Vowel Harmony in Eastern Bantu Verbs*

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Park, Jae-Ick. 2002. Vowel Harmony in Eastern Bantu Verbs. *Studies in Phonetics, Phonology and Morphology* 8.1. 101-115. This study proposes that vowel harmony in Eastern Bantu verbs can be accounted for by imposition of the radically-specified [-hi, +lo, +rd] features in constraint-based approach. These features are supported by the default vowel insertion for syllabification of consonant-ending loanwords in these languages. Vowels /e, o/ have a specified [-hi] feature and the specification itself contributes to the behavior in the mid-vowel harmony. The systematic replacement of CeCo by CeCu in Eastern Bantu verbs has been viewed as exceptional or disharmonic in various previous studies. Viewing low vowel /a/ as opaque in previous studies has also been part of the problem in vowel harmony in Eastern Bantu verbs. The radically-specified features proposed in this study are very effective to solve these problems as well as to explain the previously accepted behavior. Three constraints with regard to the specified features interact themselves to produce optimal output for the current vowel harmony in Eastern Bantu verbs. A mid vowel starts (aligns) verb-root-initially and extends all the way to the end of the verb unless it is blocked by a vowel with a specified feature such as /u/ and /a/. **(Kosin University)**

Keywords: Vowel Harmony, Eastern Bantu, Swahili, Chichewa, Luganda, Shona, Mid Vowels, Radical Underspecification

1. Background

Vowel harmony in the verbs of Eastern Bantu languages with a five-vowel system (i, e, a, o, u) states roughly that a mid vowel comes after a mid vowel (1a), a non-mid vowel comes after a non-mid vowel (1b), and the low vowel follows any vowel but precedes a non-mid vowel (1a-c). When we compare (1a) and (1c), however, we notice that in the vowel harmony of Eastern Bantu verbs, CoCo, CeCe, CoCe are found, but CeCo is not. This is attested in various Eastern Bantu languages such as Swahili, Chichewa, Luganda, and Shona. Instead of CeCo, CeCu as in (1c) is abundant in the verbs of these languages.[1]

(1) Vowel Harmony (Swahili)
a. Mid Vowel Harmony in Verbs

vr-(ext)-fv	*Gloss*
p<u>o</u>ny-<u>o</u>k-a	slip away
p<u>o</u>k-<u>e</u>-a	Receive

* This work was supported by Korea Research Foundation Grant (KRF-003-A00002).
[1] The dictionaries and grammars consulted for these languages are separately listed in the references.

pelek-e-a	send for

b. Non-mid Vowel Harmony in Verbs

vr-(ext)-fv	*Gloss*
pig-i-a	cook for
chuku-li-a	carry for
kat-az-a	forbid
anz-ish-a	start
zui-a	prevent

c. Controversial Vowel Harmony in Verbs

lev-uk-a	get sober
geuk-a	turn around

Another point to note is that in the previous studies the vowel harmony in these languages has been viewed as confined to verbal extensions with regard to root-final vowels. This means that the verb root final vowel /u/ as in *chuku-li-a* (1b) and /e/ in *pelek-e-a* (1a) decide the following vowel (i.e., /i/ or /e/) for extension. Even in nonlinear phonological analysis, the vowel harmony within verbal roots has been excluded. (See the Luganda case in Katamba 1984, Chichewa in Scullen 1992, Shona in Beckman 1995, 1997, and general Bantu in Clements 1991, Goldsmith 1993 and Rottland 1996).

2. Purpose and Procedures

The purpose of this study is to give accounts for the problematic issues in vowel harmony within Eastern Bantu verbs. So-called disharmonic behavior of CeCu and CeCa will be accounted for. It will be clear that these forms are regular and well explainable. In addition, the current study deals uniformly with verb roots and extensions. This is important in that the vowel harmony within verb roots has unfairly been overlooked. The major attention has been paid not to the root itself but to the suffixation for extension with regard to the root-final vowel. Unlike previous studies, this study seeks for a universal explanation for vowel harmony across Eastern Bantu verbs, not confining it within individual languages. The languages involved in this study are Swahili, Chichewa, Luganda and Shona.

This study first shows that the CeCu structure is regular in Eastern Bantu verbs. It then introduces the radically-specified features. Adopting radically-specified features and constraints in optimality will pursue the purpose of this study. Mid vowels have the specified [-hi] in radical underspecification and this feature critically interferes with other features for vowel harmony. The radically-specified features will be supported by the default vowel insertion for loanwords in Swahili. The three constraints with regard to the specified [-hi] will operate for the optimal output in vowel harmony. Comparing some previous analyses, the current analysis treats the so-called exceptional behaviors of /u/ and /a/ in vowel harmony as regular and explainable. This analysis requires less complexity than previous ones.

