Morpho-phonological polarity[*]

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Original: 14 May 2009
Revised: 14 January 2010

'Morpho-phonological polarity' describes a situation where a morphological contrast is productively expressed by switching the value of a segmental or prosodic feature in the stem. This chapter argues that the most cited case of morpho-phonological polarity – the Dholuo plural – is in fact a complex case of morphologically-induced mutation. Cases from other languages, including length, vowel quality, and tone exchange, are also discussed. Theoretical devices needed to express morpho-phonological polarity are reviewed. Morpho-phonological polarity is contrasted with both purely phonological and purely morphological polarity.

1. Introduction

'Morpho-phonological polarity' describes a situation where /α/ → [β] and /β/ → [α] in a particular morphological context in the same phonological environment. This chapter asks whether morpho-phonological polarity exists, and how Generative theories of phonology can accommodate it or exclude it.

The most analyzed case of morpho-phonological polarity is the Dholuo (also called 'Luo') plural (Stafford 1967, Gregersen 1974, Anderson & Browne 1973, Okoth-Okombo 1982, Omondi 1982, Anderson 1992, Stonham 1994, Spencer 1998, Alderete 1999, 2001, Kurisu 2001, de Lacy 2002a, Moreton 2004, MacBride 2004, Fitzpatrick, Nevins, & Vaux 2004, Wolf 2005a,b, Bye 2006, Trommer 2006, 2007, 2008a,b, Baerman 2007). The data are given in (1) have often been presented. The rightmost root oral stop in the singular has the opposite [voice] value to its counterpart in the plural. (The disappearance of the singular's final vowel and the ATR harmony in the plural will be discussed in section 2.)[1]

(1) *Dholuo plural* (data from Tucker 1994 (hereafter T); tones omitted)

	Singular	Plural	root gloss	source
(a)	alap	ælæbe	open space	T491
(b)	gɔt	gɔdɛ	hill	Stafford (1967:14)
(c)	agɔkɔ	agɔgɛ	chest	T491
(d)	kitæbu	kitepe	book	T514
(e)	kɛdɛ	kɛtɛ	twig	T513
(f)	hɪga	hike	year	T507

[*] This chapter owes a great deal to the morpho-phonological polarity research subgroup of the Network on Exponence research group – Marc van Oostendorp, Dieter Wunderlich, Jochen Trommer, Natascha Pomino, and Sarah Schneider. I am particularly indebted to Jochen Trommer and Patrik Bye for correcting my earlier erroneous and unfounded beliefs about the Dholuo plural, and to two anonymous reviewers for their comments. My thanks to Catherine Kitto for editing and commenting on the manuscript.

[1] Abbreviations used in this chapter: ATR = advanced tongue root; PrWd = Prosodic Word; sg = Singular, pl = Plural; T = Tucker (1994).

For Dholuo, it has been claimed that /+voice/ → [−voice] and /−voice/ → [+voice] in the same morphological context (i.e. in the plural), and in the same phonological environment. Dholuo is not only the most cited case of morpho-phonological polarity, it is arguably the clearest productive case known.

However, I will follow Bye (2006) and Trommer (2007) in claiming that Dholuo does not have morphological polarity, either in the plural or in other morphological contexts. I will also present an alternative account that makes use of featural morphemes – morphemes that are (partly) realized by feature alteration. The plural will be shown to have [−voice] and [−sonorant] features that are realized on the rightmost root consonant if it is nonfinal: i.e. /kɛdɛ+PL/ → [kɛtɛ], but /gɔd+PL/ → [gɔde]. Dholuo is discussed in detail in section 2.

Section 3 discusses other cases of morpho-phonological polarity that have been cited. The implications of not having morpho-phonological polarity are examined in section 4: What must theories of phonology have/not have to ensure that morpho-phonological polarity cannot occur? The final issue, taken up in section 5, is how morpho-phonological polarity differs from purely morphological and purely phonological polarity.[2]

2. Against Morpho-phonological Polarity in the Dholuo Plural

This section argues that Dholuo does not have morpho-phonological polarity. Of course, it may be that morpho-phonological polarity can be generated by the phonological module. However, elimination of the Dholuo case is a significant curtailment of the evidence for morpho-phonological polarity.

Bye (2006) and Trommer (2006, 2007) precede this chapter in arguing that Dholuo does not have morpho-phonological polarity. This section develops their points, and in particular is based on Trommer's (2007) insights and generalizations.

As a preliminary morphological note, the 'singular' morpheme is more accurately the 'nominative singular' (or perhaps even more accurately the 'non-genitive singular'): genitive singulars are marked by a different morpheme. From here on, 'singular' will mean 'nominative singular'.

The data in (1) seem to show that there is a reversal in the value for the [voice] feature in Dholuo that is entirely morphologically conditioned. However, the data in (2) show that [voice] reversal does not always happen. This significance of this data has been identified by Bye (2006), Baerman (2007:57), and Trommer (2007): it shows that there is no [voice] polarity in the plural (or at least that it is not obligatory).

[2] Other phenomena have also been called 'polarity'. Most famously, 'tone polarity' refers to a situation where a morpheme takes a tone that has the opposite value of an adjacent tone. For example, the Margi subject clitic for 'you {singular}' is H after a predicate ending in an L-tone and L after a predicate ending in an H tone (Pulleyblank 1986:119). Tonal polarity is not morpho-phonological polarity as it does not involve a mapping /α/→[β] and /β/→[α] in the *same* phonological environment. See Trommer (2005) for recent discussion of particularly relevant cases. The correct analysis of such cases is likely to be either phonological dissimilation or phonologically-conditioned allomorphy (see Newman 1995 for discussion).

(2) *Failure to reverse [voice] in the plural (data from T130)*

	Singular	Plural	root gloss
(a)	cupæ	cupe	bottle
(b)	ip	ipe	tail
(c)	ɔt̪ɪt̪ɔ	ɔt̪ɪt̪ɛ	small thing
(d)	bat̪	beṭe	side
(e)	ɔkɔcɔ	ɔkɔcɛ	neck rest of sisal trunk
(f)	lac	læce	urine
(g)	osiki	osike	stump
(h)	lak	leke	tooth

It is possible to make sense of the data if underlyingly vowel-final vs. consonant-final roots are examined independently.

Polysyllabic vowel final roots have the shape (C)VCV or (C)VCVCV, where the Vs can be diphthongs (e.g. [udo] 'ostrich', [cie.wu] 'porcupine', [ᵑgamɪa] 'camel' – T93; [kitæbu] 'book', [dirisæ] 'window' – T130). Two changes happen in the plural: (1) the root's final V is replaced by a front mid vowel (whose ATR value is determined by harmony – §3.1) and (2) the root's rightmost consonant becomes [−voice] (and also [−sonorant] if necessary; see below). Disyllabic roots with underlying voiced and voiceless stops are given in (3). The underlying form of the root's rightmost consonant is visible in the singular, which is faithful to the underlying form in V-final roots.

(3) *The plural of non-monosyllabic vowel-final roots with stops*

	UR	plural	root gloss	source
(a)	/cupæ/	cupe	bottle	T130
(b)	/kitæbu/	kitepe	book	T514
(c)	/ɔt̪ɪt̪ɔ/	ɔt̪ɪt̪ɛ	small thing	T130
(d)	/bɪḍɪ/	bɪṭɛ	fish spear	T128
(e)	/pata/	pæte	hinge	T130
(f)	/kɛdɛ/	kɛtɛ	twig	T513
(g)	/ɔkɔcɔ/	ɔkɔcɛ	neck rest of sisal trunk	T130
(h)	/agaɟa/	ægæce	chair made of twigs	T128
(i)	/osiki/	osike	stump	T130
(j)	/higa/	hike	year	T507

Consonant-final roots behave differently. The root's rightmost consonant *preserves* its underlying [voice] value. As with other roots, the plural's /ɛ/ suffixes to the root.

(4) *The plural of consonant-final roots with stops: Preserve the rightmost consonant*

UR	plural	root gloss	source
/ip/	ipe	tail	T130
/arib/	aribe	Milky Way	T128
/baṭ/	bæṭe	side	T130
/kɔḍ/	kɔḍɛ	rain	T128
/ŋut/	ŋute	neck	T130
/kibrid/	kibride	match	T128
/lac/	læce	urine	T130
/tiɟ/	tiɟe	work	T128
/lak/	leke	tooth	T130
/cag/	cege	milk	T129

What complicates matters on the surface is how the Singular morpheme affects the root. In the singular, root-final oral stops become [−voice]. So, while nothing happens to vowel-final roots, consonant-final roots change: e.g. /arib+SG/ → [arip] 'Milky Way (sg.)', /kibrid+SG/ → [kibrit] 'match (sg.)'. The overall effect is that it appears that some root-final voiceless consonants become *voiced* in the plural: e.g. /arib/ 'Milky Way': [arip] (sg.) vs. [aribe] (pl.).

Even at this point it is evident that Dholuo does not have morpho-phonological polarity. Morpho-phonological polarity involves a morpheme-triggered /α/→[β] and /β/→[α] in the same phonological environment. For /C/-final roots, the plural does not trigger *any* change in the [voice] value of the consonant: /lak+PL/ → [leke] 'tooth'; /cag+PL/ → [cege] 'milk' (T129-130). For /V/-final roots, [+voice] obstruents become [−voice] (e.g. /hɪga+PL/ → [hike] 'year') but [−voice] is preserved: /osiki/ → [osike] 'stump' (T507, 130).

There are exceptions to the generalizations above. The singular of 'chest' is [agɔkɔ], and the plural is [agɔgɛ] (T491). For this word, it looks as if the /k/ of /agɔkɔ/ has become [+voice] in the plural. However, it is likely that the plural form is lexicalized; other speakers have [agɔkɛ] (as expected) (T491). The reader is welcome to examine the singular and plural forms from Tucker's (1994) dictionary which I compiled into an Excel file here: http://www.pauldelacy.net/polarity

Okoth-Okombo (1982:54) lists two other exceptions: [koti] 'coat (sg.)' cf. [kode] (pl.); [oᵑgeti] ~ [oᵑgede] 'blanket'. Tucker does not list these forms, and Okoth-Okombo identifies them as English loanwords. I assume these forms are lexicalized exceptions.

In summary, I recapitulate Trommer's (2007) findings: root-final consonants devoice in the singular while in the plural the rightmost consonant devoices only if it is nonfinal (and noninitial) in the root (e.g. /agaɟa+PL/ → [ægæce], *[ækæce], *[ægæɟe]; /cag/ → [cege], *[ceke]). There is no morpho-phonological polarity; the only morphologically-triggered phonological change is devoicing.

The claims about Dholuo's singular and plural might seem strange and complex. However, they are no stranger than the other morphemes of Dholuo, and their complexity is in a way expected given what happens in the rest of the language. The following sections provide details.

3 The mutating morphemes of Dholuo

A morpho-phonological polarity analysis of the Dholuo plural faces some difficult challenges in the data, as outlined above. In contrast, an approach that recognizes a variety of morphologically-induced consonant mutations can account for the plural as well as a host of other morphemes.

To summarize this section's main themes: while many morphemes in Dholuo are unremarkably concatenative, some force a variety of changes ('mutations') in the root.

A few morphemes demand that they suffix to the head syllable of the PrWd (i.e. the primary stressed syllable), including the '*–ni* plural'. The requirement has no effect on C-final roots (e.g. /ɔlaŋ-ni/ → [ɔ.ˈleŋ.ni] 'black ant'), but causes root-final vowel deletion in V-final ones (e.g. /abaɟa-ni/ → [a.ˈbeɟ.ni], *[a.ˈba.ɟa.ni] 'large spear').

Other morphemes – like the qualitative – also demand that a root-final oral stop become [–voice] (e.g. /pog-o/ → [ˈpo.ko] 'divide'). In fact, there are some morphemes that require [–voice] without having any other overt phonological material, including the nominative singular, the verbal noun (VN), and the genitive: e.g. /muog+VN/ → [ˈmuok] 'digging'.

Some morphemes go even further, requiring root-final consonants to become [–sonorant] and – if possible – [–voice]. These are the genitive and plural: e.g. /bæwo+PL/ → [bæpe] 'plank', *[bæfe], *[bæbe]; /del+PL/ → [de^{n}de] 'skin'; /hɪga+PL/ → [hike] 'year'.

There is no general phonological processing of devoicing, root-final vowel deletion, or desonorization. All changes are forced by individual morphemes; some morphemes concatenate without mutating any part of the root.

3.1 Essential Background

The majority of data given in this chapter is from Tucker (1994), abbreviated as 'T'. However, all underlying forms given are my own proposals. There are several other grammars or sketches of Dholuo (Stafford 1967, Gregersen 1974, Okoth-Okombo 1982, Omondi 1982). However, Tucker (1994) provides the most comprehensive description (except for the genitive plural – see section 3.6).

