

Complementarity and Opacity: [l] ~ [d] in Bantu

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This paper analyzes a challenging continuum of [l] ~ [d] complementarity in three Bantu languages and documents an apparently unknown type of opacity avoidance. As seen in (1), in many—possibly even most Bantu languages, a liquid [l] or [r] alternates with [d] postnasally:

- (1) In many Bantu languages a liquid [l] or [r] alternates with [d], e.g. postnasally in Yaka
- | | | | | | |
|----|-----------|-----------------|-----------|--------------------|----------------------------|
| a. | lu-láki | 'tongue' | n-dáki | 'tongues' | (Ruttenberg 1971) |
| | lu-lálá | 'twig' | n-dálá | 'twigs' | |
| | lu-lúungu | 'peppercorn' | n-dúungu | 'peppercorns' | |
| b. | laand-a | 'follow' | n-daand-a | 'follow me' | (-a = inflectional suffix) |
| | leend-a | 'catch up with' | n-deend-a | 'catch up with me' | |
| | lok-a | 'bewitch' | n-dok-a | 'bewitch me' | |

(Also common in Bantu: $\beta \sim mb$; $y \sim nj$; $\gamma \sim \eta g$)

(1a) shows the alternation in nouns, while (1b) establishes the same l/d relationship in verbs.

Much less studied, and particularly relevant for our study, in (2), in some Bantu languages, the occurrence of [d] vs. [l] may also be conditioned by the following vowel (or glide), e.g. before /i/ vs. /e, a, u, o/ in Yaka:

- | | | | | | | |
|-----|----|----------|-------|----|-------|----------------|
| (2) | a. | dil-a | 'cry' | b. | lél-a | 'rock (baby)' |
| | | dy-a | 'eat' | | lal-a | 'get lost' |
| | | = /Li-a/ | | | lul-a | 'blame, scold' |
| | | | | | lol-a | 'punish' |

Thus, in (2a) we see that [d] occurs before the high front vowel /i/ and the glide [y], while (2b) shows an initial [l] before the other four vowels in the language.

Besides this complementary distribution within morphemes, Yaka also shows alternations of [l] and [d] when suffixes begin with [i], as in (3).

- | | | | | | | |
|-----|----|--------|-------------------|-----------|----------------------|-----------------------------|
| (3) | a. | baal-a | 'become hard' | baad-is-a | 'harden' | (causative) |
| | | | | baad-il-a | 'become hard for/at' | (applicative) |
| | | | | baad-idi | 'become hard' | (perfective) |
| | b. | sik-a | 'shoot' | sik-idi | (perfective) | |
| | | suk-a | 'come to an end' | suk-idi | (perfective) | |
| | | sak-a | 'fish (with net)' | sak-idi | (perfective) | |
| | c. | sek-a | 'brush' | sek-ele | (perfective) | [with vowel height harmony] |
| | | sok-a | 'pull out from' | sok-ele | (perfective) | |

In (3a), the verb root *-baal-* becomes *baad-* when it is followed by causative *-is-*, applicative *-il-* or perfective *-idi*. As seen in (3b) the perfective is realized [idi] when the preceding vowel is /i/, /u/ or /a/. In (3c), however, when the preceding vowel is /e/ or /o/, there is a vowel height harmony and the perfective suffix is realized *-ele*.

In response to this perfect complementarity, a single underlying consonant can be set up, for example, as the underspecified capital /L/ in (4), which, as seen, becomes [d] before the vowel /i/ (and after [n]), but is elsewhere realized as [l]:

- (4) Yaka underspecified /L/ → [d]/ ___ i (also: / n ___)
 (elsewhere) → [l]

(Only 1 exception out of 3942 entries in CBOLD version of Ruttenberg (1971): *ma-déésó* 'beans')

Perfect complementarity is also easily captured within Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1995) in (5), where the constraint against the sequence *li is ranked higher than the constraint against the voiced stop *d.

(5) Yaka constraint ranking: *li >> *d

The right result is obtained when *li outranks *d, as in (6a); the reverse ranking produces the wrong outcome, as shown in (6b).

