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[ATR] HARMONY IN TURKANA: A CASE OF FAITH SUFFIX >>
FAITH ROOT

ABSTRACT. This paper explores the consequences of [ATR] harmony in Turkana for the theory of positional faithfulness (Beckman 1997; McCarthy and Prince 1995). I argue that faithfulness to an underlying suffix value ranks higher than faithfulness to an underlying root value. This argument is based on the existence of a set of invariant [+ATR] and a set of invariant [–ATR] suffixes. These suffixes fail to agree with a preceding root in tongue root position and instead impose their tongue root specification on any vowel that precedes them, subject to the markedness constraints *HI/RTR and *LO/ATR. The invariant suffixes of Turkana are therefore characterized by two of the properties Beckman (1997) lists as typical of linguistically privileged positions: they resist and they trigger the application of a phonological process. I conclude that suffix position must be recognized as linguistically salient in Turkana and submit that root faithfulness does not outrank affix faithfulness universally, as suggested by McCarthy and Prince (1995).

1. INTRODUCTION

This paper explores the consequences [ATR] harmony in Turkana for the theory of positional faithfulness (McCarthy and Prince 1995; Alderete 1995; Beckman 1997; Casali 1997; Hyman 1998). Positional faithfulness is based on the observation that there are a small number of linguistically salient positions which include root-initial syllables, stressed syllables, syllable onsets, long vowels, and roots, as opposed to affixes. Linguistically prominent positions enjoy special status in language processing in that they (i) show a greater range of contrasts, (ii) trigger the application of phonological processes, and (iii) resist the application of phonological processes that take place in non-prominent positions. Positional Faithfulness theory aims to unite these observations analytically by proposing a set of constraints which require segments in phonologically prominent positions to show greater faithfulness to their underlying feature specification than

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segments in non prominent positions. Positional faithfulness constraints are captured by Beckman as follows:

(1) IDENT-*Position*(F)

Let β be an output segment in a privileged position P and α the input correspondent of β . If β is $[\gamma F]$, then α must be $[\gamma F]$.

‘Correspondent segments in a privileged position must have identical specifications for [F]’.

If positional faithfulness constraints rank higher than the wellformedness constraints $\mathbb{C}$ and the context-free faithfulness constraints IDENT(F) (2), then elements in phonologically prominent positions fail to alternate, while elements in non-privileged positions alternate according to the demands of $\mathbb{C}$. $\mathbb{C}$ in (2) below stands for any constraint that causes alternations, such as the markedness constraint *HI/RTR or the alignment constraint ALIGN-R ([ATR], PrWd).

(2) Ranking schema, positional phonological asymmetries (Beckman 1997)

IDENT-*Position*(F) $\gg$ $\mathbb{C}$ $\gg$ IDENT(F)

McCarthy and Prince (1995) account for the privileged status that roots seem to possess cross-linguistically by universally placing root faithfulness over affix faithfulness, as expressed by the meta-constraint in (3).

(3) Meta-constraint on constraint ranking (McCarthy and Prince 1995)

Root Faith $\gg$ Affix Faith

It is this last claim, the universality of root faithfulness over affix faithfulness, that is at issue in this paper. I argue with the example of tongue root harmony in Turkana¹ that faithfulness to an underlying suffix value can rank higher than faithfulness to an underlying root value: Suffix Faith $\gg$ Root Faith. The argument is based on the fact that Turkana roots change their underlying tongue root specification in agreement with the value of a following, specified suffix: a [−ATR] root surfaces as [+ATR] if followed by a [−ATR] suffix, while a [+ATR] root surfaces as [−ATR] if followed by a [−ATR] suffix (4). This last process is subject to a high-ranking markedness constraint which rules out the association of [−ATR] with

¹ Turkana is an Eastern Nilotic language that is spoken in Kenya (Dimmendaal 1983; Vago and Leder 1987; Noske 1990, 1991, 1996).

high vowels *HI/RTR (Archangeli and Pulleyblank 1994).² If a [–ATR] suffix is attached to a high [+ATR] root, no assimilation takes place, and each formative surfaces with its underlying value, as demonstrated by the second example in table (4).

(4)

		[+ATR] /-e/	[-ATR] /-rɛ/
[+ATR]	/-gol/ 'close'	[e-gol-e]	[a-gɔl-ɛ-rɛ]
	/-buk/ 'pour'	[e-buk-e]	[a-buk-ɛ-rɛ]
[-ATR]	/-dɔk/ 'climb'	[e-dok-e]	[a-dɔk-ɛ-rɛ]
	/-duk/ 'hide'	[e-duk-e]	[a-duk-ɛ-rɛ]

I assume that the suffixes in (4) are specified as [+ATR] and [–ATR] in the input. Spreading results from two alignment constraints which demand that the right and the left edges of the feature [ATR] coincide with the right and the left edges of the phonological word: ALIGN-R ([α ATR], PrWd) and ALIGN-L ([α ATR], PrWd). Since the suffix value is the spreading or dominant value I posit the faithfulness constraint IDENT-IO suffix [ATR] which ranks above IDENT-IO root [ATR] and the context-free faithfulness constraint IDENT-IO [ATR]: IDENT-IO suffix [ATR] $\gg$ IDENT-IO root [ATR], IDENT-IO [ATR]. In effect, then, I claim that harmony in Turkana is suffix-controlled.

The claim that vowel harmony in Turkana is suffix-controlled is complicated by the fact that there are a number of suffixes that agree with a preceding root in tongue root position (5).

