are evaluated against a set of ranked and violable constraints. The function that evaluates these rankings is called H-EVAL. The candidate which best satisfies the constraint system is the optimal candidate, or output form. Optimality theory shares with SPE the notion of an underlying form, an input, and of course both theories produce outputs. The difference is that SPE moves from input to output in a series of stages, or a derivation, whereas OT simply selects the optimal output. Within the OT phonology proper, there are only two stages: the input, and the phonological output.

Optimality theory is an output-based grammar. Yip (in progress) notes that output here really refers to the output of the phonological component, which in turn serves as an input to a phonetic component. The constraint set, which are universal, evaluate only the outputs; there are no constraints on inputs. All possible outputs for any given input are considered, and the "best" is selected as the actual output, or the optimal form.

While constraints are assumed to be universal, constraint-rankings are language specific. Interlinguistic variation may be accounted for by ranking the same constraints in

¹ Part of the material in this paper was discussed in Akinlabi's seminar course on tone at Rutgers University. The second co-author is very grateful for the encouragement he got from Mark Baker for his keen interest in Kinande and Bantu languages in general. His deep gratitude is addressed also to the Center for African Studies and the Department of Linguistics that made possible his visit at Rutgers University for the spring semester 2001.

different orders. All constraints are considered to be violable. As a result, even the optimal output candidate may violate some constraints as long as it satisfies the constraints set better than competing candidates do. These principles are summarized in (1).

1. Principles of Optimality Theory (Prince and Smolensky 1993; McCarthy & Prince 1993a,b; 1994)
 - a. Universality: UG provides a set Con of constraints that are universal and 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-particular basis; the notion of minimal violation is defined in terms of this ranking. A grammar is a ranking of the constraint set.
 - d. Parallelism: Best-satisfaction of the constraint hierarchy is computed over the whole hierarchy and the whole candidate set. There is no serial derivation.

Although outputs can vary infinitely from the inputs they are based on, Correspondence theory (McCarthy & Prince 1995) constrains how abstract the relationship between inputs and outputs may be by making it optimal for inputs and outputs to be as similar as possible. Constraints are of three types: "faithfulness" constraints, markedness constraints, and alignment constraints.

Faithfulness constraints penalize changes to the input form (no-deletion (MAX), no-insertion (DEP), or no-featural change (IDENT)). In a rule-based theory these have no direct equivalent. Inputs remain unchanged unless a rule applies, so faithfulness is just what you get when there is no applicable rule. In OT, however, the faithful output is just one of many candidates, and frequently it is quite marked, and thus fails on one or more markedness constraints. The faithfulness constraints may be dispersed for the relevant category, such as tone, as follows. The following are strictly informal definitions.

2. a. MAX-T: Input tones are realized in the output (i.e. no deletion)
- b. DEP-T: Output tones correspond to the input tones (i.e. no insertion)
- c. IDENT-T: Input and output tones are identical featurally (i.e. no featural change.)

Markedness constraints may concern features, feature combinations, or structures. Some tonal examples are:

3. a. *H: High tones are marked (i.e. no high tones)
- b. *RISE: Rising tones are marked (i.e. no rising tones)
- c. AVOID-SPONSOR: Tones are not realized on their input sponsor segments.

The interaction of markedness and faithfulness constraints determine what we get on the surface. Lower ranked constraints may be violated in favor of higher ranked constraints. For example (>> = dominates), if MAX-T >> *RISE then rising tones will be realized in the output because it is more important for input tones to be realized in the

output than to get rid of marked (rising) tones. All such rising tones are kept, in violation of *RISE. If on the other hand *RISE >> MAX-T, then no rising tones will show up in the output even if they are present in the input because it is more important NOT to have a marked (rising) tone in the output. All such rising tones are preferably deleted, in violation of MAX-T.

The third set of constraints are alignment constraints. In some works on OT (see Yip in progress) these are considered to be markedness constraints, but we shall here separate them into a different class. The theory of Generalized Alignment (McCarthy 1993a,b, 1994) formalized the generalization that edges of constituents, whether morphological or prosodic, tend to coincide (be aligned) in well-formed representations. For example, the left edge of the leftmost metrical foot and the right edge of the rightmost metrical foot are often aligned with the left and right edges of the morphological or prosodic word in a well-parsed metrical representation (and intervening syllables are also optimally parsed into feet aligned as close as possible to one edge or the other of the prosodic word). In Generalized Alignment theory, these sorts of generalizations are captured by a family of alignment constraints which specify which two constituents share an edge and which edge they share. Alignment constraints were first applied to features in Kirchner (1993), Pulleyblank (1993), and Akinlabi (1994). These constraints are now commonly employed to account for the location and movement of tones in tone languages (see Akinlabi 1996, Downing 1996a, b). Examples of tonal alignment constraints are (R = right; L = left):

- (4) ALIGN-L (H, STEM): Align every H tone with the left edge of some stem.
- ALIGN-R (H, INFL): Align every H tone with the right edge of INFL.

This above brief summary suffices for our purposes in this paper. Archangeli and Langendoen (1997) and Kager (1999) are two excellent textbooks on OT which provide detailed introductions. Yip (in progress) provides an excellent introduction to tone within OT. In the appendix, we present additional constraints that have been employed in tonal analysis, as presented in Yip and other sources.

2. The infinitive in Kinande: disyllabic verb stems.

In this section, we first describe the data relevant for the tonal processes in the infinitive in Kinande before proposing an OT account of these data.