(6) *li must be ranked higher than *d

a.	<table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px 10px;">/Li/</td> <td style="padding: 2px 10px;">*li</td> <td style="padding: 2px 10px;">*d</td> </tr> <tr> <td style="padding: 2px 10px;">→di</td> <td style="padding: 2px 10px;"></td> <td style="padding: 2px 10px;">*</td> </tr> <tr> <td style="padding: 2px 10px;">li</td> <td style="padding: 2px 10px;">*!</td> <td style="padding: 2px 10px;"></td> </tr> </table>	/Li/	*li	*d	→di		*	li	*!	
/Li/	*li	*d								
→di		*								
li	*!									

b.	<table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px 10px;">/Li/</td> <td style="padding: 2px 10px;">*d</td> <td style="padding: 2px 10px;">*li</td> </tr> <tr> <td style="padding: 2px 10px;">di</td> <td style="padding: 2px 10px;">*!</td> <td style="padding: 2px 10px;"></td> </tr> <tr> <td style="padding: 2px 10px;">→ li</td> <td style="padding: 2px 10px;"></td> <td style="padding: 2px 10px;">*</td> </tr> </table>	/Li/	*d	*li	di	*!		→ li		*
/Li/	*d	*li								
di	*!									
→ li		*								

NB: [li] is avoided whether the input consonant is represented as /L/, /l/ or /d/

Note that the sequence [li] is successfully avoided whether the input consonant is represented as underspecified /L/, /l/ or /d/.

A slightly more complicated situation is found in Yao (Ngunga 1997). First, we see in (7) that Yao also forbids the sequences [li] and [ly] just as in Yaka:

(7) Yao also forbids [li, ly]

<p>a. dil-a ‘cry’ dy-a ‘eat’ = /Li-a/</p>	<p>b. lel-a ‘nurse, take care of’ lal-a ‘be worn out, be hoarse’ lul-a ‘froth up, effervesce’ lol-a ‘look at, see’</p>
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In (8) we see that Yao also exhibits similar l/d alternations to Yaka:

(8) a.	mil-a ‘swallow’	mid-isy-a ‘swallow a lot’ (intensive)	
		mid-il-a ‘swallow for/at’ (applicative)	
		mid-ile ‘swallow’ (perfective)	
b.	kul-a ‘grow big’	kud-isy-a ‘grow very big’ (intensive)	
		kud-il-a ‘grow big for/at’ (applicative)	
		kud-ile ‘grow big’ (perfective)	

Yao differs from Yaka, however, in (9), by allowing some occurrences of [d]’s which are followed by vowels other than [i]:

(9) Unexpected [de, da, du, do] in Yao

<p>a. ci-dawáati ‘box’ ci-dúulo ‘salty acid’ ci-búdu ‘dead animal not sanctified to be eaten’</p>	<p>b. delel-a ‘be avaricious, sordid’ daal-a ‘take for granted’ duum-a ‘shout angrily’ dodom-a ‘hesitate’</p>
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In (10), the distributions of [l] and [d] by stem syllable are quantified (excluding cases where [d] is preceded by an n-prefix):

(10)	_i	_yV	_e	_a	_u	_o
l_	1*	---	522	1738	449	509
d_	699	55	6	18	31	11

*1 exception of [li] out of 7740 records in CBOLD version of Sanderson (1954): *pwítíli* ‘scattering in all directions’ (ideophone).

As seen, the sequences [di] and [dy] are very frequent. In fact, Yao does not permit [li] or [ly] at all. Finally, [de], [da], [du] and [do] are significantly less frequent than [le], [la], [lu] and [lo].

Since there are at least 62 occurrences of [d] occurring other than before /i/, Yao provides a case of Kiparsky’s (1973) “type 2 opacity”: the “derived” segment [d] occurs in the wrong environment. We

assume these syllables have an underlying /d/ which is distinct from underspecified /L/. Changing the Yaka analysis minimally, Yao must add faithfulness to input /d/ and the constraint ranking in (11).

(11) Yao constraint ranking: Faith-d >> *li >> *d

a.	/da/	Faith-d	*li	*d
	→ da			*
	la	*!		

b.	/La/	Faith-d	*li	*d
	→ la			
	da			*

In (11a) input /da/ must surface as [da], while the underspecified input /La/ in (11b) is realized [la]. The tableaux in (12) show that either input consonant will be realized [d] before the vowel /i/:

(12) /L/ = /d/ before /i/

a.	/Li/	Faith-d	*li	*d
	→ di			*
	li		*!	

b.	/di/	Faith-d	*li	*d
	→ di			*
	li	*!		

The representation in (12a) will, of course, be required when there is a morpheme break between /L/ and /i/, while either representation can be argued in cases where the sequence is tautomorphic.

We now turn to the third Bantu language, Ruwund, which adds another dimension to the l/d relation under scrutiny (Nash 1992). First, like Yaka and Yao—and as seen in (13),

(13) l/d alternations in Ruwund (Nash 1992)

a.	dil	'cry'	did-ish	'make cry'	(intensive)
			did-in	'cry at/for/over'	(applicative)
			did-in	'cry'	(recent past)
b.	sal	'work, do'	sad-ish	'make work, do'	(intensive)
			sad-in	'work, do for/at'	(applicative)
			sad-in	'work, do'	(recent past)

Ruwund [l] alternates with [d] before the vowel [i]. As seen in (14), like Yao, Ruwund tolerates [d] before vowels other than [i].