Tucker's grammar is about the Central Nyanza dialect of Dholuo. He noted that "there is a huge degree of variation between one speaker and another and indeed between the same speaker on one day and on another day" (p.11). The data presented in his grammar are evidently pooled from several different speakers. In some cases, variant forms are presented for morphemes; for example, the plural of [agɔkɔ] 'chest, breastbone' is given as [ægokni], [agɔgɛ], and [agɔkɛ] – it is not clear whether all speakers had all three forms (i.e. free variation), or whether any individual speaker consistently used just one form, or only some in free variation. However, there is apparently enough agreement that generalizations about the morpho-phonology can be extracted; difficulties are discussed where relevant.

Tone is contrastive in Dholuo. However, I have omitted all tones in the data given in this chapter. I have also omitted marking vowel length, as it is not clear to me whether it is phonological: T18 observes that stressed vowels are longer in words at the end of a phrase (except if they are absolutely phrase-final) (e.g. [ˈpeˑ.no] 'that hailstone'; but [ra-ˈhi] 'cobra'). The focus here is on segmental changes; tones do not influence those changes, and I have found that the tone markings make the data much harder to read.

The Dholuo plural is one of the most complex morphemes in the language in terms of its mutation effects. To understand it, it is necessary to identify some basic properties of Dholuo's phonology, and proceed through less complex morphemes.

The consonants listed in (5) appear in Dholuo output forms.

(5) *Dholuo surface consonants* (Tucker 1994:30)

labial	*dental*[3]	*alveolar*	*Palatal*	*velar*	*glottal*
p	t̪	t	c	k	ʔ
b	d̪	d	ɟ	g	
ᵐb		ⁿd	ᶮɟ	ᵑg	
f		s			h
m		n	ɲ	ŋ	
		r			
		l			
w			j		

Dholuo has two sets of vowels that differ in ATR: (a) [–ATR]: [ɪ ɛ a ɔ ʊ] vs. (b) [+ATR]: [i e æ o u] (T16). All vowels in a word agree in ATR. The ATR value is usually determined by the root's stressed vowel (e.g. /cwɔg/: [ɔ-ˈcwɔ.g-ɪ] 'a nickname has been composed' cf. /cuog/: [o-ˈcuo.g-i] 'the spear has been fitted' – T23). However, ATR can be overridden by certain morphemes (which all seem to have [+ATR] vowels): e.g. /bɪlɔ+o/ → [ˈbi.l-o] 'taste+{applicative}'. Like tone, ATR harmony is ubiquitous but not relevant to the central points about morpho-phonological mutation.

Syllables have the maximal shape CV(V)(C). However, root-initial syllables may lack an onset: e.g. [ʊma] 'fork', [iᵐbo] 'West', [u] 'puff-adder' (T93,95). Codas appear only in the head syllable of the PrWd.

The foot is trochaic, quantity-sensitive, and aligned with the right edge of the root: [(ˈu)] 'puff adder', [(ˈbul)] 'drum', [æ(ˈbic)] '5', [o(ˈkeb)-ni], [(ˈʊma)] 'fork', [di(ˈrisæ)] 'window' (Okoth-Okombo 1982:25, Tucker 1994:18). There are no roots of the form [CVC.CVC] or [CVC.CV] due to the coda restriction and requirement that the foot be rightmost in the root.

The majority of roots have one or two syllables (i.e. CV, CVC, CVCV, CVCVC, though CV roots are rare).[4] Tucker (p.13) suggests that in CV_1CV_2 roots the second

[3] Stafford (1967) and Okoth-Okombo (1982:19, 1997:17) identify the dental sounds as [θ] and [ð], while Omondi (1982) and Tucker (1994) call them dental stops (or 'explosives'). In a phonetic analysis, Degenshein (2004) suggests that they are affricates: perhaps [t͡θ] and [d͡ð]. In any case, their voicing is what is relevant for the following discussion; I follow Tucker's (1994) description in using [t̪] and [d̪].

vowel may be "regarded as a Suffix". I take Tucker to mean that V_2 is often deleted when particular suffixes are attached (discussed below). However, the final vowels are clearly not synchronic suffixes: they do not bear meaning or mark morphosyntactic class/function, and any vowel is possible as V_2: e.g. [kuesi] 'pipe', [fwanɪ] 'type of large fish', [wʊɔcɛ] 'shoe', [d̪ɛd̪ɛ] 'kind of bird', [^{m}baka] 'argument', [rawɔ] 'hippo', [udo] 'ostrich', [buju] 'mole', [bɔ^{ŋ}gʊ] 'entire, boneless'.

Syllable and foot restrictions are very important in explaining morpho-phonological effects in the plural and other morphemes.

3.2 The Applicative and Qualitative: Faithfulness vs. Devoicing

The Applicative and Qualitative suffix to transitive verbs; they provide good examples of morpheme-specific mutation in Dholuo. The Applicative is used when an object is expressed, while the Qualitative is used when there is no overtly expressed object.

The Applicative has the form /-ɔ/ and harmonizes with the root's vowels; the Qualitative is /-o/ and makes the root vowels harmonize with it. Both suffixes overwrite any root-final vowel.[5] The Applicative does not cause any change in the preceding consonant. In contrast, the Qualitative forces oral stops to be [–voice], /j/ to become [c], and /w/ to become [p]. The data in (6) show the forms with underlyingly vowel-final stems; the leftmost column lists the underlying form of the rightmost root consonant. The column 'UC' lists the root's rightmost underlying consonant.

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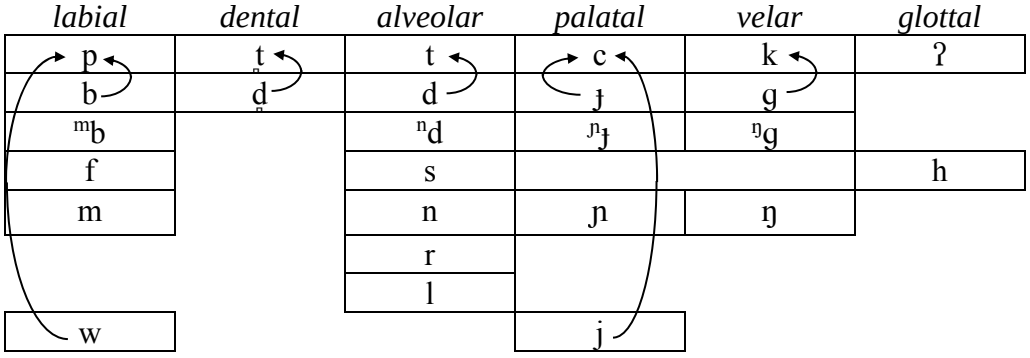
[4] Loanwords can be longer: e.g. [desiki] 'desk', [sekisen] 'section', [kabureta] 'carburettor', [telefison] 'television' (Owino 2003).

[5] The Applicative is the base for the Qualitative. With underlying CV roots, the Applicative's vowel does not overwrite the root's only vowel; instead a [j] is epenthesized: /ti-ɔ^{APPL}/ → [tijo] 'to wear out a garment'. In the Qualitative, the [j] becomes [c], as expected: /tijo+o^{QUAL}/ → [tico], *[tijo]. See section 3.5 for further discussion.

(6) *Applicative /-ɔ/ compared with the Qualitative /-o/*

UC	Applicative	Qualitative	root gloss	Source
/p/	bup-o	bup-o	hit	T67
/b/	kab-ɔ	kep-o	hold tightly	T66
/t̪/	lut̪-o	lut̪-o	dip	T67
/d̪/	lʊd̪-ɔ	lut̪-o	maltreat	T67
/c/	roc-o	roc-o	frustrate	T67
/ɟ/	gaɟ-ɔ	gec-o	tangle	T67
/k/	pɔk-ɔ	pok-o	peel	T67
/g/	pog-o	pok-o	divide	T67
/s/	lɔs-ɔ	æ-los-o	repair	T67
/h/	hɔh-ɔ	hoh-o	empty out	T67
/m/	lam-ɔ	lem-o	pray	T67
/n/	kan-ɔ	ken-o	keep	T67
/ɲ/	kuɲ-ɔ	kuɲ-o	dig	T67
/ŋ/	nɪŋ-ɔ	niŋ-o	close an eye	T68
/^{m}b/	rɪɛ^{m}b-ɔ	rie^{m}b-o	expel	T68
/^{n}d̪/	gʊ^{n}d̪-ɔ	gu^{n}d̪-o	repair	T68
/^{ŋ}g/	dʊ^{ŋ}g-ɔ	du^{ŋ}g-o	work over	T68
/l/	cɪɛl-ɔ	ciel-o	roast meat	T68
/r/	gʊr-ɔ	gur-o	trim	T68
/j/	gaj-ɔ	gec-o	reconcile	T67
/w/	kaw-ɔ	kep-o	accept	T67

(7) *The Qualitative's consonant changes*



The 'devoicing' seen in the Qualitative is clearly not a phonological process – it does not happen generally in the language. Only certain morphemes trigger it; the Qualitative is one of several.

Consonant mutation of this sort has been analyzed in Generative theories as involving floating features or partially specified segments (see Akinlabi 1996, Zoll 1996 and references cited therein; also Bye & Svenonius (this volume)). For example,

Akinlabi (1996) identifies morphemes in Nuer and Akan that have a [+voice] feature, causing voicing in preceding stem consonants. Following their lead, in Dholuo the Qualitative is /C̥o/ where the symbol /C̥/ marks a root node with a [−voice] and a [−vocoid] feature. In contrast, the Applicative is just /ɔ/ with no 'defective' segment.

When a root and the Qualitative combine, the /C̥/ coalesces with the nearest (i.e. rightmost) root-final consonant. So, /kab$_1$ɔ+C̥$_2$o/ becomes [kap$_{1,2}$o]; the [p$_{1,2}$] indicates that the [b] corresponds to both the input /b/ and input /C̥/ (McCarthy & Prince 1995). Because /b/ is [+voice] and /C̥/ is [−voice], their coalescence necessarily leads to conflict in faithfulness. The deciding factor is that the morpheme-initial segment's [voice] feature is preserved – i.e. /C̥/'s [−voice] feature survives.

Two factors mean that /C̥/ has no effect on prenasalized stops, nasal stops, and liquids: preservation of liquids and nasality, and avoidance of voiceless sonorants. So, /kan-ɔ/ cannot become [keto] because the /n/'s [+nasal] would be lost; it cannot become [keṉo] because voiceless sonorants are banned.

The glides /w/ and /j/ become voiceless stops under the influence of both [−voice] and [−vocoid]. The influence of [−vocoid] can only be made clear after examining the Singular (section 3.2). Suffice to say at this point that the glides are not protected in the same way as liquids and nasals, allowing /w/ to become its homorganic voiceless stop counterpart [p], and /j/ to become [c]. (/w/ does not become [f] because [w] and [f] do not have the same minor place of articulation (i.e. labial vs. labio-dental) – place of articulation must be preserved in all Dholuo coalescences).

In short, devoicing in the Qualitative is due to the morpheme itself: it has an underlying [−voice] feature that strives to be realized in the output. Devoicing is morpheme-specific; the Applicative does not trigger any mutation.

Of course, I am only providing the outlines of an analysis of Dholuo morpho-phonology here. A full analysis set within Optimality Theory is necessary to demonstrate that the proposals are viable. Unfortunately, providing such an analysis would take far too much space here. Even so, while it is certainly not trivial to provide an analysis, a great deal of work on featural morphemes and coalescence has already provided the tools for dealing with Dholuo (e.g. Akinlabi 1996, de Lacy 2002b:ch.7 and the many references cited therein).

3.3 Morphologically-triggered devoicing

The Verbal Noun suffix is remarkably similar to the Qualitative: it also causes the stem-final consonant to devoice. However, the Verbal Noun has no other material of its own: it is underlyingly just /C̥/. Like the Qualitative, though, the Verbal Noun causes deletion of root-final vowels.

Data is given in (8). The Applicative is given with the Qualitative and Verbal Noun forms for comparison. The Applicative accurately reflects the underlying form; the data shows that the same changes occur in the Qualitative and Verbal Noun.