(5)

		[OATR] /-Un/	[OATR] /-I/
[+ATR]	/-gol/ 'close'	[a-gol-un]	[a-gol-i]
	/-buk/ 'pour'	[a-buk-un]	[a-buk-i]
[-ATR]	/-dɔk/ 'climb'	[a-dɔk-un]	[a-dɔk-i]
	/-duk/ 'hide'	[a-duk-un]	[a-duk-i]

The suffixes in (5) belong to the same morphophonological stratum as the nonalternating suffixes in (4). I account for their harmonic behavior by leaving them unspecified for tongue root position in the input. Because they are unspecified for [ATR] they cannot act as spreaders and, instead, agree with a preceding root in tongue root position. The distinction between specified and unspecified suffixes, together with ranking IDENT-IO suffix [ATR] above IDENT-IO root [ATR], accounts for the entire range of alternations found in this language.

² I adopt Archangeli and Pulleyblank's (1994) formulation of this constraint, but assume that [RTR] is equivalent to the feature value [–ATR].

2. FAITHFULNESS CONSTRAINTS IN CORRESPONDENCE THEORY

This section provides an overview of faithfulness constraints in Correspondence Theory (McCarthy and Prince 1995). Correspondence Theory forms an integral part of Optimality Theory with which I assume the readers to be familiar (Prince and Smolensky 1993; McCarthy and Prince 1993a,b, 1994). I therefore limit the theoretical discussion to the particulars of Correspondence Theory only.

Correspondence Theory is a model of identity relations between linguistically related structures such as input and output (I-O), base and reduplicant (B-R), and base and affixed form (B-A). It assumes that the elements of a particular form are formally paired with the elements of a related form (which is indicated by coindexation), and posits a set of constraints which regulate the completeness and the identity of corresponding elements. Correspondence is formally expressed as follows:

- (6) Correspondence (McCarthy and Prince 1995, p. 262)
 Given two strings S1 and S2, **correspondence** is a relation $\mathfrak{R}$ from the elements S1 to those of S2. Elements $\alpha \in S1$ and $\beta \in S2$ are referred to as **correspondents** of one another when $\alpha \mathfrak{R} \beta$.

McCarthy and Prince (1995) propose the following three constraint families on correspondence (I discuss input-output relations only):

- (7) MAX constraint family
 MAX-IO: Every segment of the input has a correspondent in the output.
- (8) DEP constraint family
 DEP-IO: Every segment of the output has a correspondent in the input.
- (9) IDENT constraint family
 IDENT-IO (F): Output correspondents of all input $[\alpha F]$ are also $[\alpha F]$.

MAX-IO militates against phonological deletion and so replaces PARSE of the earlier containment version of Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993a,b). DEP-IO, by contrast, prohibits phonological epenthesis and so substitutes for FILL. If ranked

highly, these constraints ensure that the relation between input and output is complete so that all segments of the input are contained in the output, and vice versa.

IDENT-IO (F) requires corresponding segments of the input and output to have identical values for a feature F. Any change in the input specification of a segment results in a violation of this constraint. That is, only a segment that is specified as [+F] in the output and that corresponds to a segment that is specified as [+F] in the input satisfies IDENT-IO (F) (10a). By contrast, if the output correspondent is specified as [-F] this constraint is violated (10b). IDENT-IO (F) is also violated if an existing association line is deleted. This is demonstrated by the remaining examples in (10) which are all unspecified in the output, even though they are specified as [+F] in the input. The deletion of an association line comes at the price of one violation of IDENT-IO (F) per deleted association line.

(10)	input:					
	output:	a.	b.	c.	d.	e.
	IDENT-IO (F):	✓✓	**	**	**	**

McCarthy and Prince (1995) maintain that IDENT-IO (F) is also violated if a segment that is unspecified for F in the input is supplied with such a specification by Gen (11). This contrasts with the view taken by Orgun (1995), Ringen and Vago (1995a, b), and Zoll (1996) who assume that IDENT-IO (F) is violated only if an underlying feature specification is absent or different in the output. On their account no violation of IDENT-IO (F) is assessed if a segment that is unspecified for F in the input is specified in the output. How IDENT-IO (F) is ultimately evaluated has no bearing on the theoretical points that are advanced in this paper. For the sake of concreteness, I follow McCarthy and Prince (1995) and assume that identity is indeed violated if the output correspondent is more specified than the input.

(11)	input:		
	output:	a.	b.
	IDENT-IO (F):	**	**

McCarthy and Prince (1995) assume further that only segments, but not features correspond with each other and so are coindexed. Their model assumes that all features have a segmental affiliation in the input, so that all relations between them are transmitted through the segments they specify. I depart from this view here and assume instead that features can also enter into a correspondence relation and so are subject to the constraints MAX (F) and DEP (F) (Lamontagne and Rice 1995; Lombardi 1995; Causley 1997; Walker 1997):³

(12) MAX-IO (F): Every feature of the input has a correspondent in the output.

(13) DEP-IO (F): Every feature of the output has a correspondent in the input.

MAX-IO (F) is violated if an input feature is removed from the output representation, as in (14c–e). MAX-IO (F) is not violated, however, if an existing association line is deleted, provided the input feature is contained in the output. (14b) therefore satisfies MAX-IO (F) even though the input feature [+F] is unassociated in the output.

(14)	input:	
	output:	a. b. c. d. e.
	MAX-IO (F):	✓ ✓ *

DEP-IO (F) is violated if a feature value is inserted into an output representation, as shown by the forms in (15). All candidates in (15) violate this constraint because the output contains a feature specification that is not part of the underlying representation.

(15)	input:	
	output:	a. b. c. d.
	DEP-IO (F):	* * *

³ See also Zoll (1996) who proposes a constraint MAX (subseg) which differs from MAX (F) in some respects.

Support for featural correspondence constraints is provided in section 5 which argues that DEP-IO [ATR] is the highest-ranking constraint in Turkana. DEP-IO [ATR] militates against the insertion of a feature value into an output representation and so forces spreading to an unspecified suffix vowel in violation of IDENT-IO suffix [ATR].