3. Regular Occurrence of CeCu

The occurrence of CeCu in Eastern Bantu verbs is not exceptional. The high vowel /u/ after a mid vowel /e/ looks peculiar, but it is common in Eastern Bantu languages with a five vowel system.[2] In addition to Swahili examples in (1a), we can easily find the same vowel cooccurrence in verbs of the following languages as in (2).

(2)	a. Luganda	bembuka	'come off'
		jeemuka	'submit'
		kenkula	'become well-informed'
	b. Chichewa	yepula	'trim the top'
		pepuka	'be light'
		sefuka	'flood over'
	c. Shona	setuka	'jump'
		serenuka	'water'

An examination of Eastern Bantu verbs with a five-vowel system provides a vowel cooccurrence table as in (3).[3] From the table, we can observe two peculiar behaviors in vowel cooccurrence or harmony in the languages. First, /a/ comes after any vowel, and CiCa, CuCa, CeCa, CoCa, CaCa are allowed. After /a/, however, only non-mid vowels are allowed to come. We need to further discuss how /a/ comes after both mid and high vowels but a mid vowel does not follow /a/ (e.g., CeCaCi vs. *CeCaCe).

(3)

V_n \ V_{n+1}	i	e	a	o	u
i	✓		✓		✓
e		✓	✓		✓
a	✓		✓		✓
o		✓	✓	✓	
u	✓		✓		✓

Second, /e/ can come after /e/ and /o/, as is traditionally accepted. As is mentioned in the preceding section, the asymmetry is found in /o/ and /u/. The mid back round vowel /o/ comes only after /o/, and /u/ comes after mid vowel /e/ as well as non-mid vowels /i, a, u/. There are no restrictions of cooccurrence among non-mid vowels.

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[2] Beckman (1995) treated the cooccurrence of CeCu in place of CeCo as an exception. Scullen (1992) also sees it as exceptional or disharmonic. Diachronic explanation for this is that a historical merger of high and higher-mid vowels in a seven-vowel system is responsible for it. (The five-vowel system in Eastern Bantu appears to have been reduced from a seven-vowel system.)

[3] The cooccurrence table is attested by more Bantu languages in Hombert & Hyman (1999: 235-95).

4. Radically-specified Features in Eastern Bantu Vowels

Vowel harmony in Eastern Bantu verbs depends on the feature specification of the vowels involved. The five-vowel system in Eastern Bantu languages assumes the radical underspecification shown in (4).

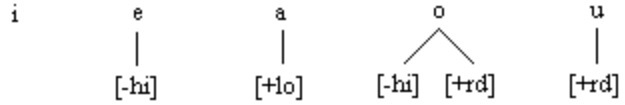
(4) Radical Underspecification

	i	e	a	o	u
High		-		-	
Low			+		
Round				+	+

[+low] → [-high] [ ] → [+high]
[ ] → [-low] [ ] → [-round]

From this type of specification, the five vowels in these languages have the structures illustrated in (5).

(5) Non-linear Structure of the Vowels



The vowel-internal structure above from radical underspecification gives a clue to solve the problems in vowel harmony in Eastern Bantu verbs. In the radical underspecification, /e/ and /o/ share the specified feature [-hi], and the presence or absence of the [-hi] feature contributes to the vowel harmony. The absence of [-hi] feature in the non-mid vowels in radical underspecification is supported by their employment in loanword syllabifycation in Swahili. That is, only /i, a, u/ without radical [-hi] specification are employed in the syllabification to satisfy the CV syllable structure for loanwords.

(6) Syllabification in Loanwords: Vowels without Radical [-hi]

Swahili	*loanword*	*Arabic source word*	*gloss*
a.	/u/ after labial		
	binadamu	Ibniadam	human
	sababu	Sabab	reason
b.	/a/ after laryngeal		
	sakafu	Saqf	flat roof
	silaha	sila:h	weapon
c.	/i/ after others		
	ujira	Ujra	wages
	samaki	Samak	fish

When the word-final consonant in loanwords is a labial consonant, it takes /u/ with the [+rd] feature as its syllabifying vowel. Word-final laryngeal consonants take the vowel /a/, which has the [+lo] feature in radical underspecification. Coronals and dorsals with no specified feature have the vowel /i/ with no radical specification. The vowel addition phenomenon in loanword syllabification provides strong evidence for the radically-specified features in Eastern Bantu vowels.