Consider first the case of a toneless verb root (-hum-) as in the following data:

Toneless verb in the infinitive (Mutaka 1994)

- | | | | |
|------|------------|--------------|-----------------|
| 5.a. | erihú:ma | 'to hit' | /ɛ-ri-hum-a/ |
| | erimuhú:ma | 'to hit him' | /ɛ-ri-mu-hum-a/ |

erinamuhú:ma	'to hit him indeed'	/ε-ri-na-mu-hum-a/
erinahú:ma	'to hit indeed'	/ε-ri-na-hum-a/
b. erihuma Magú:lu	'to hit Magulu''	
erimuhumira Magú:lu	'to hit him for Magulu''	
erinamuhumira Magú:lu	'to just hit him for Magulu''	
erinahumira Magú:lu	'to just hit for Magulu''	

In these forms, the vowel ε- is the initial vowel also called augment in Bantu linguistics, -ri- is the infinitive marker, -na- is an aspectual marker, and -mu- is an object marker. We assume Mutaka's (1994) proposal that the material preceding the object marker constitutes a prosodic word (called INFL) and that the object marker with the stem constitutes the macrostem. Evidence for treating the object marker as part of an expanded stem (here, the macrostem) will be given later when we discuss the monosyllabic verb stems.

Following Hyman (1990), we assume that the H on the penultimate vowel in (5a) is a phrasal tone and the L on the final vowel (unmarked here) is an intonational tone. This is made obvious in (5b) where we have added a name after the verb. What happens is that the phrasal H now surfaces on the penultimate vowel of the entire utterance and the intonational L surfaces on its final vowel.

Notice that the phrasal H may surface on the final vowel when the verb is in a sentential subject position as illustrated in (6a) below:²

- 6.a. erihumá sřryowé:ne 'to hit is not good'.
erihumirá sřryowé:ne 'to hit for is not good'
- b. erihumá n' erihumí:rá sřryowé:ne 'to hit and to hit for is not good'.
erihumirá n' erihú:má sřryowé:ne 'to hit for and to hit is not good'

Notice also that an H surfaces on the last vowel of a verb (-erihumá, erihumirá) that is conjoined with another verb as in (6b). Such an H is intonational and it

² We know that the H on the final vowel of a verb in subject position is phrasal because it does not associate to a Vowel that is already associated to a tone unlike the intonational H which surfaces on the FV that is presumably associated with a L in the input. The best examples to show this come from the past tenses:

- a. erihumá sřryowé:ne 'to hit is not good' (Infinitive)
b. emótwáhúmjrē sřryowé:ne 'the fact that we hit is not good' (Historical past)
c. etwahumirira sřryowé:ne 'the fact that we hit on purpose is not good' (Remote Past)

In the recent and remote past tenses, the last vowel is associated with a suffixal L, that is why the phrasal H fails to associate to it.

always surfaces on the last vowel in a list intonation.³

It is also worth mentioning that, in the sentences in (6b), there is no pause after the verb erihumá or erihumirá. The pause only occurs after the second verb (erihumí:rá or erihú:má). As also shown in the examples (in 6b), the second verb (erihumí:rá / erihú:má) surfaces with two H tones. The one on the penultimate vowel is the phrasal H and the one on the FV is the intonational H. The verbal forms in (6b) may also be rendered as follows:

7. erihú:má n' erihumí:rá ni bindú bibi:ri
'hitting and hitting for are two (different) things'.

In this case, each verb forms an intonational phrase and it has both the phrasal H on the penultimate vowel and the list intonational phrase H on the final vowel. Notice also that penultimate lengthening is a further indication of an intonational phrase in these forms.

So far, we have postulated the following tones:

- (i) Phrasal H tone
(ii) List intonation H tone⁴
(iii) Utterance final L tone.

The phrasal H may appear on the final vowel or on the penultimate vowel whereas the intonational tone (H or L) appears on the final vowel. As we will illustrate later, the generalization on the surface placement of the phrasal H and the intonational H can be captured by an interaction of two constraints in OT: ALIGN-RIGHT and NON-FINALITY.

Consider now the forms with a H(igh) tone verb root (-túm-).

³ Again, the best examples that illustrate the fact that the intonational H always surfaces on the last vowel of an intonational phrase, even if that vowel is associated to a L in the input, come from the past tenses.

- a. erihumá n' etwahumirira ni bindú bi-biri (Infinitive + Remote past)
'to hit and we hit are two different things'
b. etwahumirirá n' erihú:má ni bindú bi-biri (Remote past + infinitive)
'the fact that we hit on purpose and to hit are two different things'
c. etwahumirirá n' emótwáhúmjrē ni bindú bi-biri (Remote past + historical past)
'the fact that we hit and the fact that we hit on purpose are two different things'

As illustrated in these forms, the FV which, in the remote past and the historical past is associated to a lexical L, surfaces with an intonational H.

⁴ We will assume that the list intonation H is accounted for by a constraint placing it on the final vowel of the phrase as in (3). However, we will not provide a derivation in this paper.

- 3.a. erítú:ma 'to send' /e-ri-túm-a/
 erínátú:ma 'to send indeed' /e-ri-na-túm-a/
 b. erímútú:ma 'to send him' /e-ri-mu-túm-a/
 erínámútú:ma 'to send him indeed' /e-ri-na-mu-túm-a/

- 3.a. erítuma Magú:lu 'to send Magulu'
 erínátumira Magú:lu 'to just send for Magulu'
 b. erímútumira Magú:lu 'to send him for Magulu'
 erínámútumira Magú:lu 'to just send him for Magulu'
 c. erímútumá síryowé:ne 'to send him is not good'

With respect to the phrasal H, these forms do not differ from the toneless verb forms discussed above – the penultimate H in each form (8) and (9) is the phrasal H. Of interest here is the lexical H tone of the verb root which anticipates once onto the preceding vowel in forms without an object marker (8a, 9a), and twice in forms with the object marker (8b, 9b). This lexical H never surfaces on its underlying tone bearing unit, that is, on the root vowel. The form in (9c) illustrates the phrasal H on the final verb when the verb is in subject position.