(8) *The Verbal Noun suffix: Rightmost C devoices, final V deletes*

UC	Applicative	Qualitative	**Verbal Noun**	VN gloss "act of..."	source
/p/	capɔ	cepo	cap	a whipping	T98
/b/	cabɔ	cepo	cap	disorder	T97
/t̪/	kɛt̪ɔ	ket̪o	kɛt̪	damage	T98
/d̪/	mad̪o	met̪o	mat̪	drinking	T97
/t/	cuto	cuto	cut	such eating	T98
/d/	rido	rito	rit	tearing	T97
/c/	tuco	tuco	tuc	boring	T98
/ɟ/	daɟɔ	deco	dac	emaciation	T97
/k/	jɔkɔ	joko	jɔk	pounding	T98
/g/	muogo	muoko	muok	digging	T97
/f/	*no data*				
/s/	lɪsɔ	liso	lɪs	sipping	T98
/h/	hɛhɔ	heho	hɛh	exaggeration	T98
/m/	pimo	pimo	pim	measuring	T97
/n/	dino	dino	din	plugging	T97
/ɲ/	rɔɲɔ	roɲo	rɔɲ	renewal	T97
/ŋ/	gɛŋɔ	geŋo	gɛŋ	prevention	T97
/ᵐb/	wɪᵐbɔ	wiᵐbo	wɪᵐb	grazing animals	T97
/ⁿd̪/	lɔⁿd̪ɔ	loⁿd̪o	lɔⁿd̪	persuasion	T97
/ᶮɟ/	puoᶮɟo	puoᶮɟo	puoᶮɟ	education	T97
/ᵑg/	kɪᵑgɔ	kiᵑgo	kɪᵑg	spell killing	T97
/l/	galɔ	gelo	gal	delay	T97
/r/	puro	puro	pur	cultivation	T97
/j/	gɔjɔ	goco	gɔc	beating	T97
/w/	hɛwɔ	hepo	hɛp	ability to excel	T97

The Applicative, Qualitative, and Verbal Noun force root-final vowel deletion because they must suffix to the head syllable of the PrWd (i.e. the main-stressed syllable). So, /cap$_1$ɔ+Ç$_2$o^{QUAL}/ surfaces as [(ˈce.p$_{1,2}$o)]; as the surface [p$_2$] is an exponent of the Qualitative, the Qualitative morpheme is adjacent to the PrWd head syllable.

The Verbal Noun is interesting in that it combines its requirement of head-suffixation with a language-wide ban on infixes, effected by a requirement that the right edge of a suffix be aligned with the right edge of the stem. So for input /gɔj$_1$ɔ+Ç$_2^{VN}$/, the output [(ˈgɔc$_{1,2}$)] has the Verbal Noun's exponent rightmost in the PrWd. In contrast, [(ˈgɔc$_{1,2}$ɔ)] – while prosodically well-formed – does not have a right-aligned suffix: the root's [ɔ] intervenes between the stem's right edge and the suffix's rightmost segment [c].

The Verbal Noun and Qualitative cause the same kind of devoicing in the root. The analysis presented here implies that their similarity is (synchronically) coincidental.

The obvious alternative is that there is a general phonological devoicing process and certain morphemes happen to make the right environment while others do not.

While a process like phonological coda devoicing could account for the Verbal Noun forms, it fails on many other fronts. It does not explain the difference between the Qualitative and Applicative. If devoicing happens in codas, then the Qualitative must be syllabified as [cep.o]. However, Dholuo permits onsetless syllables root-initially and in no other position. In addition, some affixes (like the genitive – section 3.5) act like the Verbal Noun in deleting a root-final vowel but the underlying consonant does *not* devoice (at least for particular roots): e.g. /ɔd+GEN/ → [ɔd], *[ɔt] 'of house' (T190).

3.4 Two types of devoicing: The Singular

While devoicing in the Verbal Noun and Qualitative act similarly, other morphemes impose slightly different featural modifications of the root. For example, the Nominative Singular (hereafter 'Singular') is very similar to the Verbal Noun: before the Singular morpheme, the rightmost stem consonant devoices. However, it differs from the Verbal Noun in two ways: (1) the singular does not force deletion of the root-final vowel, and (2) /w/ does not devoice. The data in (9) show that the Singular causes a root-final obstruent to devoice. The plural form is provided so that the underlying [voice] value can be seen – the plural preserves [voice] in C-finals roots.

(9) *The Singular: Underlyingly C-final stems devoice*

UC	Singular	Plural	root gloss	source
/p/	ip	ipe	tail	T94
/b/	ærip	æribe	Milky Way	T128
/t̪/	bat̪	bæt̪e	side	T130
/d̪/	kot̪	kod̪e	rain	T128
/t/	it	ite	ear	T94
/d/	ŋet	ŋede	rib	T128
/c/	wac	wece	affair	T546
/ɟ/	tic	tiɟe	work	T128
/k/	lak	leke	tooth	T94
/g/	cak	cege	milk	T128
/f/	saf	sæfe	sub-chief	T130
/s/	nus	nuse	half	T130
/h/	*no data*			
/m/	tɪm	tɪ^{m}bɛ	action	T94
/n/	ten	te^{n}de	neck rest	T129
/ɲ/	pɪɲ	pɪɲɟɛ	country	T129
/ŋ/	waŋ	we^{ŋ}ge	eye	T129
/^{N}C/	*no data for /CV^{N}C/ (i.e. prenasalized stops) – T 131*			
/l/	del	de^{n}de	skin	T602
/r/	bʊr	bɛcɛ	ulcer	T94
/j/	ɪc	ɪjɛ	belly	T128
/w/	ŋew	ŋepe	peg	T128

For V-final roots the Singular has no effect whatsoever: e.g. /mula+SG/ → [mula] ‘brass’, /ko+SG/ → [ko] ‘large gourd for churning’ (T95), [bɪd̪ɪ] ‘fish spear+SG’, [kɛdɛ] ‘twig+SG’, [ciewu] ‘porcupine+SG’ (T93).

There are two underlying differences between the Singular and Verbal Noun that are responsible for their different surface effects. One is the treatment of /w/: in the Singular /w/ surfaces unchanged (e.g. /ŋew+SG/ → [ŋew] ‘peg’; /law+SG/ → [law] ‘cloth’ (T128)) while for the Verbal Noun /w/ surfaces as [p]: /hɛwɔ+VN/ → [hɛp].

The difference is that the Verbal Noun and Qualitative have a [−vocoid] feature while the Singular does not – the singular is just a root node with a [−voice] feature (/X̥/). Preservation of the features of the morpheme-initial segment’s manner features outranks preservation of underlying manner features generally (specifically [vocoid], [approximant], [sonorant]). So, when coalescing /w+Ç̥/, realizing the [−vocoid] value of the /Ç̥/ forces the output to become [p]. In contrast, preservation of underlying manner features outranks preservation of the morpheme-initial segment’s [−voice] feature. So, when coalescing /w+X̥/, the output [w] preserves underlying manner of articulation features while the output [p] does not.

So, while it seems that there is ‘devoicing’ in Dholuo, on close inspection there are really two distinct processes: devoicing with devocoidization and devoicing alone.

The palatal glide /j/ behaves differently from /w/. /j/ becomes [c] in the singular; it does not remain [j] (e.g. /tij-X̥/ → [tic], *[tij]). Unlike [w], word-final [j] is banned throughout the language. While many words end in [w] as the second part of a diphthong (e.g. [lɪw] 'clear', [ŋaw] 'weakness' (T22)), no words end in [j].

The ban on word-final [j] is clearly seen in the Subjunctive Imperative (SI), which is like the Verbal Noun in that it forces root-final vowels to delete, but differs in that it is a featureless consonant (i.e. just a root node /X/). Consequently, it forces root shortening: /kabɔ+X/ 'fatten' → [kab], *[kap]. Underlying /w/ survives: /ŋɪɛwɔ+X/ → [ŋiɛw] 'buy!' (T360). However, due to the ban on word-final [j], underlying /j/ deletes in the SI: /cwɛjɔ+X/ → [cwe] 'disappear!', *[cwej]; /kajɔ+X/ → [ka] 'bite!', *[kaj], *[kac] (T22). /j/ does not delete in the Singular because it has another option: it can devoice to form [c], and so avoid deletion. Given the choice of /tij+X̥/ → [ti] or → [tic], avoidance of deletion is favorable to coalescence.

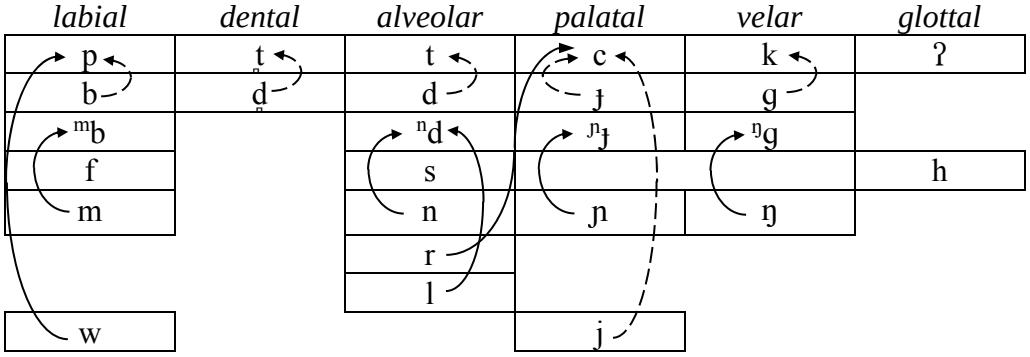
The final difference between the Verbal Noun and Singular is that the Singular does not require suffixation to the PrWd head. The overwhelming pressure on all suffixes is to be aligned with the right edge of the stem; this pressure forces /kɛdɛ$_1$+X̥$_2$/ to become [kɛdɛ$_{1,2}$] – i.e. the /X̥/ coalesces with the root-final *vowel*. Voiceless vowels are banned, so /X̥/'s [–voice] feature is lost: [kɛdɛ$_{1,2}$], *[kɛdɛ̥$_{1,2}$]. (An alternative is to say that the /X̥/ is deleted in the output; the choice between coalescence without faithfulness and deletion can be motivated by ranking compatibilities).

So, there are two types of 'devoicing' in Dholuo. One involves devoicing obstruents alone (as in the Singular); the other involves devoicing obstruents and devocoidization – changing glides into nonglides – coupled with devoicing. Devoicing is not the only morpheme-triggered mutation, as we will see for the genitive.

3.5 Desonorization in the Genitive

While we are ever closer to accounting for the plural, an account of the Genitive necessarily comes first. The Genitive appears in many morphological contexts: on its own, with possessive pronouns, in possessed-possessor constructions, and also in forming compound nouns (T116ff). In all cases it imposes the same mutation on roots. It is similar to the Verbal Noun and Qualitiative in some ways: it requires devoicing and must attach to the PrWd head. However, it differs in that it also requires desonorization: liquids and nasals must become their prenasalized obstruent counterparts. It is also selective about which consonants it devoices. Table (10) summarizes the Genitive's mutations.

(10) *The Genitive's consonant changes*



• Dashed lines marks changes that occur only with V-final roots

For both /V/-final and /C/-final roots the Genitive forces sonorant consonants to become [−sonorant] (see the solid lines in (10)). The data in (11) show roots concatenated with the Genitive and the 1st person singular person/number marker; these produce 1st person singular possessive ('my') forms.

Personal pronominal forms are created by concatenating the Genitive and one of the personal pronouns (/-a/ {1sg}, /-i/ {2sg}, /-ɛ/ {3sg}, /-wa/ {1pl}, /-u/ {2pl}, /-gɪ/ {3pl} – T165).[6] The singular forms are listed because they reflect the underlying (i.e. faithful) form. The data shows that nasals and the lateral desonorize to become prenasalized stops (prenasalized stops are [+nasal], but [−sonorant]); /r/ becomes [c].

[6] The reader might be wondering why I have asserted that the 1sg possessive forms consist of a separate Genitive morpheme concatenated with a person/number morpheme. The Genitive and person/number suffixes are clearly separable – the Genitive can appear without any person/number suffixes (see (13)). The person-number suffixes can also appear without the genitive; Tucker (1998:162) calls these 'low tension' suffixes. When they do occur alone, the person-number suffixes do *not* force any change in the root (neither vowel deletion nor consonant mutation): e.g. /cʊla+wa/ → [cʊlawa] 'island'+2pl (T163), cf. /ɔlawɔ+Q̥+wa/ → [ɔlapwa] 'saliva'+GEN+3sg, *[ɔlawɔwa].

