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Vowel Harmony and Cyclicity in Eastern Nilotic*

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0. Abstract

Vowel harmony in the Eastern Nilotic languages Maasai (Tucker & Mpaayei 1955) and Turkana (Dimmendaal 1983) is dominant-recessive: a [+ATR] vowel in either a root or a suffix causes all other vowels in the word to become [+ATR]. The phonemic low vowel in both of these languages behaves differently depending on its position in the word relative to the source of [+ATR], a fact that has previously been accounted for by two directional [+ATR] spreading rules subject to distinct conditions (Archangeli & Pulleyblank 1994, Albert 1995). I propose instead that the distinction between these two directions of harmony is (indirectly) determined by the cycle, and that harmony is due to a single bidirectional mechanism. A cyclic account makes a number of nontrivial and restrictive predictions that a directional account does not. First, a grammar in which the conditions on the two directions of harmony are somehow reversed is predicted not to exist. Second, the cyclic account crucially depends on the indirect blocking of harmony by another process that respects the cycle, and so the absence of such a process entails the absence of a directional asymmetry. Third, a grammar in which harmony only operates in one direction and not the other is predicted not to exist. Finally, only the cyclic account can readily handle a set of additional facts in Turkana.

1. Background: Stem Control vs. Dominance¹

Research on vowel harmony has revealed that there are two basic types of vowel harmony systems, stem-controlled and dominant-recessive. In stem-controlled systems, the harmonic feature value of an affix vowel is dependent on the harmonic feature value of the adjacent vowel in the stem to which the affix is at-

* I thank Sharon Rose, Colin Wilson, and audiences at BLS, UCLA, and UCI for helpful comments on some of the contents of this paper. This work is an outgrowth of my Rutgers University dissertation (Baković 2000), so those thanked there are also thanked here. Errors are mine.

¹ Here and throughout, ‘stem’ refers to any morphological constituent to which an affix may attach; ‘root’ refers to the innermost such constituent, the ultimate stem of affixation. Where the distinction between them is irrelevant, I refer to the ‘root/stem’.

tached. The vowel of the affix closest to the root changes to agree with the adjacent root vowel, the vowel of the next closest affix changes to agree with the adjacent vowel of the closest affix, and so on. Some examples are given in (1).²

(1) Stem-controlled vowel harmony

Akan (Niger-Congo, Kwa; Schachter & Fromkin 1968)

a. /E + √bu + O/ → [ebuo]
CLASS + nest + SFX 'nest'

b. /E + √bu + O/ → [ɛbuo]
CLASS + stone + SFX 'stone'

Tangale (Afro-Asiatic, W. Chadic; Kidida 1985)

c. /√tug + O/ → [tugo]
pound + NOM 'pounding'

d. /√wud + O/ → [wudo]
farm + NOM 'farming'

In dominant-recessive systems, the harmonic feature value of all vowels in the domain of harmony (here, the word) is dependent on whether or not one of them is underlyingly specified for the 'dominant' value of the harmonic feature, [αhf]. If any vowel (stem or affix) is [αhf], then all vowels surface as [αhf]; if all are [$-\alpha hf$] ('recessive'), then all surface unchanged as [$-\alpha hf$]. Examples from the two Eastern Nilotic languages that are the focus of this paper are given in (2).

(2) Dominant-recessive vowel harmony

Maasai (Tucker & Mpaayei 1955, Archangeli & Pulleyblank 1994)

a. /kI + √norr + u/ → [kinorru]
1PL + love + EF 'we shall love'

b. /√isuj + iʃɔ + re/ → [isujiʃore]
wash + INTRANS + APPL 'wash with something!'

Turkana (Dimmendaal 1983, Albert 1995)

c. /ɛ + √los + I/ → [elosi]
3 + go + ASP 's/he will go'

d. /ɛ + √koko + un + I + o/ → [ekokonio]
3 + steal + VEN + IMP + PL.PASS 'they are being stolen'

In Akan and Tangale (1), root/stem vowels are constant while affix vowels vary in terms of the harmonic feature [$\pm ATR$]. In Maasai and Turkana (2), both stem and affix vowels potentially vary in terms of the harmonic feature [$\pm ATR$], depending on whether or not any other vowel in the word underlyingly bears the dominant

² In these and other examples, the radical symbol '√' indicates the root morpheme, and capital letters represent vowels whose underlying specification for the harmonic feature cannot be determined. Underlining in underlying forms indicates the vowel instigating harmony, and in surface forms it indicates the propagation of the harmonic feature throughout the word.