This completes the overview of faithfulness constraints in Correspondence Theory.

3. SUFFIX-CONTROLLED HARMONY IN TURKANA

There are eighteen vowels in Turkana (nine short and nine long) which can be divided into two groups by the feature [ATR] (16). Each [+ATR] vowel is harmonically paired with a [-ATR] vowel. The only exception is the low vowel /a/ which is unpaired.

(16)	[+ATR]		[-ATR]	
	i	u	ɪ	ʊ
	e	o	ɛ	ɔ
			a	

In general, only vowels of the same set co-occur in the phonological word. Most often it is the root that determines the harmony category of the word. The prefixes in (17) and (18) and the suffixes in (19) and (20), for example, all agree in [ATR] with the root. They are [+ATR] after a [+ATR] root and [-ATR] after a [-ATR] root.

- | | | | | |
|--------|------------|-------------------------------------|--------------|----------------------|
| (17)a. | e-risik | ‘anti-
witchcraft
charm, sg.’ | ɛ-lukutuj | ‘wild cat, sg.’ |
| b. | e-kori | ‘giraffe, sg.’ | ɛ-kɔɾɪ | ‘ratel, sg.’ |
| (18)a. | ŋi-risy-o | ‘leopard, pl.’ | ŋi-lukutuj-a | ‘wild cat, pl.’ |
| b. | ŋi-kory-o | ‘giraffe, pl.’ | ŋi-kɔɾɪ-a | ‘ratel, pl.’ |
| (19)a. | ŋi-bur-in | ‘drum, pl.’ | ŋa-kuñ-in | ‘knee, pl.’ |
| b. | ŋi-re:t-in | ‘face, pl.’ | ŋa-tɛkɛr-in | ‘kind of gourd, pl.’ |
| (20)a. | a-lim-un | ‘to tell’ | a-kɪlɪp-un | ‘to pray this way’ |
| b. | a-gol-un | ‘to close in’ | a-dɔk-un | ‘to climb down’ |

As already mentioned, low vowels are unpaired. If an alternating suffix attaches to a low vowel root, it surfaces as [−ATR] (21). This suggests that low vowels are not specified as [+ATR] underlyingly. Whether they are actually specified as [−ATR] in the input or unspecified will not be discussed here.

- (21)a. a-rap-**un** ‘to discover’
 b. a-tam-**un** ‘to remember’
 c. a-cam-**un** ‘to like, agree’

If there are several alternating suffixes in a row, all agree in tongue root position with the root. The words in (22), for instance, contain the alternating suffix /-Un/ which is followed by the alternating aspect marker /-It/. The words in (23) contain the alternating dative suffix /-kIn/ and the aspect marker /-It/.⁴ The suffixes agree with the root in [ATR].

- (22)a. a-tam-**un**-it ‘I remember (it)’
 b. ε-dit-ε-**un**-it ‘it becomes smaller’
 c. ε-mōn-**un**-it ‘it becomes hotter’
 d. edo-**un**-it ‘she gave birth’
- (23)a. k-εmōrɪ-a-k**in**-it ‘I have forgotten’
 b. k-a-sil-i-k**in**-it ‘I am lonely’

Not all suffixes agree with the root in tongue root position, however. There are a number of invariant suffixes which surface as either [+ATR] or [−ATR] regardless of the [ATR] quality of the preceding root. Invariant [+ATR] suffixes cause regressive assimilation of any preceding non-low vowel. Invariant [−ATR] suffixes cause regressive assimilation of any preceding mid vowel.

Examples of non-alternating [+ATR] suffixes are given in (24) and (25). [+ATR] suffixes are in bold typeface. The left-hand example in each group

⁴ The dative suffix is preceded by one of four stem-forming vowels [o], [a], [i] or [ɪ]. The choice of vowel depends on the verb root and vowel harmony. Since these vowels are not part of the verb root, I separate them from the root by a dash.

shows an unsuffixed mid or high [−ATR] root. The other examples demonstrate that the root (and in some cases also the prefix) is realized as [+ATR] if followed by either the habitual suffix /-e:n/ or the gerund suffix /-e/.

- (24)a. a-kɪ-dɔk ‘to climb’ e-dok-**e:n**-e ‘s/he always climbs’
 b. a-k-ɪmuj ‘to eat’ a-k-ɪmuj-**e:n** ‘to eat regularly’
 c. a-dɛm-ar ‘to take away’ e-dem-**e:n**-e ‘s/he always takes’
- (25)a. a-kɪ-dɔk ‘to climb’ e-dok-**e** ‘way of climbing’
 b. a-k-ɪmuj ‘to eat’ e-k-ɪmuj-**e** ‘way of eating’
 c. a-dɛm-ar ‘to take away’ e-dem-**e** ‘way of taking’

The examples in (26) illustrate the behavior of low vowel roots. Low vowels remain unchanged when they are followed by a [+ATR] suffix. Any non-low vowel preceding a low root vowel surfaces as [−ATR] in this context. That is, low vowels prevent the leftward propagation of [+ATR] across the word and so are opaque.

- (26)a. ɛ-ram-**e:n**-e ‘s/he always beats’
 b. ɛ-ram-**e** ‘way of beating’
 c. ɛ-cal-**e** ‘noise, screaming’

Below are two examples of [−ATR] suffixes. [−ATR] suffixes cause regressive assimilation of any preceding mid vowel, as demonstrated in (27) and (28). The lefthand example in each group shows an unsuffixed mid vowel root that is [+ATR]. The other examples illustrate that the root and any mid vowel in a prefix or in a preceding alternating suffix surfaces as [−ATR] if followed by an invariant [−ATR] suffix. [−ATR] suffixes are also in bold typeface.