(11) *The Genitive: Desonorization*

UC	Singular	1sg gen. pron.	root gloss	source
/m/	nam	na^{m}ba	lake	T167
	lemo	le^{m}bæ	share	T167
/n/	mæsin	mæsi^{n}dæ	machine	T167
	sɪgana	siŋa^{n}da	story	T167
/ɲ/	ofuɲ	ofu^{ɲ}ɟa	heel	T167
	ɲɪɲɔ	ɲɪ^{ɲ}ɟa	leprosy	T167
/ŋ/	ɲɪŋ	ɲɪ^{ŋ}ga	name	T167
	kɔŋɔ	kɔ^{ŋ}ga	beer	T167
/l/	bul	bu^{n}dæ	drum	T167
	mʊla	mʊ^{n}da	brass ornament	T167
/r/	gara	gaca	leg bells	T166
	bʊr	bʊca	ulcer	T166

The Genitive also forces devoicing. However, devoicing only occurs with underlying /V/-final roots, not with underlying /C/-final roots. Compare the /d/, /ɟ/, /g/, /j/ and /w/ forms in (12). No /CVC/ stems ending in /p/, /b/, and /d̰/ were reported by Tucker (1994). (Prenasalized stops are – as expected – unaffected: e.g. /ko^{n}do+GEN/ → [ko^{n}da] 'my hat' (T169).)

(12) *The Genitive: Devoicing*

UC	UR	1sg gen. pron.	root gloss	source
/p/	*no data*^{CVC}			
	/dɪpɔ/	dɪpa	open space	T174
/b/	*no data*^{CVC}			
	/kitæbu/	kɪtapa	book	T166
/t̪/	/bat̪/	bat̪a	side	T169
	no data^{CVCV}			
/d̪/	*no data*^{CVC}			
	/^{m}bid̪i/	^{m}bit̪a	wild pig	T166
/t/	/ŋut/	ŋuta	neck	T169
	/ŋatɔ/	ŋata	person	T169
/d/	/ɔd/	oda	house	T165
	/kidi/	kita	stone	T166
/c/	/a-lɪɛc/	alɪɛca	pounded sesame	T172
	/ɔkɔcɔ/	ɔkɔca	neckrest	T169
/ɟ/	/tiɟ/	tiɟa	work	T166
	/ɔkwaɟɔ/	ɔkwaca	walking canes	T166
/k/	/tik/	tika	chin	T169
	/ɔsɪkɪ/	osika	stump	T168
/g/	/cag/	caga	milk	T167
	/tɪgɔ/	tɪka	bead(s)	T166
/j/	/nɛj/	nɛja	salamander	T166
	/^{ŋ}gaji/	^{ŋ}gaca	paddle	T166
/w/	/paw/[7]	papa	open field	T166
	/ciewo/	ciepa	porcupine	T166

To summarize, the Genitive changes /V/-final stems by desonorizing and devoicing the final consonant; it changes /C/-final stems by desonorizing – but not devoicing – the final consonant.

I propose that the Genitive is a root node with [−sonorant] and [−voice] features, symbolized as /O̥/. So, /mæsin+O̥+a/ surfaces as [mæsi^{n}dæ] because /n/ and /O̥/ coalesce to form a [−sonorant] nasal stop: i.e. [^{n}d]. The [−voice] feature of /O̥/ does not surface because the only viable option – [t] – would lose the [+nasal] feature.

Preservation of liquids does not outrank realization of [−sonorant], so /l/→[^{n}d] and /r/→[c]. Why /l/ does not become [t] is not clear to me – [^{n}d] must preserve some feature that [t] does not (and [^{ɲ}ɟ] must fail to preserve the same features of /r/). It is also not clear to me why /r/ becomes [c] and not [t]. The details of these segments need much

[7] A couple of /w/-final forms do not change to [p]: e.g. [lɐp] 'tongue+SG' cf. [lɛwa] {1SG-GEN} (T170), [ip] 'tail+SG' cf. [iwe] 'his tail' (T170). It is likely that these possessive forms are lexicalized. Their plurals show that they underlyingly end in /p/: i.e. [lepe], *[lewe]; [ipe], *[iwe] (T170).

closer examination than I am able to give them here. Even so, the sweeping generalization is that sonorants become [−sonorant] under the Genitive's influence.

Perhaps the most interesting issue is why the genitive does *not* force devoicing with consonant-final stems: e.g. /cag+O̥+a/ → [caga], not *[cak]; cf. /tɪgɔ+O̥+a/ → [tɪka], *[tɪga]. A way to view this lack of change is that the underlying [voice] value of root-final obstruents is preserved. I propose that this generalization follows from how the Genitive is constructed. The form of the Genitive refers to a 'base form', which is the bare root. For example, the bare root of /ɔd/ is [(ˈɔd)], and the bare root of /kidi/ is [(ˈki.di)]. So, the Genitive form of /ɔd/ can refer to [(ˈɔd)]. Furthermore, there is a faithfulness requirement on bases: the [voice] features in the base's PrWd head syllable must be preserved (akin to OO-stress-IDENT[voice] – after Beckman 1998 and Benua 1997).

So, /ɔd+O̥^{GEN}+a/ cannot be realized as *[ɔ.ta] because this form fails to preserve the [+voice] feature of [d] in the base [(ˈɔd)], and [d] is in the base's PrWd head. In contrast, the base of /kidi/ is [(ˈki.di)]. Notice that the [d] is not in the PrWd head in the Base, so it does not get preserved in the Genitive form: i.e. /kidi+O̥^{GEN}+a/ → [kita].

There is independent support for this approach. Under the influence of [−sonorant], glides become stops: /ciewo+O̥^{GEN}+a/ → [ciepa], /paw+O̥^{GEN}+a/ → [papa], /ŋgaji/ → [ŋgaca]. However, roots that end in /j/ underlyingly do not surface with [c]: /nɛj/ → [nɛja], *[nɛca] (c.f. [papa]). As mentioned in section 3.4, word-final [j] is banned, so the Base of the Genitive form of /nɛj/ is [nɛ]. If the Genitive is 'built on' the Base (i.e. the Root in the Genitive form must be as faithful to the Base as possible), then there is no /j/ to desonorize. The concatenation is therefore effectively /nɛ+O̥^{GEN}+a/, lacking the [j]. In such vowel hiatus a [j] is epenthesized, resulting in [nɛja] (see section 3.6 for details). This approach proposes that a fundamental difference between the nominative and genitive forms is that the nominative attaches to the bare root while the genitive attaches to a base form; why this should be the case (or whether it is entirely synchronically arbitrary) is unclear.

One issue with this approach is that roots never appear without a suffix, so /cag/→[cag] is morphosyntactically ill-formed.

The Genitive is like the Verbal Noun in that it forces deletion of the root-final vowel. This effect is very clear when the Genitive is paired with person/number suffixes of the form /CV/: e.g. /ɔlawɔ+O̥+gɪ/ → [ɔlapgɪ] 'saliva'+GEN+3pl (T165), not *[ɔlapɔgɪ]. Root-final vowel deletion is also clear when the Genitive appears on its own without any suffixes, as in possessed-possessor constructions. A few examples are given in (13); the root's vowel still deletes, rightmost consonants desonorize, and nonroot-final consonants devoice.

(13) *Genitive on its own (Possessed-Possessor constructions) (T190ff)*

UC	UR	Surface	Gloss	Source
/d/	/kidi+GEN gɔt/	kit gɔt	a stone from the hill	T190
	/od+GEN wiɲo/	od wiɲo	bird's nest	T190
/ŋ/	/kɔŋɔ+GEN bɛl/	kɔᵑg bɛl	eleusine beer	T191
	/ɲɪŋ+GEN rawɛra/	ɲɪᵑg rawɛra	the boy's name	T191
/l/	/welo+GEN dala/	weⁿd dala	visitors to the village	T190
	/bul+GEN laŋɔ/	buⁿd laŋɔ	a Kalenjin drum	T191
/w/	/ɔlawɔ+GEN d̈ɪaŋ/	ɔlap d̈ɪaŋ	cow's saliva	T190
	/lɛw+GEN guok/	lɛw guok	dog's tongue	T190

In summary, the Genitive is a more elaborate version of the Singular, Verbal Noun, and Qualitative: the Genitive has both a [−sonorant] and [−voice] feature, and requires attachment to the PrWd head. (It could also have a [−vocoid] feature, but any effect of that feature is subsumed by [−sonorant] – i.e. glides will become nonglides by having to realize [−sonorant].) The Genitive form refers to the base's PrWd head in preserving [voice].

3.6 The Plural

The only difference between the Plural and Genitive is that the plural also suffixes an /ɛ/ to the root (which then harmonizes with the root's stressed vowel). Data is provided in (14).[8]

[8] The plural also affects root vowels: root /a/ becomes [æ] (e.g. /pata/ 'hinge' ~ [pæte] (pl.)). Vowel mutations will be ignored here; the focus will be on consonants only.

(14) *The Plural*

UC	Singular	Plural	root gloss	source
/p/	ip	ipe	tail	T94
	cupæ	cupe	bottle	T130
/b/	ærip	æribe	Milky Way	T128
	kitæbu	kitepe	book	T514
/t̪/	baṯ	bæṯe	side	T130
	ɔṯɪṯɔ	ɔṯɪṯɛ	small thing	T130
/d̪/	koṯ	koḏe	rain	T128
	bɪdɪ	bɪṯɛ	fish spear	T128
/t/	it	ite	ear	T94
	pata	pæte	hinge	T130
/d/	ŋet	ŋede	rib	T128
	kɛdɪ	kɛtɛ	twig	T513
/c/	wac	wece	affair	T546
	ɔkɔcɔ	ɔkɔcɛ	ɔkɔcɛ	T130
/ɟ/	tic	tiɟe	work	T128
	agaɟa	ægæce	chair made of twigs	T128
/k/	lak	leke	tooth	T94
	osiki	osike	stump	T130
/g/	cak	cege	milk	T128
	hɪga	hike	year	T507
/ᵐb/	ɔbaᵐb-la	ɔbeᵐbe	dried fish	T132
	rɔᵐbɔ	roᵐbe	sheep	T130
/ⁿḏ/	ɔnⁿḏʊⁿḏɔ	ɔnⁿḏʊⁿḏɛ	bone marrow	T130
/ⁿd/	keⁿdɔ	keⁿde	hearth	T130
/ɲɟ/	ɔjɔɲɟɔ	ɔjɔɲɟɛ	feathered garment	T130
/ᵑg/	ogoᵑg-lo	ogoᵑge	snail shell	T130
	ɔrɛᵑgɔ	ɔrɛᵑgɛ	fly switch	T130
/f/	saf	safe	sub-chief	T130
	ɔfɨfɔ	ɔfɨfɛ	spoilt cotton	T130
/s/	nus	nuse	half	T130
	dirisa	dirise	window	T130
/h/	*no data*			
/m/	tɪm	tɪᵐbɛ	action	T94
	jamɔ	jeᵐbe	wind	T129
/n/	ten	teⁿde	neck rest	T129
	pino	piⁿde	wasp	T129
/ɲ/	pɪɲ	pɪɲɟɛ	country	T129
	ɲɪɲɔ	ɲɪɲɛ	iron	T129
/ŋ/	waŋ	weᵑge	eye	T129

	lɔŋɔ	lɔŋgɛ	hernia	T129
/l/	del	de^{n}de	skin	T602
	hʊla	hʊ^{n}dɛ	wax	T129
/r/	abuor	abuoce	eland	T489
	gari	gece	vehicle	T128
/j/	ɪc	ɪjɛ	belly	T128
	bije	bice	white ants	T128
/w/	ŋew	ŋepe	peg	T128
	bawo	bape	plank (Swahili)	T127

There are some exceptions to the generalizations, noted by Tucker (1994:131). For example, [ŋudi] 'neck of meat' (singular) has the plural forms [ŋude] (not *[ŋute]) and [ŋudni] (see discussion of –ni plurals below). However, this form is clearly lexicalized (and the only […dV] root Tucker lists with this form): compare [ŋut] 'neck (sg.)' and [ŋute] {plural}; [kɛdɪ] (sg.) and [kɛtɛ] (pl.). There are also five /r/-final exceptions, including [rawɛra] 'boy (sg.)' ~ [rawɛrɛ] (*[rawɛcɛ]), [bar] 'main land (sg.)' ~ [bare]/[bere] (pl.). Again, these are clearly lexicalized forms, and do not reflect a productive mutation or phonological process.

So, following the analysis for the genitive above, the plural has the underlying form /Q̥ɛ/.

Without doubt, the Plural shows some tantalizing effects that look like polarity. For example, [ɪ**c**]~[i**j**ɛ] cf. [bi**j**e]~[bi**c**e]. However, the apparent polarity is due to the demands of different morphemes: /ɪj+X̥^{SG}/ surfaces as [ɪc] because the Singular has a [−voice] feature, but /ɪj+Q̬ɛ^{PL}/ surfaces as [ɪjɛ] because the Plural form must preserve the Base's [voice] features in a PrWd head. Similarly, /bije+X̥^{SG}/ surfaces as [bije], while /bije+Q̬ɛ^{PL}/ surfaces as [bice], with the difference being that the Singular cannot affect a non-root-final consonant, while the Plural can. In short, the plural's apparent morpho-phonological polarity is really an accidental confluence of the demands of faithfulness and morpheme-triggered mutation.