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value [+ATR]: if so, then all vowels change if necessary to surface as [+ATR]; if not, all vowels surface with their underlying recessive value [−ATR].

I have argued elsewhere (Baković 2000) that the fundamental difference between stem-controlled harmony and dominant-recessive harmony is one of *cyclicity*, as defined in (3) below. (Note that this definition is purposely agnostic as to the particular theoretical mechanism that is employed to account for it.)

- (3) A phonological process is *cyclic* iff it systematically fails to apply to stems of affixation.

Stem-controlled harmony processes are cyclic because disharmony between stem and affix vowels is systematically resolved by changing the harmonic feature value of the affix vowels, not the stem vowels. On the other hand, dominant-recessive harmony processes are *noncyclic*, because disharmony between stem vowels and affix vowels is resolved sometimes by changing affix vowels and sometimes by changing stem vowels. In a dominant-recessive harmony system, vowels with the dominant feature value are the instigators of harmony; in a stem-controlled harmony system, cyclicity determines the instigator.

The cyclic approach to stem-controlled vowel harmony has a number of advantages over the familiar standard approach involving processes of directional feature propagation, two of which I briefly point out here. (For further arguments for and elaboration of the cyclic approach to stem-controlled vowel harmony, see Baković 2000, 2001.) First, harmony is never systematically determined by a morphological unit other than the root/stem; the claim that stem control is due to cyclicity explains this fact. Second, it is explained why vowel harmony is only (apparently) directional in a language when that language has only suffixes or only prefixes: harmony seems to come from the left when there are only suffixes, because the root/stem is always on the left; harmony seems to come from the right when there are only prefixes, because the root/stem is always on the right.

2. Harmonic Pairing

The above descriptions of stem-controlled and dominant-recessive systems are generally accurate under what one might call ‘ideal’ conditions where at the very least each of the vowels in the word is *harmonically paired*, as defined in (4).

- (4) A vowel x in (the vowel inventory of) a language L with a harmonic feature $[\pm hf]$ is *harmonically paired* iff there is another vowel in L that differs from x only in terms of $[\pm hf]$.

For example, in the languages in (1) and (2), all high and mid vowels are harmonically paired but the low vowel is not, because the low vowel is [−ATR] and there is no [+ATR] low vowel.³ This situation is depicted graphically in (5); arrows between vowels indicate a harmonic pairing relationship.

³ Akan has such a vowel in (gradient) postlexical contexts (Clements 1981, Kiparsky 1985).

(5) Harmonic pairings in Akan, Tangale, Maasai, and Turkana

	[-back]		[+back]		
high vowels	i	ɨ	ɔ	u	[+ATR]
	ɪ	ɨ	o	ɯ	[-ATR]
mid vowels	e	ɛ	ɔ	o	[+ATR]
	ɪ	ɛ	o	ɯ	[-ATR]
low vowel			a		[-ATR]

When there is a harmonically unpaired vowel in a word, it can exhibit one of a small number of properties due to the application of vowel harmony. One property is what is known as *opacity*. An opaque vowel is a harmonically unpaired vowel that blocks the propagation of vowel harmony, whether harmony is instigated by a root/stem vowel or by a (dominant) affix vowel. If the harmony-instigating vowel and an opaque vowel have different values of the harmonic feature, then they surface with those different values, resulting in a (predictably) disharmonic form as defined precisely in (6) below.

- (6) Let x be any vowel and y be the vowel in any word instigating $[\pm hf]$ harmony. x is *opaque* iff (a) x is not harmonically paired, (b) a harmonically paired vowel between x and y agrees with y in terms of $[\pm hf]$, and (c) a harmonically paired vowel on the side of x opposite y agrees with x .⁴

Examples of opacity from each of the four languages in (1) and (2) are given in (7). In all four languages, the phonemic low vowel /a/ is opaque; specifically, this [-ATR] vowel blocks the propagation of [+ATR].