5. Constraints for Vowel Harmony

The specified features [-hi], [+lo], and [+rd] proposed in the preceding section will support the current argument on vowel harmony in Eastern Bantu verbs. The occurrence of vowels in these languages depends on the features. In other words, vowel harmony is constrained by the presence/ absence and the structure of a feature in a specific position in verbs. The current study proposes three [Feature]-related constraints to explain the generally accepted behavior and to solve some seemingly exceptional behaviors in the vowel harmony of the verbs.

First, mid vowels characteristically occur verb-root-initially—vowel harmony starts from the beginning of the verb root. The [-hi] is positionally marked, and if a mid vowel is found in a non-root-initial position, it always has its [-hi] feature multiply-linked with a preceding vowel. This can be formulated as the constraint in (7).

(7) Constraint ALIGN-LEFT [-hi]: Align [-hi] feature specification with the left edge of the root.

Second, the [-hi] feature constrains the following vowels progressively, and vowel harmony extends to the end of the verb. This can be shaped as Constraint ALIGN-RIGHT [-hi].

(8) Constraint ALIGN-RIGHT [-hi]: Align [-hi] feature specification with the right edge of the verb.

Third, a conflicting constraint to ALIGN-RIGHT [-hi] functions to prohibit a vowel with another specified feature from following a mid vowel. In other words, the vowel harmony does not propagate but stops before a vowel with a singly-specified (not sharing with the first vowel) feature.[4]

[4] If we assume feature geometry as proposed in Clements and Hume (1995), a constraint such as in (9) is acceptable. Spreading of a feature can be constrained by the organization of a speech sound, and a sound with a branching node may behavior differently from that with a single node. Because of the higher specification for the vowel in the initial syllable, Eastern Bantu verbs show distributional unbalance. Scullen (1992) briefly introduced the tendency in Chichewa. A short examination on Swahili and other Eastern Bantu verbs proves that verbs with the structure of CuCi are more easily found than that of CiCu, where /i/ has no radically-specified feature and /u/ has one such feature. The same tendency is found in CaCi vs. CiCa,

The specified feature could be [+rd] or [+lo]. We will see this claim leads to a solution to the seemingly exceptional cooccurrence in these languages.

(9) Constraint NO-LINK with [F]: The [-hi] of mid vowels does not link with a vowel with any unshared feature with the root-initial vowel.

In the following examples, we will see that the optimal output for vowel harmony in Eastern Bantu verbs is governed by the constraints above. Constraint ALIGN-LEFT [-hi] provides good evidence against disharmonic vowel cooccurrence in the verbs. This is shown in (10). (The * denotes a prohibited structure.)

(10) ALIGN-LEFT [-hi]

a.	*C	i	C	e | [-hi]	(cf. CiCi)
b.	*C	i	C	[+rd] | o | [-hi]	(cf. CiCu)
c.	*C	a | [+lo]	C	e | [-hi]	(cf. CaCi)
d.	*C	a | [+lo]	C	[+rd] | o | [-hi]	(cf. CaCu)
e.	*C	u | [+rd]	C	e | [-hi]	(cf. CuCi)
f.	*C	[+rd] | u	C	[+rd] | o | [-hi]	(cf. CuCu)

None of the radically-specified feature [-hi] in (10) is aligned with the left edge of the verbs, and each of the structures violates the constraint.

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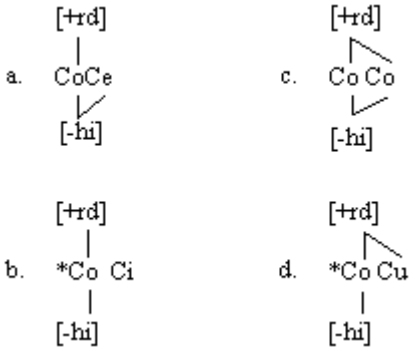
and CoCe vs. *CeCo. Structures like CiCi, CeCe, CoCo,CaCu, CuCa are equal in the number of features and they are regular in these languages. We might pursue a phonetic explanation for this tendency, but it is not in the scope of the current study.

None of them are optimal form with regard to vowel harmony.