- (27)a. a-ki-lep ‘to milk’ a-lɛp-**ɔr**⁵ ‘to milk out’
 b. a-ki-gol ‘to close’ a-gɔl-**ɔr** ‘to close out’
 c. a-ki-boɪ ‘to return’ a-boɪ-**ɔr** ‘to return to a place’

- (28)a. a-ki-rem 'to spear' ε-rɛm-ε-**rɛ**⁶ '(why) is it speared?'
 b. a-ki-mor 'to insult' ε-mɔr-ε-**rɛ** '(why) is he insulted?'

Examples (29) and (30) illustrate the behavior of high vowel roots. [+ATR] high root vowels do not assimilate to a following [−ATR] suffix, but surface as [+ATR] in this context. These forms are therefore disharmonic.

- (29)a. a-bu-**ɛt**⁷ 'swelling, sg.'
 b. a-tub-**ɛt** 'judgement, sg.'
 c. a-tij-**ɛt** 'handle, sg.'
- (30)a. a-duɲ-**ɔr** 'to cut open'
 b. a-rip-**ɔr** 'to skim off'
 c. a-buk-**ɔr** 'to pour out'
 d. a-k-ilik-**ɔr** 'to take down'

Alternating and non-alternating suffixes in Turkana attach to the same verb roots, as shown in (31). Of the three suffixes in (31) the first two alternate in agreement with the root, while the last one is invariant.

- (31)a. a-gyel-a-kin 'to buy for s.o.' a-gol-o-kin 'to close for s.o.'
 b. a-gyel-un 'to buy' a-gol-un 'to close in'
 c. e-gyel-**een**-e 's/he always buys' e-gol-**een**-e 's/he always closes'

In words that contain both types of suffixes, alternating suffixes are found on the inside and on the outside of non-alternating suffixes. The examples

⁵ The suffix [-ɔr] marks a motion away from the speaker.

⁶ The suffix /-rɛ/ marks the subjunctive. According to Dimmendaal (1983), /-rɛ/ is in certain constructions preceded by the two voice markers /-i/ and /-a/ which merge into a mid front vowel. By contrast, I assume that /-rɛ/ is preceded by a single formative which contains a mid front vowel underlyingly.

⁷ The suffix /-ɛt/ in (29) marks instrumental nouns. It is attached either to a verb root or to a verb stem that contains one of the three derivative suffixes /-Un/, /-kIn/ or /-ar/.

(32)a.	a-gyɛl-un	‘to buy’	e-gyel-un- e	‘way of buying’
b.	a-kɪ-dək	‘to climb’	e-dok-un- e	‘way of climbing this way’
(33)a.	-ɛn	‘tie’	en-i-kin- e	‘way of tying’
b.	a-kɪ-dək	‘to climb’	ɛ-dək-a-kin- e	‘way of hiding’
c.	a-k-ɪlɪp	‘to pray’	ɛ-k-ɪlɪp-a-kin- e	‘way of praying’
d.	a-k-ɪnək-a-kɪn	‘to light’	ɛ-k-ɪnək-a-kin- e	‘way of lighting’

(34)a. a-bun-ε-**re** ‘come, sg.’
 b. e-duk-ε-**re** ‘(why) is it built?’

⁸ These forms are recorded as *a-k-ɪɔ-un-ɛt* and *a-pol-ɔ-un-ɛt* in Dimmendaal (1983). The forms in (35) are from Noske (1988).

- (35)a. a-k-ido-un-**ɛt** ‘birth, sg.’
 b. a-pol-o-un-**ɛt** ‘growth, sg.’
- (36)a. ito-dol-un-**ɛ-rɛ** ‘(why) is s/he made to arrive?’
 b. e-gol-o-kin-**ɛ-rɛ** ‘(why) is it closed?’
 c. iboy-i-kin-**ɛ-rɛ** ‘(why) is it sat down?’

By contrast, an alternating high vowel suffix that is attached to a [−ATR] suffix agrees with the suffix in tongue root position (37). High vowels are therefore only opaque to the leftward spreading of [−ATR], but not to the rightward spreading of this feature value.

- (37)a. ilik-**ɔr**-it ‘it is taken down’
 b. e-duk-**ɔr**-it ‘s/he builds over there’

The examples in (37) are also important because they show that non-alternating suffixes are not always final in a word. Given that alternating and non-alternating suffixes intermingle freely, no generalization about the ordering of these suffixes is possible.

To complete this survey we need to consider words that contain both an invariant [−ATR] and an invariant [+ATR] suffix. Because of selectional restrictions, not all combinations of [+ATR] and [−ATR] suffixes are attested in Turkana. The only construction type in which the two types of suffixes occur regularly is the gerundive. The [+ATR] gerund marker /-e/ attaches to the [−ATR] suffix /-ar/ in the forms in (38). The two suffixes do not assimilate to each other, but each suffix surfaces with its underlying tongue root specification. Since low vowels cannot associate with the feature value [+ATR], there is no regressive spreading from the gerund suffix. More importantly, however, there is also no progressive spreading of [−ATR] to the following mid vowel suffix, even though mid vowels are eligible for association with this feature value. The invariant [+ATR] suffix therefore blocks the progressive spreading of the feature value [−ATR]. It differs in this respect from the alternating suffix in (37), for example, which agrees in [−ATR] with the preceding suffix.