(7) Examples of opacity (harmonically unpaired opaque vowel is *italicized*)

Akan	/O + √bɪsɪa + ɪ/ 3SG + ask + PAST	→ [obɪsɪaɪ] 'he asked (it)'
Tangale	/√pɛɛr + na + n + gO/ compel + -PRX.LOC + 1SG + PERF	→ [pɛɛrnɔŋgɔ] 'compelled me'
Maasai	/ɛ + √ɪput + a + ri + ie/ 3SG + fill + MA + N + APPL	→ [ɛɪputariɪie] 'it will get filled up'
Turkana	/a + √pɛg + aa + n + u/ GEN + deny + HAB + SG + NOM	→ [apɛgaanu] 'denial'

A second property that a harmonically unpaired vowel can exhibit due to the application of vowel harmony is *transparency*, which is just like opacity except that vowels on the side of the transparent vowel opposite the harmony-instigating vowel harmonize with the instigator, not the opaque vowel. None of the languages under discussion here exhibit transparency, and so I will not discuss it further.⁵

⁴ Note that this definition needn't presuppose that the opaque vowel (x) and the harmony instigator (y) have different values of the harmonic feature $[\pm hf]$. If they happen to have the same value in some word, then there is simply no disharmony to speak of.

⁵ See Baković & Wilson (2000) on the approach to transparency that I advocate.

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A third property that a harmonically unpaired vowel can exhibit due to the application of vowel harmony is what I call *re-pairing*. A re-paired vowel is a harmonically unpaired vowel that, unlike an opaque or transparent vowel, does alternate as otherwise expected under harmony between a [+*hf*] vowel and a [–*hf*] vowel. However, since a re-paired vowel is harmonically unpaired, the two alternants of a re-paired vowel differ with respect to at least one feature besides [+*hf*].

- (8) Let *x* be an [+*hf*] vowel and *y* be the vowel in any word instigating [+*hf*] harmony. *x* is *re-paired* iff (a) *x* is not harmonically paired, (b) *x* alternates, in agreement with *y*, with a [–*hf*] vowel *z*, and (c) there exists a feature [+*f*] such that (i) [+*f*] ≠ [+*hf*], (ii) *x* is [+*f*], and (iii) *z* is [–*f*].

Re-pairing alternations due to vowel harmony are not at all uncommon. In Diola Fogy (Sapir 1965), the [+low] vowel [a] alternates with the [–low] vowel [ə] under dominant-recessive [+ATR] harmony; in Yokuts (Newman 1944), the [–back] vowel [i] and the [+back] vowel [u] alternate under stem-controlled [+round] harmony; and in Turkish (Underhill 1976), the [+low] vowel [a] and the [–low] vowel [e] alternate under stem-controlled [+back] harmony.

Of particular interest here is the fact that Maasai and Turkana exhibit re-pairing in addition to opacity. The same harmonically unpaired low vowel /a/, which was shown to sometimes be opaque in (7), is also sometimes re-paired, alternating between a [+low, –ATR] vowel [a] and a [–low, +ATR] vowel [o].⁶ The re-pairing alternation is found in contexts distinct from the opacity contexts in (7); specifically, a suffixal /a/ is re-paired when a [+ATR] instigator of harmony is in the stem of suffixation of the /a/ (i.e., to the left of the /a/), whereas /a/ is opaque when all [+ATR] instigators are in suffixes outside the stem of suffixation of the /a/ (i.e., to the right of the /a/). Examples of this alternation are given in (9).

- (9) Examples of re-pairing

a.	Maasai	/ɪn + √mudɔŋ + a/ FEM.PL + noun + PL	→	[imudɔŋo] 'kinship'
	Turkana	/ɛ + √pup + aa + n + a/ 3 + obey + HAB + SG + VOI	→	[epupooŋo] 's/he is obedient'
b.	Maasai	/ɪn + √lɪpɔŋ + a/ FEM.PL + noun + PL	→	[ɪlɪpɔŋa] 'full-grown female'
	Turkana	/ɛ + √pɛg + aa + n + a/ 3 + argue + HAB + SG + VOI	→	[ɛpɛgaana] 's/he is argumentative'
c.	Maasai	/ɛ + √ɪput + a + rɪ + ɪe/ 3SG + fill + MA + N + APPL	→	[ɛɪputariyie] 'it will get filled up'
	Turkana	/a + √pɛg + aa + n + u/ GEN + deny + HAB + SG + NOM	→	[apegaanu] 'denial'

⁶ There is an additional difference in terms of [+round] between the alternants that I ignore here in the interests of clarity. Everything I say about [+low] applies to [+round] as well.