The sole root type that has not yet been discussed is the mono-syllabic V-final /(C)V/. The root's only vowel cannot be overwritten/coalesced, so a form like /ɲɔ+Q̥ɛ/ cannot surface as *[ᵑɟɛ] (such a prohibition is also found in French – de Lacy 1999). Instead, a [j] is epenthesized: [ɲɔ-j-ɛ]. [j] epenthesis is found in several other situations, too: e.g. /ti-ɔ/ → [tijo] 'wear out'+Qualitative; /kwo-ɔ/ → [kwojo] 'cure'+Qualitative'; /jie+a/ → [jieja] 'canoe' + 1sg.

Table (15) lists /CV/ roots with plurals listed in Tucker (1994) (some roots obligatory take a prefix, marked with a '-' below).

(15) */(C)V/ roots and plurals: epenthesis of [j]*

Singular	Plural	root gloss	source
a-lɪ	alɪjɛ	type of thorn tree	T138
ɲa-ᵑgɛ	ɲa-ᵑgɛjɛ	hoop	T134
ɔ-tɛ	ɔ-tɛjɛ	small calabash	T138
o-le	o-leje	gecko	T138
o-ᵑgo	o-ᵑgojɛ	eagle	T138
bɔ	bɔjɛ	vegetables	T138
kɔ	kɔjɛ	large gourd for churning	T515
ɲɔ	ɲɔjɛ	rings on neck	T528
a-bu	a-buje	gourd, instrument	T138
pu	puje	buttocks	T536

There are apparently eight /CV/ roots that take [cɛ] in the plural: e.g. [cwa] ~ [cwacɛ] 'tamarind'; [ge]~[gece] 'second hole in board game'. Seven roots have both [jɛ] and [cɛ] variants: e.g. e.g. [bwɛ] ~ [bwɛjɛ]/[bwɛcɛ] 'jackal'; [due] ~ [dueje]/[duece] 'moon, month'; [a-bu] ~ [a-buje]/[a-buce] 'gourd, instrument'; [o-buo] ~ [o-buoce] 'bullrush'.

I surmise that these [cɛ]-taking roots actually have the form /CV$_i$jV$_i$/. T33 reports that "it is sometimes difficult, even for Luo speakers, to determine by ear whether a semi-vowel is present or not in the middle of a word…. "yie" or "yiye" (canoe), "bie" or "biye" (termite)". The perceptual problem would be most extreme between two identical front vowels like [iji], [eje], and so on. So, 'pullet' is reported as [si] ~ [sice], but under this analysis would be /siji/ → [siji] (sg.) and [sice] 'plural', as expected. (It is possible that there is also a phonological ban on such /V$_i$jV$_i$/ sequences.)

Two facts support this proposal. One is that Tucker (1994) does not list any roots with the form [V$_i$jV$_i$] where V$_i$ is a front vowel [i ɪ e ɛ]. A few *words* do have this form: e.g. [wij-i] 'head' (T464), [lɛ-jɛ] (plural of [lɛ] – T246). 11 roots are listed with the form /CV$_k$V$_k$/ where V$_k$ is a non-front vowel. The other supporting fact is that almost all /CV/ roots reported with invariant plural [cɛ] have a front vowel: [si] 'pullet', [bwɛ] 'jackal', [cwɛ] 'leech', [due] 'moon', [ge] 'second hole in board game', [gɛ] 'gravel'. The exceptions are [cwa] 'tamarind', [sa] 'hour, time', [o-t̪o] 'tamarind'; [o-buo] 'bullrush' – T138. Of the roots reported with variable [jɛ]/[cɛ], only three have a back vowel: [mɔ] 'fat, oil', [ɔ-ᵐbɔ] 'pebble', [a-bu] 'gourd, instrument' (T138). However, [mɔ] is also reported with variants [mɔre] and [mo̱di], so is apparently lexicalized.

Finally, a few /CV/ roots clearly have lexicalized plurals: [u]~[upe] 'puff adder'; [pi]~[pige] 'water'; [jo]~[jore] 'road'; [dala] ~ [mier] 'village' (T126); [dɪɛl] ~ [diek] 'goat' (T124). There are also a few that mark plural solely by changing tone, or changing the stem vowel and tone: e.g. [mac] ~ [méc] 'fire' (T125). T125 provides details.

Forming plurals with [ɛ] and attendant consonant mutation is the major method of plural formation. It is also used in loanwords: e.g. [ɔkɛbɛ] ~ [ɔkɛpɛ] 'tin can'; [bæwo] ~ [bape] 'plank'; [ʊma] ~ [ʊᵐbɛ] 'fork' (from Swahili – T126); [saf] ~ [safe] 'sub-chief'

(English). However, like plural formation in many languages, there are some other plural formation techniques that apply to a smaller but significant group of words.

The 'minor' Plural formation method is to use the suffix /nɪ/: e.g. [ko^{m}be] ~ [ko^{m}bni] 'hole in tree'; [okebe] ~ [okebni] 'rich man' (T126). /nɪ/ is similar to the plural in that it forces the root-final vowel to delete. However, there is no consonant change, as seen in (16).

(16) *-ni* Plural

UR	*-ni* Plural	root gloss	source
/okebe/	okebni	rich man	T127
/^{ŋ}gato/	^{ŋ}getni	clog(s)	T127
/padɔ/	pedni	broken calabash	T127
/abaɟa/	abeɟni	large spear	T127
/fuko/	fukni	mole	T126
/gɔgɔ/	gɔgnɪ	lump of clay	T126
/ko^{m}be/	ko^{m}bni	hole in tree	T126
/na^{ŋ}ga/	ne^{ŋ}gni	cloth, suit, garment	T127
/kuesi/	kuesni	pipe	T126
/doho/	dohni	local court	T126
/ɔlaŋ/	ɔlaŋni	black ant	T127
/cula/	culni	island	T126
/buju/	bujni	mole	T127
/law/	lewni	garment	T127

The difference between the ɛ-Plural and ni-Plural is that the ni-Plural has no partially-specified consonant. However, it does require attachment to the stressed syllable, so causing deletion of the root-final vowel.

A minimally contrasting morpheme is the proximal demonstrative suffix /nɪ/: unlike the ni-Plural, it attaches to the end of the root without deletion: e.g. [ɔga^{n}da-nɪ] 'this bean', [ɔlawɔ-nɪ] 'this saliva' (T177).

3.7 Genitive Plural

The proposals about Dholuo morphemes make predictions about how those morphemes combine. The clearest morpheme combinations involve the Genitive, Singular, and Plural. A typical paradigm is given in (17) for /kidi/ 'stone'.

(17) Paradigm for [kidi] 'stone' (Okoth-Okombo 1982:33)

/kidi/	*singular*	*plural*
nominative	kidi	kite
genitive	kit	kite

As seen in the paradigm, the Nominative Plural and Genitive Plural are identical (Okoth-Okombo 1982:33). Further examples are provided below:

(18) *Genitive + Number Paradigms*

UR	sg.	pl.	gen.sg	gen.pl	gloss	source
/kidi/	kidi	kite	kit	kite	stone	O33
/bug/	buk	buge	bug	buge	book	O33
/wij/	wɪc	wije	wɪc	wije	head	O33
/lowo/	lowo	lope	lop	lope	soil	O33
/kɔm/	kɔm	kɔ^{m}be	*no data*	kɔ^{m}be	chair	O33
/paw/	pap	pewe	paw	pewe	field	O33

The Genitive Plural is made up of three morphemes: a root, the genitive /O͘/ and the plural /O͘ɛ/. So, /kid$_1$i+O͘$_2$+O͘$_3$ɛ/. The output is [kit$_{1,2,3}$e], where the input consonants /d/, /O͘$_1$/ and /O͘$_2$/ all correspond to the same output segment – [t]. The [t] appears as [–voice] because both the genitive and plural are specified as [–voice]. The suffix segments pile on top of each other so they can all appear suffixed to the PrWd head: [('ki.t$_{1,2,3}$e)].

3.8 Summary

Dholuo does not exhibit morpho-phonological polarity. True morpho-phonological polarity involves a change of /α/→[β] and /β/→[α] in the same morphological and phonological environment. Pairs like 'Milky Way' [ærip] (sg.) vs. [æribe] (pl.) and 'book' [kitæbu] (sg.) vs. [kitepe] (pl.) look like they might meet this description. Certainly, the morphological context is the same – the plural. However, the phonological context is different: 'Milky Way' has an underlying root-final consonant, while 'book' has an underlying root-final vowel; this phonological difference was shown to be crucial. Finally, 'tail' [ip] (sg.) vs. [ipe] (pl.) minimally contrasts with [ærip]~[æribe], showing that there is no polarity here.

An account of the Dholuo plural and many other morphemes can be achieved by recognizing that several morphemes trigger mutation (though many do not). There are four distinct mutations morphemes can produce: devoicing, desonorization, devocoidization, and root-final vowel deletion. However, there is almost no pattern as to which morpheme will use which mutation(s) in which combination. Table (19) summarizes the properties and cites relevant morphemes. For example, the plural forces desonorization, devoicing, deletion of a root-final vowel (in order to suffix to the PrWd head), and also has /ɛ/. In contrast, the singular forces the rightmost root consonant to devoice, but does nothing else and has no other material.

(19) *Properties of selected Dholuo morphemes*

Morpheme	UR	De-sonorize	Devoice	De-vocoidize	Suffix to ˈσ	Other content
Plural	/*Q̬ɛ/	✓	✓	(✓)	✓	ɛ
Genitive	/*Q̬/	✓	✓	(✓)	✓	
Qualitative	/*Ç̬o/		✓	✓	✓	o
Verbal Noun	/*Ç̬/		✓	✓	✓	
Singular	/X̬/		✓			
-ni plural	/*nɪ/				✓	nɪ
Applicative	/*Xɔ/				✓	ɔ
Subjunctive Imperative	/*X/				✓	
-ni demonstrative	/nɪ/					nɪ
-e 'here'	/e/					e

- * = the preceding segment must be part of the head syllable of the PrWd
- X = a root node
- X̬ = a root node with a [−voice] feature
- Ç̬ = a root node with [−voice] and [−vocoid] features
- Q̬ = a root node with [−voice] and [−sonorant] features

Most of the properties listed above are clearly independent. There is no relationship between causing consonant change and suffixing to the PrWd head (*-ni* pural cf. singular cf. Verbal Noun). There is no relationship between having overt content and causing consonant change (Plural cf. Genitive).

There is a relationship between desonorizing and devoicing: if a morpheme forces desonorization, it also forces obstruent devoicing. However, desonorization only happens for two morphemes (the plural and genitive), so it is impossible to say whether this implication reveals anything synchronically significant about the language.

3.9 Is it Phonological?

An alternative approach is to regard the changes in the Dholuo plural as reflecting general phonological processes, such as devoicing (e.g. Baerman 2007:57). One idea is that devoicing occurs in codas (and perhaps intervocalic voicing also occurs).

There are several problems with the coda devoicing approach. Devoicing does not occur in many codas, as in [okeb-ni] 'rich man+*ni* plural' (see (16) above); [od] 'house+GEN' (see (13)). Devoicing also occurs in onsets: [ki.di] ~ [ki.te] 'stone+PL'. The [t] in [kite] cannot be in a coda (i.e. *[kit.e]) because onsetless syllables are only permitted root-initially.

Bye (2006) argues that phonological devoicing is actually restricted to codas at the end of a prosodic domain (either the PrWd or Phonological Phrase). Consequently, medial codas will not devoice (as in [o.keb.ni]). Bye argues that word-final codas in

genitives do not devoice because they are phrase-medial: e.g. in [od wiɲo] (from (13)) the [d] is phrase-medial and so not eligible for devoicing. There are still clearly great complexities here, as phrase-medial stops in the genitive *do* devoice if they are in underlyingly /V/-final roots (e.g. /kidi+GEN gɔt/ → [kit gɔt], *[kid gɔt]), and even when they are followed by a vowel suffix: /kidi+GEN+a^{1sg}/ → [ki.ta] (see (12)). Bye (2006) provides further discussion.

In a related vein, Trommer (2007) proposes that there is a devoicing process that only applies to consonants in unlicensed positions: i.e. word-finally or before an underlyingly deleted element. So, /od+SG/ becomes [ot] because [t] is word-final, while /od+$ɛ^{PL}$/ is [ode] because it is not word-final. However, the /d/ in /kidi+$ɛ^{PL}$/ becomes [t] because the /i/ deletes: i.e. /kidi+ɛ/ → [kite]. In words with the *–ni* plural, voiced consonants survive (e.g. /okebe+ni/ → [okeb-ni]) because the [n] can share the [b]'s [+voice] feature.