Constraint ALIGN-RIGHT [-hi] selects optimal forms among the examples in (11). The structures in (11a) and (11c) are well-formed since their [-hi] links to the vowel on the right. On the contrary, the [-hi] feature in (11b) and (11d) does not link rightward, and these forms are in violation of the constraint and are ill-formed.

(11) ALIGN-RIGHT [-hi]



Linking [-hi] with the following vowel cannot occur when [-hi] meets any specified feature in the next vowel. The specified feature on the right functions as a linking blocker. The form in (12a) is an unacceptable form even though it obeys the two constraints, ALIGN-LEFT [-hi] and ALIGN-RIGHT [-hi]. Constraint NO-LINK with [F] is violated. The blocker [+rd] hinders the application of the progressive [-hi] harmony, and the correct output in (12b) looks disharmonic in vowel height. It is optimal in terms of constraint violation.

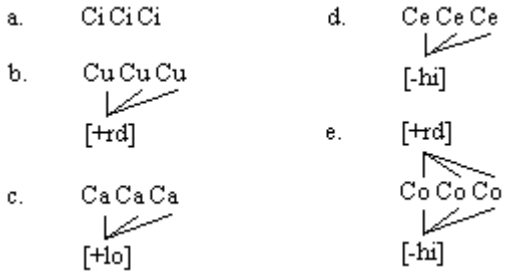
(12) NO-LINK with [F]

The form CeCu is no longer exceptional or disharmonic in Eastern Bantu verbs. The absence of CeCo is explainable in terms of its violation of Constraint NO-LINK with [F].[5]

[5] With regard to this asymmetric phenomenon, Hong (1993) aptly views it a parasitic harmony, where the harmony depends on both the triggers and the targets specified with a certain contextual feature. He proposed a constraint called *[+rd, -hi], which may control a non-initial syllable when the trigger in the preceding syllable has a specified feature [-hi]. The

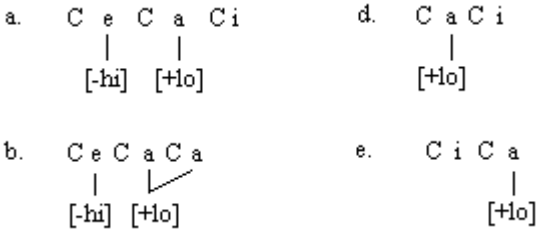
The same principle applies to the structures with the same vowel in verbs. Forms (13a-c) do not have [-hi] feature and do not violate any constraint. The form in (13d) has [-hi], and it starts from the left edge of the verb and spreads to the end of the verb. There is no other specified feature in the second and the third vowels. The form in (13e) has the specified feature [+rd] in non-initial vowels of the verb, but the specified feature is multiply-linked rather than singly-specified. The feature [-hi] links with the rest of the vowels since there is not blocking effect of the specified feature [+rd]. In other words, any possible blocker can be removed by the multiple linking. In the multiply-linked structure, there is no independent [-hi], [+lo], or [+rd] in non-initial position. The following forms are all well-formed.

(13) Same Vowels

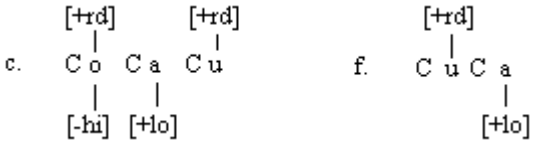


When the low vowel /a/ is involved in vowel harmony, its specified feature [+lo] serves as an effective blocker against the linking of [-hi]. This is shown in (14a-c). The mid vowels /e, o/ are aligned to the left edge of the structure, but their [-hi] does not link with the next vowels. The reason is that they own a specified feature, either [+lo] or [+rd], without sharing it with the first vowel. The low vowel /a/ can occur in the forms in (14d-f) without violating any constraint in the vowel harmony.

(14) Low Vowel



current study proposes a more generalized constraint as is already shown in (9).

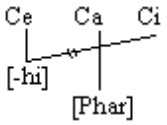


Involving /a/ in the vowel harmony does not require the concept of 'opaque' or 'neutral' as in previous studies. The vowel /a/ is just another vowel with a specified feature like /o/ and /u/ in radical underspecification. It has [+lo] as a specified feature. The occurrence of the vowel /a/ in the example shows that it is not a traditionally 'neutral' vowel. The reason is that even though /a/ comes after any vowel, it does not allow mid vowels to follow, as shown in (14a) and (14c). If it were a neutral vowel it should allow any vowel to precede or follow it. This is not the case though.