We propose that an interaction of the following constraints accounts for the surface realization of this lexical H from an OT perspective: ALIGN-H(H, INFL), ALIGN-LEFT(H, Stem), AVOID SPONSOR.⁵ These constraints may be defined as follows:

0. ALIGN-H (H, INFL): The verbal lexical H tone is aligned with the right edge of the INFL prosodic word.
1. ALIGN-LEFT(H, Stem): The verbal lexical H tone is aligned with the left edge of the stem.
2. AVOID SPONSOR: a lexical H tone is not realized on its sponsor.

A brief explanation for the motivation of these constraints is in order here. First, notice that when the lexical H anticipates once or twice, it always surfaces on the last vowel of the INFL marker (cf. -ná- or -rí-) irrespective whether there is an object marker or not. This element is precisely the right edge of the INFL domain. As is by now common in work on OT, we adopt a position in which

⁵ We propose this constraint in the spirit of Kisseberth (1993) who has a constraint called AVOID PROMINENCE.

alignment constraints are employed to account for featural spreading or movement. The ALIGN-H constraint captures the generalization on the surface location of the leftmost span of the lexical H. We need ALIGN-LEFT to attract the lexical H to the root vowel which is the left edge of the stem domain. Finally, AVOID SPONSOR ensures that the optimal candidate is the one whose H surfaces on every vowel between the INFL and the stem, but not in the stem. We propose the following ranking of the three constraints:

13. ALIGN-H, AVOID SPONSOR >> ALIGN-LEFT(H, STEM)

Both ALIGN-H and AVOID SPONSOR dominate ALIGN-LEFT since the lexical H tone never gets a chance to be realized on the root vowel, violating ALIGN-LEFT. We illustrate the derivations of the form: erítú:ma 'to send' in Tableau 1, and erínátú:ma 'to send indeed' in Tableau 2. For reasons of clarity, we abstract away from the intonational H tone in the first two tableaux, and focus on the realization of the lexical H.

Tableau 1

Input: e-ri[-tum-a

Candidates	ALIGN-H	AVOID SPONSOR	ALIGN-LEFT (H, Stem)
a. erítuma H			*
b. érituma H	*!		*
c. érituma \\ H	*!		*
d. erítuma \\ H		*!	
e. erítuma H	*!	*	

- 1.a. erítú:ma 'to send' /ɛ-ri-túm-a/
 erinátú:ma 'to send indeed' /ɛ-ri-na-túm-a/
 b. erímútú:ma 'to send him' /ɛ-ri-mu-túm-a/
 erinámútú:ma 'to send him indeed' /ɛ-ri-na-mu-túm-a/
- 2.a. erítuma Magú:lu 'to send Magulu'
 erinátumira Magú:lu 'to just send for Magulu'
 b. erímútumira Magú:lu 'to send him for Magulu'
 erinámútumira Magú:lu 'to just send him for Magulu'
 c. erímútumá síryowé:ne 'to send him is not good'

With respect to the phrasal H, these forms do not differ from the toneless verb forms discussed above – the penultimate H in each form (8) and (9) is the phrasal H. Of interest here is the lexical H tone of the verb root which anticipates once onto the preceding vowel in forms without an object marker (8a, 9a), and twice in forms with the object marker (8b, 9b). This lexical H never surfaces on its underlying tone bearing unit, that is, on the root vowel. The form in (9c) illustrates the phrasal H on the final verb when the verb is in subject position.

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10. ALIGN-H (H, INFL): The verbal lexical H tone is aligned with the right edge of the INFL prosodic word.
 11. ALIGN-LEFT(H, Stem): The verbal lexical H tone is aligned with the left edge of the stem.
 12. AVOID SPONSOR: a lexical H tone is not realized on its sponsor.

A brief explanation for the motivation of these constraints is in order here. First, notice that when the lexical H anticipates once or twice, it always surfaces on the last vowel of the INFL marker (cf. -ná- or -rí-) irrespective whether there is an object marker or not. This element is precisely the right edge of the INFL domain. As is by now common in work on OT, we adopt a position in which

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Tableau 1

Input: ɛ-ri[-tum-a

Candidates	ALIGN-H	AVOID SPONSOR	ALIGN-LEFT (H, Stem)
a. $\overset{\text{H}}{\text{erítuma}}$			*
b. $\overset{\text{H}}{\text{érituma}}$	*!		*
c. $\overset{\text{H}}{\text{érítuma}}$	*!		*
d. $\overset{\text{H}}{\text{erítúma}}$		*!	
e. $\overset{\text{H}}{\text{eritúma}}$	*!	*	

In the above tableau we are considering only candidates in which the input lexical H is realized in the output. All the candidates satisfy faithfulness in this regard. Candidate (a) wins because it satisfies the two highly ranked constraints, violating only ALIGN-LEFT. Candidates (b) and (c) are disqualified because they violate the ALIGN-H although they satisfy AVOID SPONSOR. Both candidates (d) and (e) are rejected because they violate AVOID SPONSOR, while satisfying ALIGN-LEFT. Their disqualification is an indication that ALIGN-LEFT is low ranked, since satisfying it does not prevent them from being disqualified.

The next tableau illustrates a form with the object prefix *-mu-*, occurring between the last item in INFL *-na-* and a High tone verb root.

Tableau 2.

Input: *é-ri-na [-mu-tum-a*

Candidates	ALIGN-H	AVOID SPONSOR	ALIGN-LEFT (H, Stem)
a. <i>erinámútuma</i> \ H			*
b. <i>erinámutuma</i> H			**!
c. <i>erinamútuma</i> H	*!		*
d. <i>erinámútúma</i> \\ H		*!	
e. <i>erínámútuma</i> \\ H	*!		*

The essential goal of the constraint ALIGN-LEFT is to get the H tone to be aligned to the left edge of the verb root. But this is prevented from happening

because of the dominant AVOID SPONSOR. However what this means in reality is that the ALIGN-LEFT allows only minimal violation, that is, it attracts the H tone as close to the verb root as possible, without violating AVOID SPONSOR. This tableau shows that the fact that a constraint is ranked low does not imply that it is ineffective. Candidate (b) has the lexical H tone one syllable too far from the left edge of the root vowel, violating ALIGN-LEFT one more time than candidate (a) and thus rendering it non-optimal. The rest of the candidates violate one of the two top ranked constraints, and so are non-optimal, as we already illustrated in Tableau 1.