The examples in (9a) show that an /a/ in a suffix surfaces re-paired as [o] when preceded by a [+ATR] instigator in the root/stem. The minimally different examples in (9b) show that this surface mid vowel does in fact alternate with the low [-ATR] vowel [a] when it is *not* preceded by a [+ATR] instigator. Finally, the examples of opacity in (9c), repeated from (7), show that re-pairing only occurs when a suffix /a/ is preceded, and not when only followed, by a [+ATR] instigator.

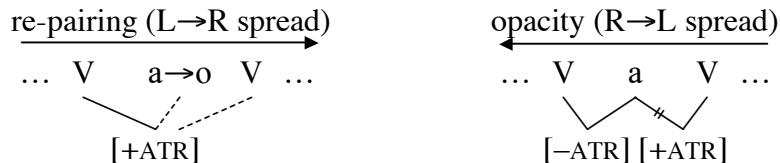
My focus in this paper is on the best explanation for the predictably asymmetrical behavior of /a/ in Maasai and Turkana just exemplified. I outline two approaches to this asymmetry, each making different claims as to its source: one in terms of directionality and the other in terms of cyclicity (as defined in (3) above). I then offer four arguments for the explanatory superiority of the cyclic approach.

3. Analytical Approaches

In this section I consider two basic analytical approaches to the question of what determines whether a suffixal /a/ is re-paired or opaque in Maasai and Turkana. One is a cyclic approach: whether /a/ is re-paired or opaque depends on whether or not a harmony instigator is *in the stem of suffixation of the /a/*. The other is a directional approach: whether /a/ is re-paired or opaque depends on whether or not a harmony instigator is *to the left of the /a/*.

Consider first the directional approach, advanced by (among others) Archangeli & Pulleyblank (1994) for Maasai and Albert (1995) for Turkana. Under this approach there are two [+ATR] harmony processes, one operating from left to right and the other from right to left. Unlike the left-to-right process, the right-to-left one is subject to some condition preventing its application to /a/.⁷ Thus, only the left-to-right process can cause re-pairing of /a/, while /a/ is opaque with respect to the right-to-left process. This is depicted graphically in (10).

(10) Re-pairing vs. opacity under the directional (spreading) approach



Under the cyclic approach, there is a difference in cyclicity between harmony and re-pairing. The harmony process itself is noncyclic, since it is dominant-recessive; a dominant [+ATR] suffix vowel can and does cause the vowel(s) of the stem to which it is suffixed to change (if necessary) to [+ATR]. However, whether a suffixal /a/ will be opaque or re-paired crucially depends on the cycle. The re-

⁷ This could be a condition on the (immediate) product of the process were it to apply to /a/ (e.g., a grounding condition against low [+ATR] vowels; Archangeli & Pulleyblank 1994:309) or one on the overall mapping from /a/ to [o] that would be necessary if the process were to apply to /a/ (a faithfulness constraint against changing the value of the feature [±low]; Albert 1995).

pairing process by which a suffixal /a/ becomes [o] — i.e., the change in [\pm low] in addition to the harmonic change in [\pm ATR] — only occurs under compulsion of harmony from the stem of suffixation, never under compulsion of harmony from a later suffix. So, if the /a/ is a part of a suffix attached to an already [+ATR] stem, then the /a/ is re-paired to [o]; if the /a/ is a part of a [-ATR] stem to which a suffix with an [+ATR] harmony instigator is suffixed, then the /a/ is opaque.

Empirically, the two approaches just outlined agree on the facts in (9). However, there are at least four arguments in favor of the cyclic approach. I discuss each of these arguments in turn in the next section.