For the three structures in (14a-c) and any other structure involving the low vowel /a/, one could insist that the [-hi] vowel height harmony vacuously occurs but does not incur any phonemic change to /a/. ([+lo] is specified for /a/, but [-hi] is just unspecified.) In this case, we still have to provide an explanation for the blocking effect of both /a/ and /u/. That is, the [-hi] does not cross over /a/ or /u/ for some reason since a mid vowel does not harmonize with a vowel across /a/ or /u/.

Beckman (1995) characterized /a/ in terms of privative feature [Phar], and tried to account for the opaqueness to the spreading of [-hi] such as in the structures in (14a-c). She claimed that harmony fails across an intervening low vowel because of the [Phar] feature. This was illustrated as in (15).

(15) Opaque [Phar] in /a/ (Beckman 1995)

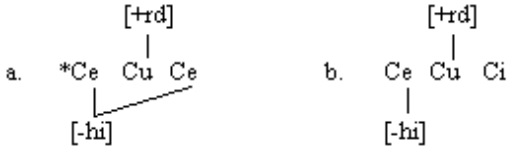


If /a/ in CeCaCi is opaque because of [Phar], we should also be able to explain the opaqueness of /u/ in CeCuCi, where the /u/ has no [Phar] feature. Verbs with CeCuCi as opposed to CeCuCe are well-formed in Eastern Bantu. The round vowel /u/ does not have the feature [Phar], but still blocks the spreading of [-hi] feature to the right. In short, if we accept that only /a/ is opaque as in Beckman's claim, we cannot account for the presence of the correct form CeCuCi.

If we assume the opaqueness of only /a/ with [Phar], we are forced to allow the non-actual form in (16a) since /u/ does not have the opaque feature. The [-hi] of the initial /e/ can spread across the non-[Phar] /u/ to doubly-link with another /e/. The multiple-linking of [-hi] removes the

possible violation of the positional markedness of [-hi] in a non-root-initial position. Not only /a/ but /u/ should be opaque in order to satisfy Beckman's analysis, but her analysis does not provide any evidence supporting the blockage of [-hi] spreading to the final syllable across the intervening high vowel /u/ in (16b).

(16) Blocking Effect of /u/ without any Opaque Feature



Beckman (1997) tried to solve the same problem with a constraint prohibiting a non-high round vowels (Constraint *RoLo) in addition to many other constraints, including contrastive features *Mid and *High as well as various IDENT constraints. As is already shown at the beginning of this section, the current study, however, analyzes the blockage of [-hi] linking in terms of constraint interaction. Both /a/ and /u/ can come after a mid vowel but block the linking of [-hi] from their left because of their radically-specified features, [+lo] or [+rd]. The current approach, a uniform analysis for both /a/ and /u/ after a mid vowel, is simpler and more effective than previous analyses.

With regard to the distribution of mid vowels, Beckman (1995) views them as more marked than other vowels, and this could be an explanation for the restricted mid vowel occurrence in the vowel harmony. However, we do not find any evidence for that. We find an equal distribution of a high vowel /i/ and a mid vowel /e/, for example, in the extension of monosyllabic verbs as in (17).

(17) Monosyllabic Verbs and Extension

Swahili	*stem*	*caus.*	*pass.*	*trans.*	*gloss*
/i/	la	li̲a	li̲wa	li̲sha	eat
	fa	fi̲a	fi̲wa	fi̲sha	die
/e/	nywa	nywe̲a	nywe̲wa		drink
	wa	wi̲a/we̲a			be

Luganda	*stem*	*applic.*	*caus.*	*pass.*	*gloss*
/i/	gwa	gwi̲ra	gwi̲sa	gwi̲bwa	fall
	fa	fii̲ra	fii̲sa	fii̲bwa	die
/e/	nywa	nywe̲ra	nywe̲sa	nywe̲bwa	drink
	kya	kee̲ra	kee̲sa		dawn

Chchewa	*stem*	*caus.*	*pass.*	*gloss*
/e/	dya	dyetsedwa		eat
	mwa		mwedwa	be drunk

Shona	*stem*	*caus.*	*pass.*	*intens.*	*gloss*
/i/	ba	bika	bikisa		steal
	da			disa	want
	dya	dyisa	dyisika		eat

There is no predetermined vowel for monosyllabic verbs in Eastern Bantu languages, and when monosyllabic verbs are to extend, they have to take a vowel. The vowel is either /i/ or /e/ depending on the language. Swahili and Luganda take both /i/ and /e/, while Chichewa and Shona take /e/ and /i/, respectively. Data from verbs in four different Eastern Bantu verbs do not reveal any tendency to prefer a non-mid vowel. This can be seen as counter-evidence for the markedness of mid vowels.