Let us now return to the phrasal H and the intonational tones that we discussed earlier. More precisely, how can these tones be integrated into the analysis?

The ultimate question to solve for integrating these phrasal and intonational tones is to know how these should be represented in the input. In case the verbal forms appear in a non-phrase final context, these phrasal and intonational tones need not appear in the input. But when the verbal forms appear in a phrase final context we need to have them in the input. Because we need to distinguish the intonational H from the phonological phrasal H, we will encode these two H's differently. We will call the phonological phrasal H "H_P" and the intonational H "H_I". This way we are able to distinguish them from the lexical H which does not have any subscript. We also use these subscripts as a mnemonic strategy for encoding the linearity of these tones as we attribute the appearance of the phrasal tones on the final or penultimate position of the stem as a response to the constraints NONFINALITY, ALIGN-R(Stem, H_P), ALIGN-IP-H(IntPh, H_I), ALIGN-IP-L(IntPh, L), and *CONTOUR. These constraints may be defined as follows.

14. ALIGN-R (Stem, H_P): Every stem is right aligned with a phrasal H tone.
15. ALIGN-IP-H (IntPh, H_I): Every Intonational phrase is right aligned with High tone.
16. ALIGN-IP-L (IntPh, L) Every Intonational phrase is right aligned with a Low tone. (What is the difference between the H and L intonational phrases?)
17. NONFINALITY: An H tone cannot occur on the phrase final vowel.

We now give the complete picture of the tableaux that illustrate our account of both the lexical tones and the phrasal tones. Tableau 3 illustrates a case of a form

that has both a phrasal H and an intonational L (e.g. 8a) whereas tableau 4 illustrates the list intonation when the phrasal H appears on the final vowel (e.g. example (9c)). We indicate the input form at the beginning of the tableau and the ranking of the constraints immediately below the tableaux. The right square bracket indicates the boundary.⁶ In the following tableau, we will put two constraints in the same column when there is no evidence for ranking between them, for reasons of space. We will consider only candidates that satisfy the constraints ALIGN-H and AVOID SPONSOR, which have already been illustrated above. Both of these constraints are in our opinion at the top of the hierarchy in Kinande.

Tableau 3: Lexical H, Phrasal H and Intonational L

Input: e-ri-tum-a]

 H H _P L _I				
Candidates	ALIGN-H, AV-SPON	NON-FIN	ALIGN-R (St, H _P)	ALIGN-IP-L, *CONTOUR
a. erítú:ma H H _P L _I			*	
b. erítumâ H H _P L _I		*!		*
c. erítúma H H _P L _I			*	*!*

In this tableau, candidate (b) is crucial because it will be seen that an HL contour does surface on the final vowel in the monosyllabic stems. Though it also violates *CONTOUR, it is NONFINALITY that rules out this candidate. The last candidate ties with the optimal candidate in avoiding a NONFINALITY violation and violating ALIGN-R instead, but it is non-optimal because the final Low tone is not right aligned. In addition, it also violates *CONTOUR.

The next tableau presents a situation in which the phrasal H is indeed in final

⁶ We will not consider candidates that violate LINEARITY in these tableaux, for reasons of space. We assume a LINEARITY constraint defined as follows, and we assume that it is inviolable in Kinande. LINEARITY-T: The tones in the output follow the same sequence as they are in the input.

position. This happens when the verb is in sentential subject position (example number (9c)), and is followed by some complement. We argue that the H_P is not in absolute phrase final position here and is not subject to NONFINALITY. Notice also that the Intonational Low is absent here.

Tableau 4: Phrasal H on final vowel.

Input: e-ri-na-mu-tum-a]

 H H _P				
Candidates	ALIGN-H, AV-SPON	NONFIN	ALIGN-R (St, H _P)	ALIGN -LEFT
a. erinámútumá H H _P				*
b. erinámútuma H H _P			*!	*

Both candidates satisfy NONFINALITY, therefore the decision is passed on to the next constraint, in this case ALIGN R. Since there is no pressure from any higher ranked constraint to violate this constraint, candidate (a) is optimal.

3. The monosyllabic verb stems.

Before giving an OT account of the data on the monosyllabic stems of the infinitive in Kinande, a brief description of these data is in order here. Consider first the following forms.

- 18.a. erít:tâ 'to bury' /e-ri-tá-a/
- b. erít:tâ 'to kill' /e-ri-ít-a/
- c. eryô:tâ 'to light' /e-ri-ýt-a/

To account for these forms, we assume the analysis in Mutaka (1994) who treats the stems here as monosyllabic. In the forms in (18b,c), the initial vowel does not count as a syllable because it has no onset. We give the underlying representation of these forms in the rightmost column. We follow Mutaka's (1994) proposal that in the forms in (b,c) there is a buffer vowel which is inserted just in case the stem is too short, that is, when it does not meet the minimum requirement (

being bimoraic, as illustrated in (19) below. This bimoraicity may be met in two ways. For a verb root of the CV type, it becomes bimoraic with the addition of the FV, as in (18a). For a verb root of the VC- type, it becomes bimoraic if it takes the shape VCV-V where the last V is the FV and the penultimate V is inserted (19a,b). It also becomes bimoraic when it takes the shape CVCV where the last V is the FV and the first C is the onset from the segment that is in the expanded stem, more precisely, from the Object marker (19c). This is better clarified in the following data in which we compare the root -ta- (CV) and -ɔt- (VC).