- (38)a. ɛ-k-ɪlot-**ar-e** ‘way of washing’
 b. ɛ-mat-**ar-e** ‘way of clearing out’

To sum up, the following generalization emerges from these data: the domain of vowel harmony in Turkana is the prosodic word. If an invariant suffix is attached to a root of the opposite specification, it is the suffix that determines the harmony category of the entire word; i.e., roots agree with a following specified suffix in tongue root position, subject to the restriction that high vowels do not combine with the [−ATR] value of a following suffix and low vowels do not combine with the [+ATR] value of a following suffix. Faithfulness to an underlying suffix value is therefore a higher priority than faithfulness to an underlying root value. The first thing that is remarkable about this system is that either [+ATR] or [−ATR] can trigger regressive spreading. Neither value can therefore be considered active or dominant in Turkana. That is, harmony in Turkana is not of the dominant-recessive type. Instead it is the feature that occurs in a position of phonological prominence that determines the harmony category of the entire word. The second remarkable thing about this system is that in words that consist of a specified root and a specified suffix, it is the suffix that is phonologically privileged and so determines the harmony category of the entire word.

Before I proceed with an account of these data I would like to consider an apparent exception to the claim that the phonological word is the domain of vowel harmony in Turkana, namely compounds. Although compounds are rare in Turkana, the few examples that exist show that the two halves of a compound do not harmonize. Consider the examples in (39) which are based on two nominal roots (a), two adjectival roots (b), an adjectival plus a nominal root (c), and a verb plus a nominal root (d). The two roots surface with different [ATR] specifications in all of these cases (Dimmendaal 1983).

- (39)a. na-moru-tuŋa
 PREP-stone-people
 ‘Namoruntunga’s village’
- b. lo-kori-ɲaŋ
 PREP-blotched-yellow
 personal name
- c. ɛ-pusi-kuyen
 MASC-blue-leaf
 ‘kind of plant’

- d. lo-per-o-kɔɔki
PREP-sleep-e-stomach
 ‘spy’

Compounds differ from simple words in yet another respect: Turkana has a process of spirantization which affects a voiceless coronal stop that is final in a morpheme and followed by a front vowel, as shown in (40).

- (40)a. a-ki-mat ‘to drink’ a-mas-i ‘I am drinking’
 b. -lot ‘go’ a-los-it ‘I am going’

Spirantization does not apply across a word boundary (41a). More importantly, it also fails to apply across the two halves of a compound (41b).

- (41)a. a-ki-mat e-pur-ot
INF-e-drink MASC-beer-SG
 ‘to drink beer’
 b. e-bit-i-wos-in
MASC-greed-e-anus-SG
 ‘kind of tree’

The other phonological process of Turkana that is of interest in the context of this discussion is low vowel raising. A low vowel in a suffix is raised to a mid back vowel if it is preceded by a [+ATR] morpheme. This is illustrated by the plural suffix in (42). This suffix is [-a] if it is preceded by a [–ATR] morpheme, but [-o] if it is preceded by a [+ATR] morpheme.

- (42)a. ɛ-pɔɔl ‘large intestine, sg.’ ŋɪ-pɔɔl-a ‘large intestine, pl.’
 b. a-mosiŋ ‘rhinoceros, sg.’ ŋa-mosiŋ-o ‘rhinoceros, pl.’

I assume that the plural suffix is /-a/ underlyingly and that the low vowel is raised to mid back if it is preceded by a [+ATR] morpheme. Raising and [+ATR]-spreading are separate processes, however, as is evidenced by the fact that an underlying low suffix vowel can be raised to a mid back vowel after a [+ATR] morpheme, without undergoing [+ATR] harmony (Noske

1996). This is shown by the non-alternating suffix /-**ar**/ which marks a motion away from the speaker.⁹ (This suffix was already introduced in (27).) The low vowel in this suffix is raised, without assimilating in [+ATR] to a preceding morpheme. It therefore has the alternant [-ar] after a [-ATR] morpheme and [-ɔr] after a [+ATR] morpheme. I will not attempt to formalize low vowel raising and its interaction with [ATR]-spreading in this paper.

- (43)a. a-gyɛl-**ar** 'to sell' a-buk-ɔ**r** 'to pour out'
 b. a-dɛm-**ar** 'to take away' a-pɛd-ɔ**r** 'to pour out'

Raising does not take place in compounds. The second root in (44) surfaces with a low vowel, even though it is preceded by a [+ATR] morpheme.

- (44) lo-kori-ɲaɪ
 PREP-blotched-yellow
 personal name

I consider this sufficient evidence to propose that compounds in Turkana consist of two prosodic words, each of which defines its own span of harmony. This assumption not only explains why there is no vowel harmony in compounds, but it also accounts for the failure of spirantization and low vowel raising if we assume (as we must, given the behavior of phonological words at the phrase level) that spirantization and low vowel raising are limited strictly to the prosodic word.

This discussion also has consequences for the analysis of invariant suffixes in Turkana. One could conceivably argue that invariant suffixes are "non-cohering" (Booij and Rubach 1984, 1987) and therefore do not agree with a preceding root in tongue root position. That is, we could argue that words with an invariant suffix have a prosodic structure similar to that of compounds. This position cannot be defended seriously for a number of reasons. First, invariant suffixes can be followed by alternating, 'cohering' suffixes (45). Second, invariant suffixes trigger spirantization (46). Third, invariant suffixes undergo low vowel raising if preceded by a [+ATR] root

⁹ I assume that this suffix is /-**ar**/ at the deepest level of the phonology, but represent it with a mid rather than a low vowel in the input if it is preceded by a [+ATR] root.

(47). In the light of all these facts we must assume that invariant suffixes form a single prosodic word with their base of affixation.