6. Constraint Ranking and Optimal Analysis

The three constraints proposed are ranked, and select optimal output in the vowel harmony in Eastern Bantu verbs. From the observation in previous sections, we can notice that ALIGN-LEFT [-hi] and NO-LINK with [F] outrank ALIGN-RIGHT [-hi]. Even though Candidate (18a) violates NO-LINK with [F] and Candidate (18b) violates ALIGN-RIGHT [-hi], the latter is an optimal form since it violates a lower-ranked constraint than the former.

(18) CeCu

	Candidate	ALIGN-LEFT [-hi]	NO-LINK with [F]	ALIGN-RIGHT [-hi]
a.	[+rd] | C e Co | / [-hi]		*!	
☞b.	[+rd] | C e Cu | [-hi]			*

The tableau in (19) shows that [-hi] in non-initial position is disallowed due to ALIGN-LEFT [-hi] (19a), and [-hi] in the initial vowel does not

spread to its right because of NO-LINK with [F] (19b).[6] Both candidates are ill-formed and there is no ranking between the two constraints. Candidate (19c) is the correct form, since it obeys the first two constraints at the expense of the third constraint.

(19) CeCuCi

	Candidate	ALIGN-LEFT [-hi]	NO-LINK with [F]	ALIGN-RIGHT [-hi]
a.	[+rd] | C e Cu C e | | [-hi] [-hi]	*!		*
b.	[+rd] | C e Co Ce | / / [-hi]		*!	
☞c.	[+rd] | C e Cu C i | [-hi]			*

The candidates in (20) show that Constraint ALIGN-RIGHT [-hi] is effective in choosing the correct form. The harmonic mid vowels in (20b) are well-formed in Eastern Bantu verbs.

(20) CoCe

	Candidate	ALIGN-LEFT [-hi]	NO-LINK with [F]	ALIGN-RIGHT [-hi]
a.	[+rd] | C o C i | [-hi]			*!
☞b.	[+rd] | C o C e | / [-hi]			

[6] The calculation of violations is not necessarily gradient. ALIGN-LEFT [-hi] is violated by the third vowel, and the violation itself is crucial in these languages. It is not the case that a less violated candidate for a certain constraint is better than a more violated candidate. Both are equally ill-formed.

The vowel harmony in the sequence of the same vowel is also well explained in the ranked constraints. Feature [-hi] from the initial vowel links with the following vowel (21b), even though the following vowel is specified with [+rd]. The feature is shared with the first vowel and it is not singly-specified. Thus, the structure does not violate the second candidate. In (21d) feature [-hi] is aligned with the left edge of the verb root and correctly linked with the following vowel. Candidate (21c) crucially violates ALIGN-RIGHT [-hi].

(21) CoCo and CeCe

	Candidate	ALIGN-LEFT [-hi]	NO-LINK with [F]	ALIGN-RIGHT[-hi]
a.	[+rd] | \\ C o C u | [-hi]			*!
☞b.	[+rd] | \\ C o C o | / [-hi]			
c.	C e C i | [-hi]			*!
☞d.	C e C e | / [-hi]			

7. Conclusion

Vowel harmony within Eastern Bantu verb roots and extensions is treated uniformly. Unlike previous studies, the analysis of this study requires no discrimination among Eastern Bantu languages or between verb roots and extensions in dealing with their vowel harmony. Loanword syllabification for nativization supports the radically-specified features [-hi], [+lo] and [+rd]. Vowel harmony in Eastern Bantu verbs with five vowels is accounted for by three ranked constraints with regard to the specified features, ALIGN-LEFT [-hi], NO-LINK with [F] >> ALIGN-RIGHT [-hi].

The importance of this study is that it effectively accounts for the two major issues as well as other previously accepted phenomena. One is that

the cross-height vowel harmony in CeCu in place of CeCo is well explained when we view the form as observing NO-LINK with [F] at the expense of ALIGN-RIGHT [-hi]. The other is that the low vowel /a/ as in CeCaCi or CoCaCi serves as a blocker not because of its unique opaque feature, but because of the presence of the radically-specified feature, [+lo]. The same very simple principle applies to CeCuCi with high vowel /u/, which has [+rd], and the two seemingly independent issues are explained in the same constraints and their ranking.

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received: April 15, 2002
accepted: May 28, 2002