Trommer identifies a challenge in Genitive forms such as [ɔd] 'house+GEN', but proposes that these are actually truncated forms with a possessive pronoun form as a base: e.g. /od+$e^{3.SG.GEN}$/ → [od-e] 'his house' → truncation: [od]. The truncated form remains faithful to its base form rather than devoice.

The proposal can be extended to morphemes like the Subjunctive Imperative. For example, /kabɔ/ 'fatten' in the Subjunctive Imperative is [kab], but this could be treated as a truncation of the Imperative form [kab-ɪ] (T358).

A minimally contrasting suffix pair is the Applicative and Qualitative. The Applicative is /ɔ/ and the Qualitative is /o/, as for *kabo*: [kabɔ] {Applicative} and [kepo] {Qualitative}. Notice that the root's consonant remains faithful to the underlying /b/ before the Applicative, but devoices before the Qualitative. Trommer (2007:§7.1) argues that such cases involve the root (e.g. /kab/) and straightforward suffixation of the Applicative to form [kab-ɔ]. However, the Qualitative is built *on* the Applicative so that /kabɔ-o/ surfaces as [kepo] because the /b/'s [+voice] feature is not licensed.

In short, Trommer's (2007, 2008a) approach has a general phonological process (devoicing word-finally and before a deleted vowel), supplemented with morpheme-specific truncation; Bye's (2006) approach has a general phonological process (devoicing phrase-finally) coupled with morpheme-specific processes (e.g. subtraction). In contrast, the proposal presented here is that there is no general phonological process of devoicing (or desonorization, or devoicoidization). Instead, morphemes are highly idiosyncractic: some morphemes force devoicing while others do not (i.e. some morphemes have a floating [−voice] feature and others do not). Truncation is seen as following from the need for certain morphemes to suffix to the PrWd head syllable (also found in Ulwa – McCarthy & Prince 1993). The great challenge for proposals that employ general phonological processes in accounting for Dholuo is that several mutations take place: not just consonant devoicing, but also desonorization, truncation, and devocoidization. It is also not possible to predict which process applies with which morpheme (see the summary in (19)). Faced with such morpheme-specific idiosyncrasy, it is difficult to discern the role of any general phonological process in Dholuo morpho-phonology.

4. Other Cases of Morpho-phonological Polarity

The Dholuo plural is probably the most cited case of morpho-phonological polarity. However, several other cases have been identified. Each should receive as much attention as I have given to Dholuo here before any hard and fast conclusions could be drawn. Nevertheless, I will identify some of the major issues relevant for such cases.

This section focuses on languages that reportedly involve synchronic morpho-phonological polarity. Diachronic polarity will not be discussed (e.g. 'tonal inversion' in Loma – Dwyer 1981). Also excluded are cases that involve different registers or dialects of a language. For example, Anderson & Browne (1973) discuss correspondences between Literary and Colloquial Czech where Literary [iː] corresponds to Colloquial [ej], but Literary [eː] corresponds to Colloquial [iː]. Apart from the fact that this correspondence is not true polarity (i.e. Literary [iː] should correspond to Colloquial [eː] for it to be polarity), the idea that the underlying forms of Literary Czech are the same as those for Colloquial Czech, or vice versa, is questionable.

Cases of phonological polarity are not discussed here. For phonological polarity in intermediate levels of English derivations see Chomsky & Halle (1968), and in Menominee see Bever (1967).

4.1 Length exchange: Kumeyaay (Diegueño), Dinka, and Czech

There are several languages that seem to have morpho-phonological polarity involving vowel length, often involving the plural. However, these languages have many ways of forming the plural, indicating that they have distinct morphological classes where one involves vowel lengthening and another involves vowel shortening.

For example, some Kumeyaay languages (also called Diegueño) have been reported to have morpho-phonological polarity in plural formation: underlying short vowels become long and underlying long vowels become short (Langdon 1970, Walker 1970). I focus on Miller's (2001) grammar of the Jamul dialect of the Tiipay language of the Kuumeyaay dialect group here.

Miller (2001) reports that the most productive pluralization process involves changing a root's short vowel into a long one. Lengthening affects 136 plural stems in Miller's corpus, which is 72% of the total. Examples are given in (20).

(20) *Jamul Tiipay plural lengthening* (Miller 2001§4.2)

Singular	Plural	Gloss	Source
uʔis	uʔiːs	to sneeze	105
akkwi	a-tʃ-kwiː-p	to ask question	106
wiɾ	wiːɾ	to be stiff	22
miːwan	miːwaːn	to be lazy	105
njaj	njaːj	to hunt	105
kaːkap	nekaːkaːp	to go around	105
axpu	a-tʃ-x-uː-puː-tʃ	to thresh grain	105

In contrast, there are 7 roots in Miller's corpus that have underlying long vowels in the singular and a short vowel in the plural. Examples are [saːw] 'eat'(sg) ~ [saw] (pl); [meʃejaːj] ~ [mes-t-uː-jaj] 'to be afraid'; [uːjaːw] ~ [atʃuːjaw] 'to know'; [aːmuːtʃ] ~ [a-tʃ-uː-mutʃ] 'to kill' (p.102).

It is unclear whether there is a productive process of length polarity in Jamul Tiipay. While underlying long vowels shorten for 7 roots, there are many in which no shortening occurs: e.g. [waːw] ~ [uː-waːw] 'yell'; [xemiː] ~ [t-exmiː] 'grow'; [tejuːt] ~ [te-tekjuːt] 'greet'; [waːjp] ~ [a-tʃ-uː-waːjp] 'talk, discuss' (102-104). Moreover, the language has nine different ways to mark plurals, and there seems to be no generalizations about which will apply to which root. In fact, a number of roots take more than one plural marker, sometimes simultaneously: e.g. the plural of [axpu] – [a-tʃ-x-uː-puː-tʃ] has four different plural markers (underlined). Of all the ways of marking plurality, shortening long vowels is the second most rare with 3.7% of the total (/-a/ suffixation happens to two verbs only). In contrast, [uː] prefixation applies to 30% of roots, [tʃ] prefixation to 23%, and [n]-prefixation to 9.7%.

The process of lengthening short vowels is probably the general pluralization strategy (analyzable as a morpheme consisting of a mora). In contrast, shortening underlying long vowels is one of the most limited pluralization strategies in the language. Furthermore, some underlying long vowels do not lengthen. It is quite likely that the 'shortened' plurals are listed in the lexicon (cf. Topintzi 2007).

An alternative is that there are distinct classes of words in Jamul Tiipay, and they take different plural suffixes. One suffix lengthens vowels, while a different suffix shortens vowels. The overall effect is apparently morpho-phonological polarity. However, there is *no single morpheme* which both lengthens short vowels and shortens long vowels. In fact, it is probably impossible to exclude such a situation from a Generative theory: i.e. where a morphological category (like plural) is expressed by several different morphemes, and one causes the mutation /α/→[β] while another causes the mutation /β/→[α]. If a theory allows distinct morphemes and class behavior, it will allow such a situation. See sections 5.1 and 5.5 for further discussion.

Other cases like Jamul Tiipay are Shilluk and Dinka. In Shilluk there are many ways to form the plural with several affixes, tone mutation, vowel quality mutation, vowel shortening, and vowel lengthening (Westermann 1912b). The same is true of Dinka; there are several ways of forming the plural, though Nebel (1948) reports that

most are formed by shortening long stem vowels (e.g. [tʃiːn] ‘hand’ ~ [tʃin] (pl.)) and lengthening short stem vowels (e.g. [pal] ‘knife’ ~ [paːl] (dim.)). Like Jamul Tiipay, there is considerable variation in how plurals are formed. For example, there may be tone changes (e.g. [páːl] ‘knife+sg.’ ~ [pâːl] (pl.)) or vowel changes ([ŋaːp] ‘fig-tree’ ~ [ŋɛ́ːp] (pl.)) (Storch 2006). So, like Jamul Tiipay, it is likely there are several classes of words in Dinka. In one class, vowels shorten; in another, vowels lengthen. On the surface, this class behavior looks like morpho-phonological polarity (see section 5.1 and 5.5 for discussion), but there is no single morpheme that demands lengthening of short vowels and shortening of long vowels. Certainly, vowel lengthening is a common mutation imposed by morphemes in Dinka; Andersen (1995) identifies 11 morphemes that force lengthening of the root vowel.

Anderson & Browne (1973:460) observe that long vowels in Czech shorten for some roots in the diminutive, and that short vowels lengthen: e.g. [duːm] ‘house’ ~ [domek] {dim.} cf. [dar] ‘gift’ ~ [daːrek] {dim.}. However, they go on to cast doubt on its status. They observe that the majority of stems with long vowels do not change in the diminutive (only 33% shorten), and the majority of stems with short vowels do not change (only 16% lengthen). Loanwords and recently adopted words have no length exchange in the diminutive. It is likely, then, that many diminutive forms are lexicalized, or that there are different classes, one with shortening, another with lengthening, and others with completely different strategies.

Finally, Anderson & Browne (1973:459) report that in the Pari dialect of Anuak the appertentive involves turning a stem-final nasal into a prenasalized stop (e.g. [buom] ‘wing’ ~ [buo^{m}be] {App.}) and a stem-final prenasalized stop becomes nasal (e.g. [aweendo] ‘guinea fowl’ ~ [aweene] (pl.)). Like Shilluk, there are many ways to form the plural in Anuak (Westermann 1912a); this case no doubt warrants careful investigation.

Hausa and Ancient Greek have also been reported to have length polarity with some morphemes. For Hausa, the verbalizing suffix is [-ataː] when the preceding syllable is heavy, and [-aːtaː] when the preceding vowel is light: e.g. [tsoːr-ataː] ‘fear, frighten’; [fuʃ-aːta] ‘anger, be angry’ (Newman 1997; Topintzi 2007). Topintzi reports a similar case for Ancient Greek. However, Topintzi argues that these cases are not morpho-phonological exchanges, but are rather surface alternations conditioned by restrictions on sequences of heavy syllables.

4.2 Vowel Quality Exchange and Morphological Polarity

Some cases of apparent vowel quality polarity are morphological polarity, not morpho-phonological polarity. Morphological polarity describes a situation where a morphological distinction is marked by (at least) two classes of morphemes: e.g. A1,A2 and B1,B2. A1 and B1 appear in the same morphological environment, and A2 and B2 appear in the same morphological environment. However, the underlying phonological material of A1 and B2 is the same, and the underlying form of A2 and B1 is also the same.

For example, Callow (1965) and Chomsky & Halle (1968:357ff) observe that there are two different ways of marking a singular-plural distinction in Kasem (Gur; Burkina Faso). For one class of words, the singular is marked by the suffix /-i/ and the plural /-a/, but for another class the singular is marked by /-a/ and the plural by /-i/ (e.g. [sad-a] 'grass mat' cf. [sad-i] (pl.)). This situation involves different morphemes that happen to have identical phonological exponents associated with opposite morphosyntactic features: one class's singular suffix is /-i/ and the other class's is /-a/; one class's plural is /-a/ and the other happens to be /-i/. There is also a class where the singular is marked as /-u/ and the plural as /-a/ (but no class where the singular is /-a/ and the plural is /-u/). Morphological polarity is discussed further in section 6.

The same can be said for the other cases cited by Chomksy & Halle (1968:356) – Tiberian Hebrew and Arabic. In Classical Arabic, the first binyan's Perfective and Imperfective's 'class vowel's (i.e. the second vowel in the stem) are as in (21).

(21) *Classical Arabic first binyan: Perfective and Imperfective* (McCarthy 1979:292)

	Perfective	Imperfective	Examples
a.	a	i	dạrab ~ yadṛib 'beat'
b.	a	u	katab ~ yaktub 'write'
c.	i	a	9alim ~ ya9lam 'know'
d.	u	u	hạsun ~ yahṣun 'be beautiful'

McCarthy (1979:293) proposes an Ablaut rule with α-notation that derives a [–αhigh, αback] vowel in the Perfective from an [αhigh] vowel in the Perfective, excluding class (d). So, if the Perfective has [i] (+high, –back) in the Imperfective, the Perfective has a [–high, +back] vowel (i.e. [a]).

The alternative is to see the subtypes in (21) as involving distinct classes of morpheme, as Trommer (2008b:63) does for the analogous Tiberian Hebrew case (and to some extent advocated by Wolf 2005b:27ff). There is a morpheme /i/ that subcategorizes for class (a) imperfectives, a morpheme /u/ that subcategorizes for class (b) imperfectives, a morpheme /i/ for class (c) perfectives, and a morpheme /u/ for class (d) forms. There is also a default 'elsewhere' morpheme /a/ for all classes. Such a morphological account makes no reference to a phonological process, but rather to different morpheme classes; the apparent polarity in (a), (b), and (c) is therefore coincidental.