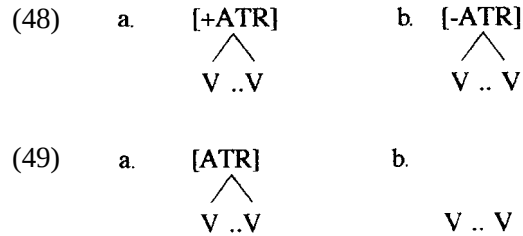
- (45)a. η a-tub-**et** 'judgment, pl.'
 b. η a-tij-**et**-a 'handle, pl.'
 c. ilik-**or**-it 'it is taken down'
 d. e-duk-**or**-it 's/he builds over there'
- (46)a. a-ki-mat 'to drink' a-mas-**et** 'cup'
 b. a-k-ijit 'to ask, apply' a-k-ijis-**et** 'application'
 c. -lot 'go' e-los-**e** 'way of going'
 d. e-los-**e:n**-e 's/he is always going'
- (47)a. a-gyel-**ar** 'to sell' a-buk-**or** 'to pour out'
 b. a-dem-**ar** 'to take away' a-ped-**or** 'to pour out'

The Turkana data present two challenges, then: first, we need to account for the dominance of [+ATR] and [−ATR] suffixes over the [ATR] value that is specified in roots under the assumption that they form a single prosodic word with the base of affixation. Second, we need to account for the fact that there are suffixes that alternate. In the next section we will see that these data require us to combine the notion of positional faithfulness with the assumption of underspecification.

4. A POSITIONAL FAITHFULNESS ACCOUNT OF TURKANA VOWEL HARMONY

Tongue root position is contrastive in roots. Roots surface as either [+ATR] or [−ATR] when they are unsuffixed or when they are followed by an alternating suffix. Their underlying [ATR] distinction is neutralized, however, when they are followed by an invariant suffix. The basic distinction between advanced and non-advanced roots can be represented in one of two ways: either roots are specified as either [+ATR] or [−ATR] in the input (48), or they are either specified for the harmonic feature [ATR] or

left unspecified in the input (49) (Pulleyblank 1993, 1994). Vowels that are unspecified in the input and that remain unspecified in the output receive an interpretation as unadvanced in the phonetics of grammar.



There are no arguments from the grammar of Turkana that force a choice between these two possible lexical representations of roots. Neither can any reasons of phonological symmetry be given in favor of one of these two positions. While I argue below that both values of the feature [ATR] are specified underlyingly in invariant suffixes, I also claim that alternating suffixes are unspecified for [ATR] in the input to distinguish them from non-alternating suffixes. Since a principled decision between the two possible representations of roots is impossible, I assume in the remainder of this paper that root vowels are specified as either [+ATR] or [-ATR] in the input and leave it to the readers to verify for themselves that this assumption is immaterial to the main point that is advanced in this paper.

Prefixes do not contrast in tongue root position, but always agree with a following root or invariant suffix in [ATR]. One way of accounting for the behavior of prefixes is to assume that prefixes are unspecified in the input and receive a value for [ATR] by feature-filling spreading from a following root or invariant suffix. This approach, which was popular during most of the last decade, is based on the assumption that assimilation affects mostly segments that lack a value for the spreading feature. Being unspecified, segments are more likely to undergo assimilation than segments that bear a specification for F underlyingly (Steriade 1995). On this account the difference between alternating and non-alternating segments in Turkana is correlated with a difference in their underlying representation: alternating segments are unspecified in the input and are found in prefixes only. Non-alternating segments are specified for [ATR] and are located exclusively in roots (and some suffixes). I illustrate this approach immediately below to show that underspecification can be fully reconciled with an optimality-theoretic approach to vowel harmony.

I assume that spreading in Turkana follows from the two constraints in (50) and (51) which align the feature [α ATR] with the right and the left edges of the prosodic word (Kirchner 1993; Pulleyblank 1993, 1994;

Itô and Mester 1994).¹⁰ I argue further below that ALIGN-L [α ATR] dominates ALIGN-R [α ATR] in Turkana. Since the data we are about to consider have no bearing on this issue, however, I leave them unranked for now. If we assume that prefixes are unspecified for [ATR] in the input and that the feature-filling specification of a segment violates the faithfulness constraint IDENT-IO [α ATR] (52), the alignment constraints need to dominate the faithfulness constraint to explain why unspecified prefixes agree with the following root in [ATR]. Consider the two candidates in tableau (53). Candidate (a) is properly aligned, but violates the faithfulness constraint. Candidate (b), by contrast is faithful to the input, but violates alignment. If the two alignment constraints rank above the faithfulness constraint IDENT-IO [α ATR], candidate (b) is inferior to (a) and is therefore excluded.

(50) ALIGN ([α ATR], R, PrWd, R)

(51) ALIGN ([α ATR], L, PrWd, L)

(52) IDENT-IO [α ATR]: Let β be an output segment and α the input correspondent of β . If β is [α ATR], then α must be [α ATR].

(53) ALIGN [α ATR] $\gg$ IDENT-IO [α ATR]

$\begin{array}{c} [+ATR] \\ | \\ \eta I - k o r \end{array}$ 'Samburu person, pl.'

	ALIGN-R [α ATR]	ALIGN-L [α ATR]	IDENT-IO [α ATR]
a. $\begin{array}{c} [+ATR] \\ \swarrow \searrow \\ \eta I - k o r \end{array}$			*
b. $\begin{array}{c} [+ATR] \\ \\ \eta I - k o r \end{array}$		*!	

There is, however, yet another candidate that needs to be considered in this context, namely an output that is completely unspecified. Consider the two

¹⁰ For familiarity's sake, I use ALIGN instead of ANCHOR or NO-INTERVENING (Elison 1995; Zoll 1996). I assume that ALIGN is evaluated gradiently; each vowel that intervenes between the feature [ATR] and the right or left edge of the phonological word registers for one ALIGN violation.

competing forms in tableau (55). Both candidates violate the faithfulness constraint IDENT-IO [α ATR]. Assuming that the second, unspecified form is properly aligned and therefore on a par with the first form, we need to appeal to the constraint INTERPRETABILITY to prevent it from surfacing (54). INTERPRETABILITY requires all vowels to bear a specification for tongue root position and so rules out underspecification in the output (Pulleyblank 1997).¹¹ Candidate (b) violates this constraint twice and so loses out to candidate (a) in which all vowels are fully specified in the output.

