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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
	leend-a	'catch up with'	n-deend-a	'catch up with me'	suffix)
	lok-a	'bewitch'	n-dok-a	'bewitch me'	

(Also common in Bantu: β ~ mb; y ~ nj; ɣ ~ ŋg)

(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.	lel-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
		sok-a	'pull out from'	sok-ele	(perfective)	harmony]

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 prefective in 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.

/Li/	*li	*d
→di		*
li	*!	

b.

/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]

a.	dil-a	'cry'	b.	lel-a	'nurse, take care of'
	dy-a	'eat'		lal-a	'be worn out, be hoarse'
	= /Li-a/			lul-a	'froth up, effervesce'
				lol-a	'look at, see'

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

a.	ci-dawáati	'box'	b.	delel-a	'be avaricious, sordid'
	ci-dúulo	'salty acid'		daal-a	'take for granted'
	ci-búdu	'dead animal not sanctified to be eaten'		duum-a	'shout angrily'
				dodom-a	'hesitate'

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): *pwítílí* '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 tautomorphemic.

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-lìm	'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. *ĕ > i, *ŏ > a
aa		a		

b.

Proto-Bantu	*-did-	>	Ruwund		dil	'cry'
	*-dim-	>			dim	'cultivate'

c.

Proto-Bantu	*-ded-	>	lel	>	lil	'raise (child)'
	*-dek-	>	lek	>	lik	'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 tautomorphemic /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 → Ø / ___ # (also most other final vowels, although u → u̥ instead)

b. i → Ø / ___ 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 → dì-nêe-d 'this' (class 5) cf. kù-nôo-ku̥ (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-di̯	'I am'		d-a	dy-a	'eat'
	câad	câadi̯	'thus'		d-eey	dy-eey	'your' (class 5)
	ê-d	ê-di̯	'this' (class 5) [near speaker/hearer]		d-aawònsu	dy-aawonsù	'all' (class 5)

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 underylying /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, tautomorphemic 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-intial 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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