19a.	erí:tâ /ε-ri-ta-a/ 'to bury'	eryô:tâ /ε-ri-ô-tV-a 'to light'
b.	eríbi:tâ /ε-ri-bi-ta-a/ 'to just bury'	eríbyô:tâ /ε-ri-bi-ô-tV-a/ ⁷ 'to just light'
c.	eríbi:tâ /ε-ri-bi-ta-a/ 'to bury them'	eríbyô:ta /ε-ri-bi-ô-t-a/ 'to light them'

In these forms, the -bí- in (b) with an underlying H tone is an aspectual marker whereas the -bi- in (c) is an object marker. As we noted earlier, the object marker is part of the stem with which it forms the macrostem whereas the aspectual marker is part of the INFL prosodic word. As shown in the underlying forms between back slashes, the stem -ta- does not need the buffer V because its stem already consists of two vowels. The stem -ɔt- in the right hand column needs this buffer vowel only when the root is not preceded by the object marker. In other words, because of the fact that the object marker is part of the expanded stem, the root vowel of -ɔt- has an onset, and the phrasal H can target it as the penultimate vowel as in (19c).

Going back to the forms in (18), what is striking here is the appearance of contours. The falling tone on the final vowel is the result of the linking of the phrasal H and the intonational L. Indeed, when the form is in a non-phrase final

⁷ That the buffer vowel is not in the underlying representation is also supported by the following forms

where the tense marker -ire is suffixed to the verb:

a. mótwaté:re /mɔ-tu-a-ta-jre/ we buried

b. mótwótj:re /mɔ-tu-a-ɔt-jre/ we lit

Coalescence of a + j into "e" apply in (a) but not in (b) because the input for coalescence is lacking in the verb stem of (b). Mutaka (1994:42) argues that this buffer vowel is inserted at the second stratum to meet a constraint in Kinande that bans a monomoraic stem at stratum two.

position, these contours do not show up as illustrated below.

20.a.	eríta Magú:lu	'to bury Magulu
b.	eríta Magú:lu	'to kill Magulu'
c.	eryôta Magú:lu	'to light Magulu'

As also shown in the forms in (20), the contour on the root vowel in (18) must be the result of a phrasal phenomenon as it does not appear when the form is in a non-phrase final position. The H tone in this contour is the lexical H tone that results from vowel deletion (20b) or gliding (20c) of the vowel that precedes the root vowel and on which its underlying H tone would have surfaced. (Recall that the lexical H always anticipates one step back.) The L in the contour is a default (epenthetic) L tone on the root vowel. Notice that this contour on the root vowel persists when the verb is in a phrase final position, that is, when both the phrasal H and the intonational L are present in the form as illustrated below.'

21.a	erítí:ra	'to bury for	/ε-ri-tá-ir-a/
b.	erítj:ra	'to kill for'	/ε-ri-ít-ir-a/
	erítjír:ra	'to kill on purpose'	/ε-ri-ít-irir-a/
c.	eryôté:ra	'to light for'	/ε-ri-ô-t-ir-a/
	eryôteré:ra	'to light on purpose'	/ε-ri-ô-t-irir-a/

As shown in these forms, at first blush it appears that this contour persists just in case the lexical H that forms the first portion of this HL contour would be adjacent to the phrasal H, preventing an OCP violation. (We argue below that the OCP is not responsible here.) The longer forms in (21b,c) do not exhibit this contour. Using the verb in a context where the phrasal H surfaces on the final vowel also yields the same observations.

22 a.	erítá sýrywé:ne	'burying is not good' ⁸
	erítirá sýrywé:ne	'burying for is not good'
	erítirirá sýrywé:ne	'burying on purpose is not good'
b.	eryôta sýrywé:ne	'lighting is not good'
	eryôterá sýrywé:ne	'lighting for is not good'
	eryôtererá sýrywé:ne	'lighting on purpose is not good'

⁸ Although the lexical H is adjacent to the phrasal H in this form, this is not a counterexample to the observation that the contour appears just in case the lexical H would have been adjacent to the phrasal H because the default L is never assigned in this form that would be an input to a contour.

Just to be complete in the presentation of these data, in contexts where both the phrasal H and the intonational H appear on the verb, the same observation about the persistence of the contour tone holds as shown below:

23. a. *erí:tá n'érítirí:rá ni bindú bibiri*
 'burying and burying for are two (different) things'
 b. *eryô:tá n'eryôté:râ ni bindú bibiri*
 'lighting and lighting for are two (different) things'
eryôté:râ n'eryôteré:râ ni bindú bibiri
 'lighting for and lighting on purpose are two (different) things'

When compared to the disyllabic verb stems, there are two questions to answer in the monosyllabic stems. First, why do contour tones appear on the verb stems, and secondly why do the contour tones seem to disappear when the lexical H is not adjacent to the phrasal H (21b,c; 22b)?

For an OT account of the tones in the monosyllabic stems, let us first examine the forms where the lexical H, the phrasal H and the intonational L surface as in the following forms:

- 24.a. *eryô:tâ* / ϵ -ri-ô-t-a H₁L₂/ 'to light'
 b. *eryôté:ra* / ϵ -ri-ô-t-ir-a H₁L₂/ 'to light for'
 c. *eryôteré:ra* / ϵ -ri-ô-t-irir-a H₁L₂/ 'to light on purpose'

At first blush, it appears that the first contour surfaces in forms where the lexical H of the stem would have been adjacent to the phrasal H as in (24a,b). This suggests something of an OCP effect. However, if we examine forms where the monosyllabic root has an onset, the two tones can occur side by side without an intervening L tone (24d). This confirms that the contour in (24a-b) is the result of something else other than the OCP.