- (54) INTERPRETABILITY All vowels must bear a specification
[α ATR]: for tongue root position.

- (55) [+ATR]
 |
 η I - k o r 'Samburu person, pl.'

	ALIGN-R [α ATR]	ALIGN-L [α ATR]	IDENT-IO [α ATR]	INTERPRET
a. η I - k o r [+ATR]			*	
b. η I - k O r			*	***!

The last two tableaux have shown that the harmonic behavior of prefixes can be accounted for within Optimality Theory under the assumption that prefixes are unspecified in the input. Underspecification as an explanation of phonological behavior has, however, been called into doubt within Optimality Theory by Smolensky (1993), Itô et al. (1995), and Kirchner (1997). These authors argue that there are no constraints on input structures

¹¹ An appeal to INTERPRETABILITY would be unnecessary in this case if we assumed, contrary to McCarthy and Prince (1995), that segments that are unspecified in the input can receive a feature specification without violating faithfulness. The feature-filling spreading to the unspecified prefix in (55a) would then not result in a violation of IDENT-IO [α ATR]. (55a) would be the winner because it satisfies IDENT-IO [α ATR] and is properly aligned. The competing candidate (55b), by contrast, violates the faithfulness constraint on this account, because the underlying feature [+ATR] is absent in the output. Candidate (b) violates this constraint twice and so loses out to candidate (a) in which all vowels are fully specified in the output.

Note, however, that INTERPRETABILITY must be invoked anyway to account for spreading to unspecified suffixes. As will be discussed in greater detail below, unspecified suffixes undergo harmony despite the high ranking of the faithfulness constraint IDENT-IO suffix [α ATR]. Assimilation follows in these cases from the ranking INTERPRET $\gg$ IDENT-IO suffix [α ATR]. We therefore need to appeal to this constraint independent of what assumption we make about the evaluation of faithfulness constraints.

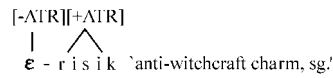
beyond those of general wellformedness and that the distribution of features and hence the phonological behavior of segments can be accounted for on the basis of output constraints alone.¹² Beckman (1997), for example, suggests that we account for alternating affixes in harmony systems by assuming that roots and alternating affixes alike are specified for the harmonic feature in the input. Affixes alternate on her approach because the faithfulness constraint IDENT-IO (F) is ranked below the wellformedness constraint $\mathbb{C}$ that governs the distribution of F. Since the distribution of F in affixes is governed by the output constraint $\mathbb{C}$ alone, it is immaterial whether affixes are specified as [+F], [−F] or [0F] in the input. Roots, by contrast, fail to alternate, if the constraint mandating faithfulness to an underlying root value (IDENT-IO root (F)) dominates $\mathbb{C}$. Roots must therefore be specified as either [+F] or [−F] in the input; this distinction emerges in surface forms because of the ranking IDENT root (F) $\gg$ $\mathbb{C}$.

Following Beckman, we could assume that Turkana prefixes are specified for tongue root position in the input. If the general faithfulness constraint IDENT-IO [ATR] ranks below the positional faithfulness constraint IDENT-IO root [ATR] (56) and the two alignment constraints, prefix vowels alternate in agreement with a following root vowel. To demonstrate this approach I assume in tableau (57) that the masculine gender prefix is specified as [−ATR] in the input: /-ε/. It is combined with the [+ATR] root /-risik/ ‘anti-witchcraft charm’. The prefix and root vowels of the first candidate in (57) surface with their underlying [ATR] value in violation of the alignment constraints. In the second candidate the prefix value dominates over the root value. In the third candidate the root value dominates over the prefix value. If IDENT-IO root [ATR] ranks higher than IDENT-IO [ATR], the last form emerges as optimal.

- (56) IDENT-IO root [ATR]: Let β be an output segment in a root and α the input correspondent of β . If β is [α ATR], then α must be [α ATR].

¹² However, see Akinlabi (1997), Inkelas (1994), Pulleyblank (1993, 1997), and Ringen and Vago (1995a,b) for analyses that incorporate underspecification.

- (57) ALIGN, IDENT-IO root [
- α
- ATR]
- $\gg$
- IDENT-IO [
- α
- ATR]



	ALIGN-R [α ATR]	ALIGN-L [α ATR]	IDENT-IO root [α ATR]	IDENT-IO [α ATR]
a. [-ATR][+ATR] ε - r i s i k	**	*		
b. [-ATR] ε - r i s i k			**!	**
c. ~~ε~~ ε ⁺ [+ATR] ε - r i s i k				*

In tableau (58), the same gender prefix is combined with the [-ATR] root /-pɔɔl/ 'large intestine'. Candidate (58a) is faithful to the input, but misaligned. Candidate (58b), by contrast, is impeccable with respect to both constraints and therefore wins.

- (58) [-ATR][-ATR]
 |
 ε - p ɔ ɔ l 'large intestine, sg.'

	ALIGN-R [α ATR]	ALIGN-L [α ATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. [-ATR][-ATR] ε - p ɔ ɔ l	**	*		
b. ~~ε~~ ε ⁺ [-ATR] ε - p ɔ ɔ l				

Prefixes also harmonize with a following root if they are specified as [+ATR] in the input, as shown in (59) and (60). I now assume that the masculine gender prefix is specified as [+ATR] underlyingly: /e-/. Tableau (59) shows the combination of this prefix with a [-ATR] root. The first candidate in this tableau is misaligned. The second candidate violates the root faithfulness constraint. Since this constraint ranks higher than the general faithfulness constraint, the last candidate wins.

- (59) $\begin{array}{c} [+ATR][-ATR] \\ | \quad \wedge \\ e - p \text{ } \text{ } \text{ } l \end{array}$ 'large intestine, sg.'