The same point can be made for the Tiberian Hebrew Perfect and Imperfect (and in fact has been made by Trommer 2008b): there are three morphological classes, where class one has Imperfect /o/ (e.g. *lam<u>o</u>d~yilm<u>o</u>d* 'learn'), class two has Perfect /o/ (e.g. *qat<u>o</u>n~yiqt<u>a</u>n* 'be small'), class three has Perfect /e/ (*zaq<u>e</u>n~yizq<u>a</u>n* 'age'), and the default morpheme is /a/. In short, there is no need to appeal to a morpho-phonological polarity process for these vowel-quality alternations. So, while there are cases that look somewhat like morpho-phonological polarity, many are better – or at least alternatively – analyzed as involving morphological polarity.

4.3 Other cases

Wolf (2005b) lists a few other cases of possible morpho-phonological polarity. One is tonal exchange rules in Vietnamese (Ngo 1984, with an alternative account by Pham 2001). There may be a polarity involving stress in Palantla Chinantec (Wang 1967; Merrifield 1968), though Wolf observes that it is "not very productive". In the North Sahaptin diminutive, /s/'s may be replaced with [ʃ]s and /ʃ/s with [s]'s, though the facts are few and disputed (Nichols 1971, Cole 1987:43-45). All three cases deserve much closer examination than I can give them here.

Wolf (2005b:fn.23) also mentions Hilgaynon as having a type of exchange of stress in reduplicants (Wolfenden 1971, Urbanczyk 2005). For example, [baláy] 'house' is [balày-bálay] 'doll house' (diminutive form), while [nánay] 'mother' is reduplicated as [nanày-nánay] 'make-believe mother' (dim.). Urbanczyk observes that in diminutive stems the generalization is that stress falls on different syllables – a kind of reduplicative avoidance of similarity. However, an alternative way of characterizing the diminutive is that stress always falls on the final syllable of the reduplicant and on the initial syllable of the base (as above, and also in [lakàt-lákat] 'walk a little', [dasìg-dásig] 'a little faster'). Given the fixed position of stress in the diminutive, this case does not match the definition of morpho-phonological polarity stated above.

In any case, I consider the discussion in the preceding sections to be tentative because none of the cases – Jamul Tiipay, Dinka, Shilluk, Tiberian Hebrew, Classical Arabic, Vietnamese, Palantla Chinantec, Hilgaynon, and so on – were examined here in the level of detail that is necessary to determine valid cases of morpho-phonological polarity. It is difficult to show that a putative case of morpho-phonological polarity is valid. Any morphological polarity analysis must be eliminated, and even establishing the correct generalizations is difficult. The Dholuo case underscores this point: not until Okoth-Okombo's (1982) and Tucker's (1994) extremely detailed grammars was it possible to identify all the evidence relevant for the analysis of the plural.

5. Theories with(out) Morpho-phonological Polarity

It is important to emphasize what the preceding sections have and have not shown. They have not shown that morpho-phonological polarity is unattested and cannot be generated by the Language Faculty; they have merely argued that there is no morpho-phonological polarity in Dholuo.

Dholuo was chosen as the object of study because I found it to be the apparently clearest case of morpho-phonological polarity cited, and of all the cases it has been subject to the most extensive linguistic analyses. Clearly, there is a need to examine all other proposed cases in depth to see if they are valid. At this point, I do not consider the evidence provided for any to be complete or conclusive.

While there is a significant element of uncertainty about whether morpho-phonological polarity exists, theoretical issues can still be addressed: if morpho-phonological polarity does/do not exist, what kinds of structures and processes must Generative theories of the language faculty allow/exclude?

5.1 Development of morphological polarity

Even if morpho-phonological polarity is not attested, the lack of attestation does not necessarily imply that the Language Faculty is unable to generate it. It may be unlearnable: either impossible to actuate or difficult to transmit (i.e. highly confusable with another more easily learnable pattern). Suppose that a language's Plural really did involve an exchange of the feature values for [voice]. What kind of diachronic changes (i.e. actuations) would have to occur for such an exchange to come about?

The path to morphologically-induced mutation involves a phonological process. The phonological process or the environment for its application could be generally lost, but preserved for just one morpheme. For example, imagine a language with a general process of coda devoicing, a root /bad/, and a zero singular morpheme /∅/. So, /bad/ → [bat] and /bad+$\varnothing^{SG}$/ → [bat]. However, the coda devoicing process is then lost, but the devoicing in the singular remains (i.e. it is reinterpreted as the expression of the singular) so that while /bad/→[bad], /bad+$\varnothing^{SG}$/ surfaces as [bat]. The result is a morphologically-induced coda devoicing process (similar to the actual Dholuo Singular).

Similarly, imagine a language with a coda devoicing process and a morpheme /ʔo/. /bad-ʔo/ surfaces as [bat.ʔo], while /bad-a/ → [bada]. Suppose that [ʔ] is eliminated generally but the devoicing remains: /bad-o/ would surface with a devoicing /d/ in *onset* position: [ba.t-o]; again, this results in a morpheme-specific devoicing (similar to the Dholuo Qualitative).

So, it is not difficult to see the path by which morpheme-specific mutations come about. However, these mutations are 'one-way': i.e. for one morpheme /α/→[β] and for another /β/→[α]. How could polarity come about in a similar fashion: how could just *one* morpheme have *both* /α/→[β] and /β/→[α]?

If morpheme-triggered [voice] polarity develops out of general phonological processes, the most likely contenders are coda devoicing and intervocalic voicing. Let us suppose that there is a language L with both processes. In addition, suppose there are two distinct ways to form the plural in L. For Class I words, the singular is /∅/ and the plural is /-a/; For Class II, the singular is /-ə/ and the plural is /-ha/. There is also coda devoicing and intervocalic voicing in this language. To simplify, suppose that the language limits root size to one syllable (not an uncommon prohibition – Ketner 2006).

(22) *DL: Devoicing and Intervocalic voicing*

	UR	Singular	Plural
Class I	/pat/	pat	pa.da
	/pad/	pat	pa.da
Class II	/pat/	pa.də	pat.ha
	/pad/	pa.də	pat.ha

Suppose that coda devoicing and intervocalic voicing are then lost but the effects of both classes of singular and plural morphemes are preserved. So, Class I plural forces a preceding obstruent to become voiced, and Class II plurals force the preceding consonant to devoice. In short, the paradigms in (22) are preserved but the changes in them are now morphologically-triggered.

Now suppose there is leveling of the Class I and Class II plural morphemes, either through phonological or morphological means. Apocope and loss of /h/ would result in [padə] becoming [pad] and [patha] becoming [pata].

At this point, there are still two separate classes of singular and plural morphemes. Their overt phonological material is the same, but they have different effects. So, on the surface we see [pat]~[pada] but [pad]~[pata]. Importantly, due to the language's previous phonological processes of coda devoicing and intervocalic voicing, the lexicon is limited so that every morpheme that ends in a voiceless consonant in the singular happens to be Class I, and every morpheme that ends in a voiced consonant in the singular happens to be Class II. So, alternations like [pad]~[pada] and [pat]~[pata] are never seen.

This stage is important: it shows that there is a way to get the effect of morpho-phonological polarity without having any special theoretical mechanisms – just word Classes and morphological polarity (see section 5.5 for discussion). There is nothing in the phonological system at this stage that is controversial: there are just different classes of morphemes that cause different kinds of mutations. In short, if there are two classes of morpheme that have the same overt material but impose complementary mutation requirements, the effect will be – descriptively – morpho-phonological polarity. In this case, the Class I and Class II plural are both /a/, but the Class I plural requires a preceding consonant to be [+voice] while the Class II plural requires it to be [–voice].

However, this stage is very unstable and transitory. Nothing in this system prevents a new root /pab/ from entering the system as a Class 1 morpheme. /pab/ would then have the singular [pab] and plural [paba]; polarity would then be lost. It is also not true morpho-phonological polarity in the sense that there is no one morpheme for which /α/→[β] and /β/→[α]. Instead, there are two different morphemes that have the same overt phonological material, and one has /α/→[β] and the other has /β/→[α]. This type of 'pseudo' morpho-phonological polarity is seen in parts in Dholuo (see section 3.8). It is likely that it is also present in Jamul Tiipay, with one class of words undergoing vowel lengthening in the plural and another class undergoing vowel shortening.

The crucial issue is whether at this stage it is possible to amalgamate the two morpheme classes while preserving their distinct mutation effects. Concretely, is it possible to have a single plural morpheme /a/ that causes underlying /t/ to become [d] but underlying /d/ to become [t]? Of course, this is the issue of whether there is a specific morpho-phonological mechanism that can generate such polarity. Several theories will be discussed in the following sections.

From this brief discussion it is clear that (at least pseudo-)morpho-phonological polarity could come about from the usual processes that create morpheme-specific mutations. However, several factors need to converge at the right time of the language. It is likely that instances of morpho-phonological polarity should be quite rare (as they apparently are). (See section 5.5 for further discussion). Certainly, morphological polarity is ripe for testing by means of artificial language elicitation (along the lines of, e.g., Carpenter 2006).

5.2 Mutating morphemes and polarity

It is uncontroversial that morphemes can impose mutation requirements. Akinlabi (1996) and Zoll (1996) provide many examples. For example, Akinlabi (1996) identifies morphemes in Nuer and Akan that require preceding consonants to become [+voice]. If the analysis of Dholuo in section 2 is on the right track, then there are morphemes that require preceding consonants to be [−voice]. Zoll and Akinlabi argue that such morphemes have a floating feature or features, or that they have a root node that is associated to various features.

de Lacy (2002a) observes that nothing in this approach prevents featural morphemes from having two floating features with contradictory specifications. Specifically, there could be a featural morpheme with both [+voice] and [−voice] features. A similar effect can be produced by having one morpheme with a floating [+voice] feature and another morpheme with a floating [−voice] feature. Of course, when such a morpheme/morphemes appear in a word (together), they will compete over which one's feature value is realized.

However, the possibility of such representations does not mean that morpho-phonological polarity will occur. Crucially, there must be a mechanism that requires [+voice] to surface when the underlying form is [−voice], and [−voice] to surface when the UR is [+voice].

de Lacy (2002a) proposes such a mechanism through a constraint called MORPHDISF. The constraint requires that every morpheme makes a distinctive appearance in the output.

(23) MORPHDISF For all morphemes M,
there is some faithful exponent E of M,
and E is not a faithful exponent of any other morpheme M_2,
where M and M_2 are in the same stem.

- 'Exponent' = 'feature' in this context.

Take a root like /ot/ and two featural morphemes M1 (floating /[+voice]/) and M2 (floating /[−voice]/). MORPHDISF favors the output [od] over [ot]. [ot] violates MORPHDISF twice: (1) there is no faithful exponent of M1 ([+voice]) and (2) while there *is* an exponent of M2's [−voice] in [t], it is not a *unique* exponent because it is shared with underlying /t/. In contrast, [od] violates MORPHDISF only once: M2's [−voice] is not realized in the output.

In contrast, for the input /bid+M1+M2/ MORPHDISF will favor [bit] over [bid]. [bit] realizes M2 distinctively; [bid] does not.

Wolf (2005b) proposes a different theory that broadly follows the same theme as MORPHDISF. Wolf proposes a single plural morpheme in Dholuo with two suppletive allomorphs, one being /[+voice]ɛ/ and the other being /[−voice]ɛ/. The choice of which allomorph appears in the winning output form is phonologically conditioned (after Mascaró 1996). The crucial constraint is NOVACUOUSDOCKING, which is violated whenever a floating feature docks onto a segment with the same underlying value. Like MORPHDISF, NOVACUOUSDOCKING essentially requires distinct realization. So, for /ot+{/[−voice]ɛ/, /[+voice]ɛ/}/, the winning output will be [odɛ] where the /[+voice]ɛ/

allomorph is realized; the /[−voice]ɛ/ cannot be realized distinctly enough because the /t/ is [−voice].

MacBride (2004) presents a theory similar to MORPHDISF and NOVACUOUSDOCKING, though it is set within a non-concatenative morphological theory in which morphemes are realized through constraints.

To generalize, theories that permit featural morphemes and provide a mechanism that promotes distinctive realization in the way implemented by MORPHDISF and NOVACUOUSDOCKING allow for morpho-phonological polarity.