- 24.d *erítí:ra* 'to bury for' / ϵ -ri-tá-ir-a H₁L₂/

We propose that the reason why there is a Low tone insertion in (24a-b) is that vowel deletion or glide formation results in the potential realization of the lexical H tone on its SPONSOR. This is in violation of the constraint AVOID SPONSOR. We attribute glide formation or vowel deletion to the constraint NO

HIATUS, which forbids a sequence of two vowels in the output and we attribute the fact that all the tones are realized to the high ranking of the constraint MAX-T. These constraints are formally defined as follows:

25. NOHIATUS: a heterosyllabic sequence of vowels not separated by a consonant is prohibited. (Ola Orié & Pulleyblank 2000)

26. MAX-T: a tone in the input must have a correspondent in the output.

We will abstract away from a discussion of NOHIATUS, and focus on its effect on tonal output. We propose that the L tone is inserted on monosyllabic verb stems (to create an HL fall) when the lexical H tone will surface on its sponsor. One crucial difference between the monosyllabic verbs in (24a-b) and (24d) is that in (24d) the lexical H tone is still able to shift one step back, whereas in (24a-c) it is unable to do this. The insertion of the L results in a DEP-T violation, but this is the price to pay if AVOID-SPONSOR is to be minimally respected in these forms. We assume that the L tone is preferred as the inserted tone because it is the less marked tone.

The following rankings of the constraints have been motivated in the preceding discussion. For clarity, we show the ranking now, and we indicate the motivation for the proposed ranking:

- 27
 (i) MAX-T >> NONFINALITY: all tones are realized, even when they are realized on the final vowel.
 (ii) AVOID-SPONSOR >> DEP-T: A Low tone is inserted to make short forms respect AVOID-SPONSOR.

We now derive the forms in (24a):

Tableau 5
 Input: ϵ -ri[-ô-t-a]
 |
 H H_PL₁

ϵ -ri[- ot -a] H H _P L ₁	ALIGN-H, AV-SPON, MAX-T	NONFIN	ALIGN-R (St,H _P)	ALIGN-IP-L, *CONTOUR, DEP-L
a. ϵ ry $\acute{\text{o}}$ t $\acute{\text{a}}$ \ HLH _P L ₁		*		**
b. ϵ ry $\acute{\text{o}}$ t $\acute{\text{a}}$ \ H H _P L ₁	*!	*		*
c. b. ϵ ry $\acute{\text{o}}$ t $\acute{\text{a}}$ H H _P	*!*	*		

The above tableau is interesting in that all candidates are equal in satisfying ALIGN-R. But they all violate NONFINALITY in the process, because the phrasal H tone occurs on the final vowel. What separates them is in how well they satisfy the top-ranked constraints. Candidate (b) violates AVOID-SPONSOR by not inserting the L tone on the sponsoring vowel (in bold in (a)). Candidate (c) violates both AVOID-SPONSOR and MAX-T, the first violation because of the lack of the epenthetic L, and the second because the input intonational L tone is deleted. Both of these candidates are ruled out on these grounds. The resulting output has two contour tones, one from the L insertion, and the other from the combination of phrasal H and the intonational L. We now turn our attention to a form like (24c), where there is no contour, and where the lexical H still superficially appears on the sponsoring vowel. We repeat this example below, for convenience:

28. ϵ ry $\acute{\text{o}}$ t $\acute{\text{e}}$:ra / ϵ -ri- $\acute{\text{ot}}$ -irir-a H₁L₂/ 'to light on purpose'

We propose that this form does not realize an epenthetic L because the HL fall that will result from it is immediately followed by another L. We assume that this L actually results from the constraint SPECIFY-T. This constraint ensures that all vowels get a tone on the surface, even if they have none in the input. We also rest the selection of L as the default tone on markedness considerations. We propose that a constraint bans the marked sequence HL L, neutralizing it to H L. We state the constraint as follows:

29. *HL L: A falling tone may not be followed by a L tone. (i.e. the sequence HL L is marked.)

Finally, since there are enough vowels, NONFINALITY is respected because the phrasal H is realized on the penultimate vowel. ALIGN-IP-L is also satisfied, because the intonational L is realized on the final vowel. Therefore there is no contour on the final vowel as in (24a).

We propose that the markedness constraint *HL L dominates all other constraints that we have proposed so far. We derive the form in (28) (= 24c) in tableau 6.

Tableau 6.

ϵ -ri- $\acute{\text{ot}}$ -irir-a H H _P L ₁	*HL L	ALIGN-H, AV-SPON, MAX-T	NONFIN	ALIGN-R (St,H _P)	ALIGN-IP-L, *CONTOUR, DEP-L
a. ϵ ry $\acute{\text{o}}$ t $\acute{\text{e}}$ ra H LH _P L ₁		*		*	*
b. ϵ ry $\acute{\text{o}}$ t ϵ r $\acute{\text{e}}$ ra HLLH _P L ₁	*!			*	**

In this tableau, the optimal candidate violates AVOID-SPONSOR by not having a surface L tone on the stem vowel, but this is simply to satisfy a higher ranked constraint, the constraint *HL L which says that this sequence is marked. The second candidate does the opposite, and is ruled non-optimal.

Conclusion.

Our basic aim in this paper was to show how a set of ranked constraints currently used in works on OT can account for the complex tone in the infinitive in Kinande. What makes the tone in the infinitive in Kinande complex is that one should distinguish lexical tones from phrasal and intonational tones. In addition, one should determine the domains in which these tones surface. The challenge for accounting for these tones was basically to motivate an input that results in an output mediated by a set of ranked constraints. We have achieved this by considering the phrasal and intonational tones as boundary tones à la Hyman (1990). We show that even high ranked constraints such as AVOID-SPONSOR can be violated under pressure from other constraints, such as *HL

L. This way of annotating tones supports the claim in Bickmore (1999:110) that "a single pass through a constraint ranking, where constraints are annotated for the lexical domain in which they apply, is superior to an account in which a block of constraints (in a stem domain) produces an output which is then fed to another block of constraints (in a word domain)." We want to end this paper by mentioning a problem in Kinande phonology we have not attempted to answer: is the phrasal H or the intonational H featurally different from the lexical H? The answer to this question awaits further investigation. Two areas in Kinande where the difference between the lexical H and the phrasal H may be teased apart is in the recent past tense and the nominal forms whose final vowel has an underlying H. In these forms, the phrasal H is not assigned because the lexical H surfaces on the penultimate vowel.