(14) Unexpected [dV] in Ruwund

a.	ru-dung	'heart'	b.	dookal	'come out'
	dì-caada	'day after tomorrow'		duut	'settle'
	ru-pàd	'polygamy'		sudeen	'end up on/at (applicative of sul 'end')

What makes Ruwund different, as seen in (15), is that it also allows [li] sequences, i.e. Kiparsky's "type 1 opacity", where [li] looks like it should have become [di], but hasn't:

(15) Unexpected [li] in Ruwund

a.	ku-lim	'weight'	b.	lik	'stop, leave (alone)'
	n-kaliweeñ	'craftsman'		lil	'raise (child)'
	ci-salijook	'deed'		palik	'fall from a height'

The following table in (16) shows the distribution of [lV] and [dV] in verb stems (out of 1348 records in CBOLD version of Nash 1991):

(16)		_i(i)	_ee	_a(a)	_u(u)	_oo
	l_	22	24	39	113	14
	d_	73	2	8	5	3

As in Yao, the consonant [d] occurs in great numbers only before [i]. However, somewhat surprising is the number of [li] syllables. In (17a) we give the phonological vowel system of Ruwund:

(17) Ruwund vowel system

a.	ii	uu		i	u	
	ee	oo				N.B. *ě > i, *ǔ > a
		aa		a		
b.	Proto-Bantu	*-did- *-dim-	>	Ruwund	dil dim	'cry' 'cultivate'
c.	Proto-Bantu	*-ded- *-dek-	>	lel lek	> lil > lik	'raise (child)' 'stop, leave (alone)'

As seen, Ruwund has a system of five long vowels, but only three short vowels. This is because the inherited short /e/ and short /o/ merged with /i/ and /a/, respectively. Thus, while the expected [di] sequences are derived in (17b), (17c) shows first the realization of Proto-Bantu *d as [l], and then raising of [e] to [i]. As seen, this produces minimal pairs such as *dil* 'cry' vs. *lil* 'raise a child'.

In order to capture these facts, we need to extend Faith-d to include underlying /l/ as well, as shown in (18).

(18) Faith-d, l >> *li >> *d

This will account for sequences of [dee, da, du, doo], and also guarantee that tautomorphic /li/ will not be realized as [di]. Note that the required faithfulness to underlying /l/ and /d/ requires that predictable alternating [l, d] have a representation distinct from nonalternating /l/, /d/, namely the underspecified /L/ we have already proposed.

Type 2 opacity is also created by the vowel deletion processes in (19).

(19) Vowel deletion processes affecting /i/

a.	i	→	∅	/	___	#	(also most other final vowels, although u → u̥ instead)
b.	i	→	∅	/	___	V	(Standard Ruwund does not tolerate [Cy])

As seen in all of the above cited forms, most word-final vowels are deleted in Ruwund, which is known to its neighbors as Luwunda. Thus, most Ruwund words have the very un-Bantu property of ending in a consonant. When the word-final input syllable is /di/, as in (20a), the result of i-deletion is a word-final [d], here from the class 5 affix [di], which occurs both as a prefix and suffix in this demonstrative form.

(20) Type 2 opacity created by deletion of [i] of [di]

a.	di-nêe-di	→	dî-nêe-d	'this' (class 5)	cf.	kù-nôo-ku (cl. 15), mà-nâa-m (cl. 6)
b.	di-a	→	d-a	'eat'	cf.	Yaka, Yao dy-a

As schematized in (19b) and exemplified in (20b), the vowel /i/ is also deleted before another vowel. Thus, the verb 'eat' is realized [da] in Ruwund vs. [dya] in Yaka and Yao.

These outputs in (20a,b) can be produced by using any opacity mechanism proposed for OT, e.g. 2-level rules (McCarthy 1996), Sympathy theory (McCarthy 1998), Enriched Input Theory (Sprouse 1997).

Dialects exist, however, which have the properties in (21).

(21) Opacity avoidance in "Ruwund2"

- a. "Many dialects of Ruwund, including virtually all western and southern dialects as well as the speech of the very elderly in Musumb and Kalamb, have retained final *i* in cases where historically it followed *d*. For all speakers who use it, word-final *i*, like final *u*, is always devoiced, non-moraic and non-tone-bearing." (Nash 1992:27)
- b. "Elder speakers and speakers of dialects other than Musumban also have syllables with /y/ between C and V, but only after /d/ [i.e. dyV and dyV:]...." (Nash 1992:18)

As seen in (21a), speakers of many dialects of Ruwund have retained final *i* in cases where historically it followed *d*. In the same dialects in (21b), the glide /y/ exists between a consonant and a vowel, but only after /d/. As a result, we have the different realizations in (22) between the standard language, which we refer to as Ruwund1, and these other dialects, which we designate as Ruwund2:

(22) Dialectal realizations of input word-final and prevocalic [di]

a.	Ruwund1	Ruwund2		b.	Ruwund1	Ruwund2	
	nî-d	nî-d _o	‘I am’		d-a	dy-a	‘eat’
	câad	câad _o	‘thus’		d-eeey	dy-eeey	‘your’ (class 5)
	ê-d	ê-d _o	‘this’ (class 5)		d-aawònsu	dy-aawonsù	‘all’ (class 5)
			[near speaker/hearer]				

This avoidance response to potential opacity is, to our knowledge, unique—and problematic: None of the constraints proposed thus far will select the Ruwund2 outputs in (22). A new constraint appears to be needed which will explicitly ban [d] in environments other than [i]. In (23), we refer to this constraint as “if-d-then-di”, which is ranked just after Faith-d, l in (24).

(23) Ruwund 2 Constraint: “If-d-then-di” i.e. *[dee, da(a), doo, du(u)]

(24) Ruwund2 constraint ranking: Faith-d, l >> “If d-then-di” >> *li >> *d

Not only do we have to change the constraint ranking, but we must also reconsider underlying representations for the predictable /l/ and /d/ segments. As seen in (25a), if the morphemes in (22) are represented with an underlying /d/, the correct output will be derived—vs. the wrong output in (25b), if these morphemes are represented with underspecified /L/ + /i/:

(25) [dy] will surface in Ruwund2 only if “predictable” [di] is /di/

a.	/di-a/ ‘eat’	Faith-d, l	If d-then-di	i-deletion	*li	*d
	lia [lya]	*!		*		
	→ dia [dya]			*		
	la	*!				
	da		*!			

b.	/Li-a/ ‘eat’	Faith-d, l	If d-then-di	i-deletion	*li	*d
	lia [lya]			*!		
	dia [dya]			*!		
	→ la					
	da		*!			

So, what we seem to have here is two things. First, as in Ruwund1, there has been a serious breakdown of [l, d] complementarity. In order to obtain the correct output in (25a), we have had to treat the consonant of /di/ morphemes with an underlying /d/, i.e. exactly the same as /de, da, du, do/. A major question arises, then: If this is the same prespecified, i.e. unpredictable /d/, why do we need to preserve the following /i/? It would seem that although tautosyllabic /di/ cannot be represented in Ruwund2 with predictable, underspecified /L/, the If-d-then-di constraint explicitly recognizes the l/d relation obtained with underspecified /L/ across morphemes—i.e. the effects of the *li constraint. In other words, the constraint If-d-then-di, though duplicating information about the distribution of [l] and [d] captured by the *li constraint, is required to capture this interesting case of type 2 opacity.

We acknowledge that our approach to these l/d phenomena is but one of several possible within Optimality Theory. Our strategy here has been to keep the analysis as simple and straightforward as possible. As seen, we arrived at a solution with partial constraint duplication—and also a surfacy input representation of non-alternating, tautomorphic sequences.

Concerning the most interesting facts in Ruwund2, we ask whether such opacity-avoidance is attested elsewhere—and if not, why not? Can these data, then, be reinterpreted without opacity-avoidance? One strategy might be to marginalize the facts by viewing the preservation of [di] as a property of specific morphemes. According to Nash (personal communication), opacity-avoidance appears to be a property of grammatical morphemes such as the class 5 affix *di-* seen in several examples. The question, then, would be whether it is an accident that this shape *di-* resists *i*-deletion, rather than, say, the class 4 affix *mi-* exemplified in (26).

(26) Deletion of [i] of plural class 4 *mi-*

a.	mu-j	‘root’	(class 3)	pl.	mi-j	(class 4)
	mu-tònd	‘tree’			mi-tònd	

b.	mw-âaw	'yawn'	m-âaw	i.e. /mi-V/ → [mV]
	m(w)-ôj	'cord'	m-ôj	

In (26a), the class 3 singulars have the prefix mu- before a consonant-initial stem, while their corresponding class 4 plurals have mi-. In (26b), mu- prefix is realized mw- before a vowel-initial stem, and the corresponding plural prefix mi- loses its [i], as we predict. Now, Nash (1992:36) does mention that "in some dialects, the /i/ of the class 4 noun prefix /mi/ becomes [y] before a vowel-initial stem," hence: *my-âaw*, *my-ôj*. His other statements, however, indicate a much more widespread tendency to preserve the /i/ only after /d/. Even if there are dialects that preserve [i] in more contexts, the dialects that preferentially preserve [i] after [d] indicate the likelihood that opacity avoidance is at work (at play?).

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