If there was no MORPHDISF/NOVACUOUSDOCKING-like constraint, merely having two morphemes with contradictory feature specifications or a single morpheme with contradictory suppletive allomorphs will not create morpho-phonological polarity. Regardless of the input, the output's value will either default to the least marked value ([−voice]) or to the most faithful value (e.g. if IDENT[+voice] outranks IDENT[−voice], then [+voice] will always survive). For example, if IDENT[+voice] is paramount, then /ot+[+voice]+[−voice]/ will surface as [od] but /bid+[+voice]+[−voice]/ will surface as [bid] − i.e. no polarity. Even with a faithfulness constraint that preserves both feature values (e.g. IDENT[±voice]), the winner will be the most faithful one (i.e. the one most like the root's segment: /ot+[+voice]+[−voice]/ → [ot] and /bid+[+voice]+[−voice]/ → [bid] (again, not morpho-phonological polarity). See de Lacy (2002b:ch.7) and references cited therein for discussion about the various effects of markedness and faithfulness constraints on the output of coalescence.

5.3 Alpha notation and Classes

The classic rule-based approach to morpho-phonological polarity is to have alpha notation: i.e. to specify variables in rules. For example, suppose there really is morpho-phonological [voice] polarity in the Dholuo plural. An alpha rule could be formulated as in (24) (following Gregersen 1974):

(24) *Exchange rule for Dholuo*
[αvoice] → [−αvoice] / __(V)#PLURAL

A problem with such powerful notation is that it allows *phonological* polarity, too (see section 5.5).

Stonham (1994) proposes a way of using morphological class and class-specific rules to avoid alpha notation. Suppose there are two classes of words. In Class I the singular form is 'unmarked' and the plural is 'marked'; in Class II, the plural is unmarked and the singular is marked. The language needs a morpheme-sensitive rule like the one in (25).

(25) *Stonham (1994:102)*
C → [+voiced] / _ (V)#
[+marked number]

For example, 'rib' would be Class I; its singular form is [ŋet] and is unmarked so (25) would not apply to it. However, the rule would apply to the marked plural form, so it would appear as [ŋede]. In contrast, 'stone' would be Class II so the plural form [kite] is unmarked, and the rule would apply to the singular to make it [kidi]. Stonham's proposal avoids having α notation (also see Smith 1979, Serzisko 1982; cf. Baerman 2007§3).

If there is no morpho-phonological polarity, then excluding the ability to refer to 'marked' and 'unmarked' classes in rules (as opposed morphological/morphosyntactic features like [+plural]) would effectively exclude this approach.

As a final comment, Stonham's (1994) proposal does not work for Dholuo because it cannot explain cases where there is no voicing difference: e.g. [ip] 'tail' cf. [ipe]. Whichever of these forms is basic, the other should have a [b]. It is possible to salvage the theory by proposing a third class to which rule (25) does not apply, but the challenge would be explaining why there are no pairs like [ab] (sg.) ~ [abɛ] (pl.). In short, no matter how the proposal is cast in terms of classes, it misses the phonological regularity that devoicing in the plural depends on the shape of the root.

5.4 Requiring Difference

Alderete (2001) proposes a constraint type that in some sense reintroduces alpha notation. He proposes constraints that require two derivationally/inflectionally related forms to not agree on a particular feature value. In many situations, this simulates the alpha-notation effect; however, the constraints cannot apply on the Input-Output dimension and so cannot produce phonological polarity.[9]

Alderete (2001) argues that the Dholuo plural is effectively processual (akin to Anderson 1992): the morpheme's presence activates an anti-faithfulness constraint that forces a change in the [voice] value of the root. The crucial constraint is given in (26).

(26) *Anti-faithfulness* (Alderete 1999, 2001)
¬OO-IDENT[voice] "It is not the case that every OO-corresponding segment agrees in the feature [voice]."

The constraint is violated when every corresponding segment in forms related by morphological derivation faithfully preserves [voice].

So, in Dholuo with a [voice] morpho-phonological polarity, there would be a ¬OO-IDENT[voice]$_{PL}$ constraint which comes into force in a word like /kidi+PL/. The base of /kidi+PL/ is [kidi], so the base's rightmost consonant's [voice] value is reversed, resulting in [kite].

It is clear that if morpho-phonological polarity is impossible, anti-faithfulness constraints must be excluded from the grammar.

It is worth observing that anti-faithfulness constraints make some interesting predictions about morpho-phonological polarity. If two morphemes A and B make use of

[9] The ban on anti-faithfulness constraint on the Input-Output dimension apparently does not follow from theoretical necessity – i.e. it is an arbitrary restriction.

the same anti-faithfulness constraint, then the relevant feature value will switch back and forth as A and B are concatenated.

For example, in Dholuo the Genitive has the same effect on voicing as the Plural: /kidi+GEN/ → [kit], so the Genitive must spur a ¬OO-IDENT[voice]$_{GEN}$ constraint into action.

The Genitive and Plural can appear in the same word (section 2.6). The base of /kidi+GEN+PL/ is [kit] (i.e. the Genitive form; or it could be the Plural [kite] – it doesn't matter for this point). The anti-faithfulness analysis therefore predicts that the Genitive Plural will reverse the [voice] value of the base's consonant: i.e. *[kide]. So: [kidi] (sg.) ~ [kit] (gen.) ~ [kide] (pl.). Contrary to the prediction, the actual genitive plural is [kite].

Antifaithfulness has the same effect as successive applications of an α-rule. For example, if both the Genitive and Plural were expressed by a rule [αvoice] → [−αvoice], /kidi+GEN+PL/→[kit+PL]→[kide].

The back-and-forth effect does not happen in the featural morpheme approach developed in section 3 (see sec.3.7). It also does not happen with MORPHDISF. For MORPHDISF, /kidi+[−voice]/ will produce [kiti], and /kidi+[−voice]+[+voice]/ will also produce [kiti]. In all inputs with two or more morphemes with [αF] and two or more morphemes with [−αF], MORPHDISF will return the same set of violation marks, so other faithfulness or markedness constraints will determine the winner. The 'back-and-forth' cannot apply in Stonham's Class theory either as successive applications of rule (24) have the same effect as a single application.

In short, anti-faithfulness predicts that the value of [voice] will switch back and forth for each anti-faithfulness-inducing morpheme: i.e. [kidi] (nom.) ~ [kit] (gen.) ~ [kide] (gen.pl.). This prediction is not borne out in Dholuo; the genitive plural of [kidi] is [kite], as is the nominative plural. However, for a valid case of morpho-phonological polarity, if anti-faithfulness or α-notation is the right way to analyze it one should expect to see the 'back-and-forth' effect.

For further discussion of antifaithfulness and polarity, see Wolf (2005b:25ff).

5.5 Morphological Polarity

If MORPHDISF, alpha notation, marked/unmarked class reference, and anti-faithfulness were all excluded from the grammar, it would still be possible for morpho-phonological polarity to appear (on the surface).

Suppose that, following Stonham's approach, there are two classes of words in a language (call it 'Dholuo-Prime'). Suppose that Class I has a singular suffix /-Ç̥/ that induces devoicing and a plural suffix /-Ç̬ɛ/ that induces voicing, while class II has a singular suffix /-Ç̬/ and plural /-Ç̥ɛ/. The effect would look like morpho-phonological polarity. Table (27) shows that regardless of the [voice] value of the underlying consonant, Class I forms surface with a [−voice] consonant in the singular and a [+voice] one in the plural; the opposite is true of Class II forms.

(27) *Class behavior and complementary morphological exponence*

		/ot/	/od/
Class I	Singular /-Ç̥/	ot	ot
	Plural /-Ç̥ɛ/	odɛ	odɛ
Class II	Singular /-Ç/	od	od
	Plural /-Ç̥ɛ/	otɛ	otɛ

It is undesirable to attempt to exclude such a situation by a grammatical principle. It is undeniable that roots can fall into different classes and can take different suffixes as a result. In Dholuo, for example, some roots take the *–ni* plural while others take *-ɛ*. There is nothing inherently ill-formed about any of the underlying singular and plural forms in either class. Therefore, the situation sketched above should be possible.

However, this is not true morpho-phonological polarity in the sense that it involves *distinct* morphemes, not the same morpheme. Morpho-phonological polarity is supposed to involve mappings /α/→[β] and /β/→[α] in the same morphological environment (i.e. in the context of the same morpheme). In (27), there is no individual morpheme which forces /+voice/ to surface as [–voice] and /–voice] to become [+voice]. Nevertheless, the surface effect is the same. It is quite likely that such a system is not viable – i.e. not stable in language transmission. It is possible that learners would easily confuse such a system for one in which the Singular is ∅ and there are two plurals: one which caused devoicing and one which forced voicing. If a new word like [bod] entered as Class I, it would have the singular [bod] and plural [bodɛ], destroying the fragile appearance of morpho-phonological polarity.

6. Morphological and Phonological Polarity

Morphological polarity is different from morpho-phonological polarity (see Baerman 2007 and Lahne 2008 for the most recent and comprehensive discussions). Gender marking in Hebrew shows morphological polarity: while –a marks feminine in adjectives, it marks masculine for numerals; -∅ marks masculine for adjectives and feminine for numerals.

(28) *Gender-marking in Hebrew (Baerman 2007:34)*

	Masculine	Feminine
Adjectives	-∅ davar-∅ tov-∅ word(M)-SG good-M	-a tmun-a tov-a picture(F)-SG good-F
Numerals	-a ʃloʃ-a dvar-im three-M word(M)-PL	∅ ʃaloʃ-∅ tmun-ot three-F picture(F)-PL

Morphological polarity differs from morpho-phonological polarity because there is no phonological process involved. It is not even clear that there is any generative process occurring, whether phonological or morphosyntactic. Morphological polarity can be expressed by having distinct morphemes with different subcategorization requirements. In Hebrew, there would be four morphemes: a morpheme /-∅/ that attaches to [−FEMININE] adjectives, an /-a/ that attaches to [−FEMININE] numerals, a /-∅/ that attaches to [+FEMININE] numerals, and an /-a/ that attaches to [+FEMININE] adjectives. This purely lexical approach would not capture the fact that the masculine morpheme for numerals is [-a] and the feminine for adjectives is [-a], but it is not clear to me that such a generalization is something that the grammar should capture by generative means.

The connection between morphological polarity and morpho-phonological polarity is that morphological polarity can seem to give rise to morpho-phonological polarity (see sections 5.1, 5.5).

Phonological polarity is where /α/→[β] and /β/→[α] regardless of morphological context. They can be more elaborate with the same effect: e.g. /α/→[β], /β/→[γ], and /γ/→[α]. Such mappings have also been called 'circular chain shifts' (Moreton 2004). There is a connection between phonological polarity and morpho-phonological polarity: if phonological polarity exists, then a morpheme-specific version of it may necessarily be possible.

Anderson & Browne (1973) and Moreton (2004) discuss several putative cases of phonological polarity and circular chain shifts, and argue that they are not in fact attested. Anderson & Browne argue that all phonological chain shifts are actually morpho-phonological ones, which this chapter suggests requires even further scrutiny.

The most recent work to argue for phonological polarity is Fitzpatrick, Nevins, and Vaux (2004) which discusses vowel alternations in Zok Armenian and Flemish Brussels Dutch. The Zok Armenian data presented are complex, and careful evaluation is beyond the scope of this chapter. Moreton (2004) examines the Brussels Flemish data and argues that there is no phonological polarity; the alternations actually involve [oː]~[u] and [uː]~[ɔ] (not, as reported elsewhere, [oː]~[u] and [uː]~[o]).

Without a doubt, demonstrating that there is phonological polarity would have an impact on whether there is morpho-phonological polarity or not. However, at this point in time there has not been a conclusive demonstration that phonological polarity exists.

7. Conclusions

Morpho-phonological polarity involves mappings /α/→[β] and /β/→[α] in the same phonological environment and morphological environment. Along with Trommer (2006, 2007, 2008a,b) and Bye (2006), this chapter has argued that the most well known case – Dholuo – does not have morpho-phonological polarity. In the Plural, the following generalizations emerged for the voicing of oral stops (Ç is a voiced oral stop):

(29) *Dholuo plural generalizations for oral stops*

UR	Plural	Example			
/…C̥/	…C̥ɛ	/ip/	→	[ipe]	‘tail’
/…C̬/	…C̬ɛ	/ærib/	→	[æribe]	‘Milky Way’
/…C̥V/	…C̥ɛ	/cupæ/	→	[cupe]	‘bottle’
/…C̬V/	…C̬ɛ	/kitæbu/	→	[kitepe]	‘book’

For C-final roots, there is no exchange of [voice] values: the underlying value surfaces faithfully. For V-final roots, there is no exchange of [voice] values: [+voice] becomes [−voice], but [−voice] remains [−voice].

The discussion about Dholuo here suggests that other cases cited as showing morpho-phonological polarity deserve greater scrutiny. If there are no such cases and morpho-phonological polarity is shown to be impossible to generate, then a number of theoretical devices need to be re-evaluated, such as constraints that demand distinct morph realization, anti-faithfulness, and class behavior coupled with reference to ‘unmarked’ features.

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