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Appendix: Some Constraints on Tone (from the Bantu literature)

The reason for adding this appendix is to provide researchers working on Bantu languages with guidelines of the types of constraints currently used and how these can be tested for future research on other Bantu languages. These constraints are compiled from several sources, already cited in our list of references; but they by no means exhaust those that have been proposed. They represent just a sampling. The constraints are grouped into three sets, alignment, faithfulness, and markedness constraints for ease of reference. Note that the alignment constraints (especially those with asterisks (*)) can be classified as markedness constraints.

ALIGNMENT CONSTRAINTS:

These are usually of the type: ALIGN-L (H, STEM): Align every H tone with the left edge of some stem. They are dispersable constraints, that is, alignment constraints can be stated to align any tone to a grammatical, morphological, or prosodic category.

These constraints are stated in two ways:

ALIGN-L (H, STEM) or ALIGN (H,L; STEM,L): Align every H tone with the left edge of some stem

EXAMPLES

ALIGN (H, L, So, L): The left edge of a HTS (High Tone Span) must align with the left edge of its lexical source (Bickmore Ms, citing Ham 1996). What is called a HTS is a series of TBUs on which the H can eventually spread in a specific domain: e.g. the last three vowels in CV[CVCVCV. The square bracket indicates the beginning of the HTS.)

ALIGN-L [H]: The left edge of a high tone span is aligned with the left edge of the verb. (Pulleyblank 1996). Similarly for ALIGN-R [H]. The constraints require that the domain of a tone extend to the edges of the verb.

ALIGN (High, L, Syllable, Left): The H tone is aligned with the beginning (left edge) of a syllable (Poletto 1998). Poletto equates this with a constraint called NO-RISE that would prevent the formation of a rising tone on a long vowel at the beginning of a stem. Another equivalent for this constraint could be *CONTOUR.

ALIGN (High, L, PWd, L): The left edge of each tone is aligned with the left edge of the prosodic word (Myers 1997).

ALIGN (subseg H, L, Stem, L): The left edge of a subsegment (i.e. floating) H must align with the left edge of the stem (Bickmore 1999). Of interest in this constraint is that it specifically refers to the association of a floating tone.

* ALIGN (H, L, So, L): The left edge of a HTS must not align with the left edge of its lexical source (Bickmore, ms.). Bickmore notes that this constraint is interpreted categorically,

i.e. if the two edges align, a penalty is incurred; if they do not, regardless of the distance between them, no penalty is incurred. He also comments that if *ALIGN dominates ALIGN then the High tone will be minimally misaligned with the specified edge.

* ALIGN (H, R, S, R, L): The right edge of a HTS in the output must not align with the right edge of the leftmost TBU of the source (Bickmore Ms).

* ALIGN (Stem, L, High, L)Inf, Fut, Pres, Rec Pst: The beginning of a stem (left edge) does not start with a High tone in the Infinitive, Future, Present tense, recent past tense. (Poletto 1998). This constraint is obviously the opposite of ALIGN (High, L, Syllable, Left), and it mentions the specific morphological domains in which the H tone does not surface at the beginning of a stem.

* ALIGN (Stem R, High, R): The H tone is banned from the final vowel of the stem (Poletto 1998). Poletto rightly equates this to a constraint called NON-FINALITY. This constraint accounts for the extrametricality (extratonicity, extraprosodicity) of the final vowel.

FAITHFULNESS CONSTRAINTS

Faithfulness constraints penalize changes to the input form (no-deletion (MAX), no-insertion (DEP), or no-featural change (IDENT)). Various forms of these are found in the Bantu literature. We begin with the most basic statements before giving a sampling of the variations. I-O means Input-Output.

MAX-IO-(T): Input tones are realized in the output (i.e. no deletion)

DEP-IO-(T): Output tones correspond to the input tones (i.e. no insertion)

IDENT-IO-(T): Correspondent tones have identical tonal values in the input and output (i.e. no change)

MAX-IO-(A): A tone association in the input must have a correspondent in the output (Myers 1997). Notice that in this constraint and the next, the focus is on the association line as opposed to a specific tone for example.

DEP-IO-(A): An association in the output must have a correspondent in the input. (Myers 1997)

FAITH-T. In Pulleyblank (1996), this constraint is actually a family of constraint that is specified as FAITH-H, i.e. the H in the input is maintained in the output; FAITH-L, i.e. the L in the input is maintained in the output. Basically, this constraint corresponds to MAX-T, DEP-T, and IDENT-T, all combined.

MAX-ET: Each TBU must have a correspondent tone. (Bickmore Ms). Bickmore equates this constraint to SPECIFY-(T).

DEP-ET: Every tone must have a correspondent TBU (Bickmore Ms). Bickmore equates this

constraint to *FLOAT.

NEARITY-T: Preserve the underlying linear order; in other words, do not metathesize tones.

UNIFORMITY-IO-(X): If a and b are distinct elements of type X in the input, then their output correspondents a' and b' are also distinct elements of type X (Myers 1997). This constraint is presumably the same as NO-FUSION, that is, two different tones should not merge into one tone.

ANCHOR-L: Assign a violation if and only if: (a) there is an output syllable S' that has an input correspondent S, (b) both S and S' bear tone, and (c) either S or S' is the leftmost syllable associated with its tone, and its correspondent syllable is not the leftmost syllable associated with its tone (Myers 1997). In much simpler terms, this constraint penalizes a tone which, in the underlying representation, is on the first vowel but surfaces on a different vowel.