4. Four Arguments for the Cyclic Approach

4.1. One: The Position of /a/ Relative to the Harmony Instigator

The first argument is that the cyclic approach predicts rather than stipulates the correct relationship between (i) suffixal /a/ being re-paired vs. opaque and (ii) the position of suffixal /a/ relative to a harmony instigator. Under the cyclic approach, the re-pairing process (the change in [\pm low]) is cyclic while the harmony process (the change in [\pm ATR]) is not. From this it follows that when a suffixal /a/ and its stem of suffixation disagree in [\pm ATR], the incompatibility will be resolved by effecting changes (those of harmony and re-pairing) on the suffixal /a/. However, a suffixal /a/ will not be re-paired when it only disagrees in [\pm ATR] with a following suffix; since /a/ is still harmonically unpaired, it will be opaque.

This does not follow directly from the directional approach. Under the directional approach, it is an arbitrary fact of the two directional harmony processes which one causes re-pairing of /a/ and which one doesn't. Consider the reverse situation, that the left-to-right process is subject to a condition preventing its application to /a/ whereas the right-to-left process is unencumbered. This would allow one to generate a pattern that is essentially the opposite of the pattern found in Maasai/Turkana — a pattern in which /a/ is re-paired where it is opaque in Maasai/Turkana and vice-versa. No such pattern seems to be attested.

There is thus an important typological consequence here: the pattern just described is predicted to be an impossible one under the cyclic approach. This is because re-pairing can be either cyclic or noncyclic. If it is cyclic, then we get the Maasai/Turkana pattern; if it is non-cyclic, then we get a pattern in which /a/ is always re-paired.⁸ The directional approach predicts these two patterns in addition to the unattested pattern described above. The way in which each of the three patterns is (or is not) predicted under the two approaches is summarized in (11).

⁸ This pattern corresponds to Diola Fogny (Sapir 1965), where low [a] alternates with mid [ə].

(11) Typological predictions of the two approaches

	<i>Pattern</i>	<i>Directional approach</i>	<i>Cyclic approach</i>
a.	Maasai/Turkana	right-to-left harmony cannot apply to /a/	re-pairing is cyclic
b.	/a/ always re-paired	both harmony processes can apply to /a/	re-pairing is noncyclic
c.	the opposite of Maasai/Turkana	left-to-right harmony cannot apply to /a/	impossible

A fourth pattern, one in which /a/ is always opaque, is predicted to exist by both approaches: under the directional approach, neither harmony process can apply to /a/; under the cyclic approach, one simply does not posit a re-pairing process in the first place. I do not at present know whether this prediction is attested.

In sum, the cyclic approach makes a desirably more restrictive claim than does the directional approach about the typology of possible dominant-recessive harmony patterns, and is therefore to be preferred.

4.2. Two: Interaction of Harmony and Re-pairing

The second argument for the cyclic approach has to do with the interaction between harmony and re-pairing. Under the cyclic approach, it is crucial that there be a process in addition to harmony that can be said to be cyclic, since harmony itself is dominant-recessive and therefore noncyclic. As noted above, /a/ is predicted to always be opaque if there is no re-pairing process. So, again, there is a restrictive typological consequence to the cyclic approach: a pattern just like that of Maasai/Turkana except that /a/ is not re-paired is predicted not to exist.

Under the directional approach, on the other hand, it is simply an accident that an /a/ which undergoes left-to-right harmony also undergoes re-pairing. It could just as simply have undergone harmony and surfaced as a low [+ATR] vowel. This is precisely because there are two separate harmony processes under the directional approach; the fact that both of them fail to create a low [+ATR] vowel, one via opacity and the other via re-pairing, is completely accidental.

4.3. Three: Two Directions of Harmony

The third argument in favor of the cyclic approach is the fact that it predicts rather than stipulates why harmony applies in both directions rather than in just one. The two ‘directions’ of harmony are only *apparent* under the cyclic approach, being distinguished by the cycle itself. Harmony processes can therefore be claimed to be inherently bidirectional, which Clements (1976 *et seq.*) originally argued is the right claim to make. Under the directional approach, there is no principled reason why Maasai and Turkana have two [\pm ATR] harmony processes in the first place, one applying in one direction and the other applying in the other direction. The

two processes are completely independent of one another, and so the prediction is that a grammar could have just one of these two independent processes, applying harmony in only one direction. Languages with unidirectional vowel harmony systems — that is, without any morphological motivation such as stem control coupled with a lack of prefixes — do not seem to exist.⁹