MARKEDNESS CONSTRAINTS

In the OT literature, markedness constraints relating to tone are stated in two ways: NO-X or *X; implying "X is not permitted" or "X is a marked structure or feature". Not all markedness constraints are stated in this way. For example, the constraint AVOID-SPONSOR proposed in this paper is a markedness constraint not stated in that format, and the Obligatory Contour Principle (OCP) is usually simply stated as "OCP".

*H: High tones are marked. (A TBU cannot be high toned)

*L: Low tones are marked. (A TBU cannot be low toned)

*M: Mid tones are marked. (A TBU cannot be mid toned)

*ASSOCIATE: Do not create new association lines. This constraint is the opposite of LINK proposed in Pulleyblank (1996).

AVOID PROMINENCE (AP): A metrically prominent TBU is not a member of any HTS (Bickmore 1999).

AVOID-SPONSOR: Tones are not realized on their input sponsor segments (This paper).

BOUND: Successive syllables in a tone span must be in different domains (Myers 1997). This constraint helps account for a tone that spreads across a morpheme and not inside the same morpheme.

*CONTOUR: Do not create contour tones (Pulleyblank 1997).

This constraint may be dispersed as NO-RISE, NO-FALL (Akinlabi 1996, Poletto 1998, and others).

*DISASSOCIATE: Do not delete association lines. This constraint is the opposite of *ASSOCIATE. (See above).

DOM-BIN (HTS): A High Tone Span must contain exactly two TBUs (Bickmore Ms). This constraint can be called BINARITY and it is the same constraint that Poletto (1998) calls MTA.

*FLOAT: No floating tones. Every tone must have a correspondent TBU (Myers 1997, Bickmore 1999). Bickmore equates this constraint to DEP-TBU/Tone. This constraint basically penalizes floating tones. Myers (1997) gives it a different definition: a tone must be associated with a syllable.

*FUSION or NO-FUSION: This constraint prohibits the merging of tones.

Fused High Requirement (FHR): An output H which has multiple input correspondent H's must contain within its HTS all the correspondent TBUs of the input HTS's (Bickmore 1999). This constraint appears to be the opposite of NO-FUSION.

HEAD: A tone is attracted to the head of a metrical constituent.

NO-GAP: (Kirchner 1993, Archangeli and Pulleyblank 1994): As the name indicates, this constraint prohibits a structure (say CVCVCV) where a tone is linked to both the first and last vowel, leaving a gap (the second vowel). This constraint is probably almost never violated.

NO-LONG-T: A tone may be associated with at most one syllable (Myers 1997). An alternative name for this constraint is *MULTILINK. It prohibits a tone that is associated to several TBUs.

NON-FINALITY: Do not align tones with the right edge of the prosodic word. Poletto (1998) defines it as: "a tone does not surface on a final TBU".

NON-INITIAL-S: The initial TBU of the stem must not be H-toned (Bickmore 1999).

LOCAL: An output TBU bearing a tone t must be adjacent to TBU b, where b' bears t' (Bickmore Ms a). Bickmore attributes this constraint to Myers (1997). As we understand it, this constraint is meant to capture the non-iterative nature of the spreading of a (typically H) tone.

LINK: A tone has to be associated to a vowel (Pulleyblank 1996). It forbids floating tones.

MONO-SPAN (MS): A HTS (high tone span) cannot be more than one TBU (Bickmore Ms). This

constraint is meant to capture tones that do not spread.

OCP: Adjacent identical tones are prohibited (Leben 1973, Myers 1997). This is one of the earliest constraints in tonal phonology.

SPECIFY-(T): A syllable must be associated with a tone (Myers 1997). This constraint requires TBUs in the output to be associated with a tone which might be already present in the input or is the default tone. That is, it disallows tonelessness in the output. It is equivalent to *TONELESS.

STEM (H): A stem must be associated with a high tone (Poletto 1998). In the data that Poletto discusses, this constraint aims at assigning an H to the default tone. Presumably for a language whose default tone is Low, and if the tone should apply in the stem only, one could use such a constraint as STEM(L).

*STRUCTURE: This constraint is used in Poletto (1998) to prevent unrequired associations that would be otherwise consistent with more highly ranked constraints. Poletto notes that it may reject structures that have more tones than others. Since this is a constraint that mentions association lines in the structure, it could also be called *ASSOCIATE, i.e. Do not create new association lines.

TAA (Tone to Accent Alignment): The leftmost TBU of HTS of a subsegment H must coincide with the accented TBU (Bickmore 1999). Because this constraint mentions accent, it might as well be called HEAD-H, that is, a H tone is aligned with the head of a (trochaic/iambic) foot.

*TONELESS: Each TBU must have a correspondent tone (Bickmore 1999). This corresponds to MAX-TBU/Tone in Bickmore's work. It is equivalent to the constraint SPECIFY-(T). (See above)

MTA (Minimal Tone Association): Requires a tone to be associated to at least two tone bearing units (Poletto 1998). Poletto writes it as follows:

$$\begin{array}{c} *H \\ | \\ \mu \mu \end{array}$$

This constraint is referred to as DOM-BIN in Bickmore (1999) and DOUBLING in Odden (1998).

Language Index

In this index, the names of Bantu languages are given as they appear in the text. There are some language groups that have been included as well (e.g. Bamileke, Beti), and also a few acronyms such as NACALCO, PAPTAL, BASAL to allow easy search for them in the text.

- Afade 94, 96, 97, 98, 115
 Apache 190, 195
 Awing 33, 183
 Bafang 232, 233
 Bafia 188
 Bafut 33, 54, 159, 160, 161, 162, 163, 164, 167, 168, 169, 170, 171, 172, 173, 174, 175, 177, 180, 182, 184, 188, 189, 197, 198, 199, 223, 224, 332
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