4.4. Four: Additional Evidence for Cyclicity in Turkana

So far I have offered what I consider to be three typological arguments for the cyclic approach: the set of possible patterns predicted by this approach are restricted in three ways that both explain crucial aspects of the facts at hand and appear to be typologically desirable. The fourth and final argument for the cyclic approach concerns an interesting additional set of facts from Turkana. These facts independently require that the re-pairing process be cyclic, as originally pointed out by Dimmendaal (1983:23ff; see also Albert 1995) and thus the burden of proof rests on the directional approach: since cyclicity is independently necessary, there appears to be no need for directional harmony processes.¹⁰

Even though [+ATR] vowels are the usual harmony instigators of Turkana, there is a small set of suffixes with a [–ATR] vowel such that when one of them is suffixed to a stem with an otherwise dominant [+ATR] vowel, the suffix vowel causes the [+ATR] vowel to become [–ATR]. The “anti-dominant” behavior of one of these suffixes is shown in (12) below; note that even the usually dominant [+ATR] vowels of the root ‘give birth’ surface as [–ATR].¹¹

(12) “Anti-dominant” [–ATR] harmony in Turkana

/a + k + <u>√ido</u> + un + <u>ɛt</u> /	→	[<u>akidounɛt</u>]
GEN + K + give birth + VEN + INST-LOC		‘birth’

Of immediate interest is the interaction between one of these anti-dominant [–ATR] suffix vowels and a dominant [+ATR] vowel when there is an /a/ between them. Relevant examples are given in (13). The first two examples establish that the suffix vowel glossed as ‘E’ is an /a/ that (expectedly) surfaces re-paired as [o] when suffixed to a root like ‘drop’ with dominant [+ATR] vowels.¹² The example in (13b) is also the stem of suffixation for the anti-dominant suffix glossed as

⁹ I am not well acquainted with harmony processes limited to morphophonological domains smaller than the word, such as height harmony in some Bantu languages. If these show some evidence of directionality independent of the cycle, one would want to examine these domains to see if the mechanisms responsible for their existence might help to explain the apparent directionality.

¹⁰ Levergood (1984) argues for the cycle in her analysis of Maasai vowel harmony, but not with respect to re-pairing; see Levergood’s work as well as Baković 2000 (esp. pp. 232-236) for details.

¹¹ Double underlining indicates the [–ATR] suffix vowel and its effect on the rest of the word.

¹² The gloss ‘E’ stands for ‘epipatetic vowel’. According to Dimmendaal (1983:203-204), this suffix is phonologically regular but serves no morphosyntactic function, though it probably once did (like the ‘moveable *k*’ prefix, glossed here as ‘K’).

‘VOI’ in (13c). Note what happens in this last example: all vowels are [−ATR], and the vowel of the ‘E’ suffix surfaces not as [a] but as [ɔ].

(13) Dominance, anti-dominance, and /a/ in Turkana

- | | | | |
|----|---|---|-----------------------------------|
| a. | $/a + k + \sqrt{\text{ipud}} + a + \text{kin}/$ | → | $[\text{akipudakɪn}]$ |
| | GEN + K + trample + E + DAT | | ‘to trample’ |
| b. | $/\varepsilon + \sqrt{\text{ibus}} + a + \text{kin}/$ | → | $[\text{eibusokɪn}]$ |
| | 3 + drop + E + DAT | | ‘it has fallen down’ |
| c. | $/\varepsilon + \sqrt{\text{ibus}} + a + \text{kin} + \underline{a}/$ | → | $[\underline{\text{eibusokina}}]$ |
| | 3 + drop + E + DAT + VOI | | ‘it has thrown itself down’ |

The analysis of these facts under the cyclic approach is straightforward. In the cyclic direction, [+ATR] harmony causes the /a/ of the ‘E’ suffix to become [+ATR] because it can be cyclically re-paired, as in (13). This form serves as the stem of suffixation for the ‘VOI’ suffix with the anti-dominant [−ATR] vowel in (13). The disagreement between the anti-dominant vowel and the vowels in the stem of suffixation is resolved in favor of the anti-dominant vowel, which is possible in Turkana because harmony is noncyclic. However, since re-pairing is cyclic, the vowel of the ‘E’ suffix cannot be changed back to [a]. [−ATR] harmony in the anti-cyclic ‘direction’ can thus *only* produce [ɔ] under these circumstances.

The correct result is also possible under the directional approach, but *if and only if* left-to-right harmony is *crucially ordered* before the process responsible for anti-dominant [−ATR] harmony. When left-to-right harmony applies, the low vowel of the ‘E’ suffix is re-paired, becoming [+ATR, −low]; then [−ATR] harmony applies, changing this vowel back to [−ATR] but not back to [+low]. The result is thus the correct vowel [ɔ]. The directional analysis thus has two related disadvantages when compared with the cyclic analysis. First, the facts in (13) must be stipulated (via extrinsic ordering) under the directional analysis, whereas they follow automatically from the cyclic analysis (via the intrinsic ordering imposed by the cycle). Second, the directional analysis presupposes a theory in which processes may be extrinsically ordered with respect to each other, whereas the cyclic analysis is also compatible with a theory that only countenances intrinsic ordering imposed by the cycle. The cyclic analysis is clearly to be preferred.

5. A Fly in the Ointment

There is an empirical difficulty with the cyclic approach that should be noted, however. The directional and cyclic approaches agree on the facts in (9) but differ in their predictions of the behavior of /a/ in prefixes. The directional approach predicts that an /a/ in a prefix will be re-paired only if a harmony instigator is somewhere to the left of it (i.e., in a preceding prefix). If the only harmony instigator(s) is/are somewhere to the right of it (in a following prefix, root, or suffix), it will be opaque. The cyclic approach, on the other hand, makes essen-

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tially the opposite prediction. An /a/ in a prefix will be re-paired if a harmony instigator is in the stem of prefixation; i.e., in a following prefix or root (or even in a suffix, if suffixed hierarchically ‘inside’ the prefix). If the only harmony instigator(s) is/are in a preceding prefix (or in a suffix, if suffixed hierarchically ‘outside’ the prefix), the /a/ is predicted to be opaque.

It seems that the directional approach is consistent with the full set of facts in these two languages, while the cyclic approach would need to be augmented somehow. Specifically, a prefixal /a/ is opaque when a harmony instigator is anywhere to the right of it, as shown by the data in (14) below.

(14) Opacity in prefixes

Maasai	a.	$/a + \sqrt{r\acute{o}k} + \underline{u}/$	→	$[a\underline{r\acute{o}k}u]$	
		1SG + black + INCEP			‘I become black’
	b.	$/a + \sqrt{d\acute{u}ŋ} + ak\acute{ı}n + \underline{ie}/$	→	$[a\underline{d\acute{u}ŋ}ok\acute{ı}nie]$	
		1SG + cut + DAT + APPL			‘s/he will hide him/herself’
Turkana	c.	$/a + \sqrt{l\acute{i}l\acute{i}m} + \underline{u}/$	→	$[a\underline{l\acute{i}l\acute{i}m}u]$	
		GEN + cold + NOM			‘coldness’
	d.	$/a + \sqrt{t\acute{u}r} + a\acute{a}n + \underline{a}/$	→	$[a\underline{t\acute{u}r}o\acute{o}nu]$	
		GEN + agile + HAB + NOM			‘agility’

There is an important systematic gap in the facts to consider, however: there are no dominant prefix vowels in either of these languages; that is, no prefix vowel is ever a harmony instigator. So, what happens to a prefixal /a/ when there is a harmony instigator preceding it, or one in a following prefix, cannot be tested. Given only the facts in (14), then, the problem with the cyclic approach amounts to the following: /a/ is never re-paired in prefixes, even though it is expected to be based on the behavior of /a/ in suffixes. Therefore, the solution to this problem is to somehow limit the re-pairing process to apply only in suffixes. Such a solution would ideally be derivable from independently necessary principles. Maasai and Turkana are not alone in having no dominant prefix vowels; it appears that *no* language with dominant-recessive harmony has dominant prefix vowels. While I do not know of (and do not offer) a principled account of this apparent universal, the unexpected behavior of prefixes more generally is clearly a vital area of further research into the problems posed by and related to the facts in (14).

6. Conclusion

I hope to have convinced the reader that there are more and stronger arguments for a cyclic as opposed to a directional approach to the asymmetrical behavior of /a/ in Maasai and Turkana. Since three of the four arguments presented rest on the restrictive typological claims made by the cyclic approach, it remains to be seen whether future research in this area will confirm or refute those arguments.

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