	ALIGN-R [α ATR]	ALIGN-L [α ATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [+ATR][-ATR] \\ \quad \wedge \\ e - p \text{ } \text{ } \text{ } l \end{array}$	**	*		
b. $\begin{array}{c} [+ATR] \\ \quad \wedge \\ e - p \text{ } \text{ } o l \end{array}$			**!	**
c. $\begin{array}{c} [-ATR] \\ \quad \wedge \\ e - p \text{ } \text{ } \text{ } l \end{array}$				*

In tableau (60) the [+ATR] prefix is attached to a [+ATR] root. The first candidate in this tableau is misaligned, and therefore the flawless second candidate is optimal.

- (60) $\begin{array}{c} [+ATR][+ATR] \\ | \quad \wedge \\ e - r i s i k \end{array}$ 'anti-witchcraft charm, sg.'

	ALIGN-R [α ATR]	ALIGN-L [α ATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [+ATR][+ATR] \\ \quad \wedge \\ e - r i s i k \end{array}$	**	*		
b. $\begin{array}{c} [+ATR] \\ \quad \wedge \\ e - r i s i k \end{array}$				

Ranking IDENT-IO [ATR] root above IDENT-IO [ATR] also accounts for the harmonic behavior of prefixes, if prefixes are unspecified for [ATR] in the input. This is shown in the following two tableaux. The first candidate in each tableaux is misaligned. Therefore the second candidate wins even though the faithfulness constraint IDENT-IO [ATR] is violated.

- (61) $\begin{array}{c} [+ATR] \\ | \quad \wedge \\ E - r i s i k \end{array}$ 'anti-witchcraft charm, sg.'

	ALIGN-R [α ATR]	ALIGN-L [α ATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [+ATR] \\ \quad \wedge \\ E - r i s i k \end{array}$		*!		
b. $\begin{array}{c} [-ATR] \\ \quad \wedge \\ e - r i s i k \end{array}$				*

- (62)
- $$\begin{array}{c} [-\text{ATR}] \\ \diagup \quad \diagdown \\ \text{E} - \text{p} \text{ } \text{ɔ} \text{ } \text{ɔ} \text{ } \text{l} \end{array}$$

'large intestine, sg.'

	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [-\text{ATR}] \\ \diagup \quad \diagdown \\ \text{E} - \text{p} \text{ } \text{ɔ} \text{ } \text{ɔ} \text{ } \text{l} \end{array}$		*!		
b. $\begin{array}{c} [-\text{ATR}] \\ \diagup \quad \diagdown \\ \text{ɛ} - \text{p} \text{ } \text{ɔ} \text{ } \text{ɔ} \text{ } \text{l} \end{array}$				*

Since the mapping of either the specified input form /ɛ-/ or the specified input form /e-/ onto a well-formed output results in a single violation of IDENT-IO [ATR] if the root bears the opposite [ATR] specification, the choice between these two input forms is arbitrary. That is, we could assume either that prefixes are specified as [−ATR] or that they are specified as [+ATR] in the input. Considerations of learnability which are encoded in the principle of lexicon optimization do not help in making a decision between these two input forms (Prince and Smolensky 1993; Inkelas 1994; Itô et al. 1995). As long as we assume that the feature-filling specification of a segment violates IDENT-IO (F), either of these two input forms would be preferable to an unspecified input, however, since the mapping of an unspecified input onto a fully specified output leads to a violation of IDENT-IO [ATR] regardless of the [ATR] specification of the following root.¹³ In the next section, I argue that prefixes cannot be specified as [+ATR] in the input. This argument is based on the interaction of the alignment constraints with the markedness constraint *HI/ATR which will be discussed in greater detail there. Given the conclusion I draw in that section, I assume in the remainder of this paper that non-low prefix vowels are specified as [−ATR] in the input.¹⁴

I now turn to the harmonic behavior of suffixes. The analysis so far distinguishes between two types of morphemes: (i) roots which are phonologically prominent and (ii) affixes which are not. Faithfulness to an

¹³ By contrast, if we assumed that the feature-filling specification of a segment does not violate IDENT-IO (F), the unspecified input would be preferable to either of the specified input forms.

¹⁴ I also assume that low prefix vowels are specified as [−ATR]. As will be discussed further below, low vowels cannot associate with the feature value [+ATR], because of the output constraint *LO/ATR which prohibits the association of the two feature values [+low] and [+ATR]. We could therefore assume that low vowels in prefixes are specified as either [+ATR] or [−ATR] in the input. They will always surface as [−ATR] in the output. To simplify the discussion, however, I will represent low prefix vowels as [−ATR] underlyingly.

underlying root value dominates over faithfulness to an underlying affix value and so prefix vowels alternate, while root vowels are stable. This approach could easily be extended to the analysis of alternating suffixes. In words that consist of a prefix, a root and an alternating suffix, the suffix agrees with the preceding root in [ATR]. Under the ranking IDENT-IO [ATR] root $\gg$ IDENT-IO [ATR] this phenomenon is accounted for, regardless of what [ATR] value, if any, is specified in suffixes underlyingly. This is demonstrated in the next two tableaux with the help of the [+ATR] verbal root /-gol/ 'close' and the [-ATR] verbal root /-dɔk/ 'climb' which are extended with the suffix marking a motion towards the speaker. In tableau (63) this suffix is specified as [-ATR] underlyingly: /-un/. In tableau (64) it is specified as [+ATR] underlyingly: /-un/. The first candidate in each tableau is optimal, because it violates only the lower of the two faithfulness constraints.

- (63) [-ATR][+ATR][-ATR]
 | | |
 a - g o l - u n 'to close in'

	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [αATR]	IDENT-IO [αATR]
a. $\begin{smallmatrix} \text{[-ATR]} \\ \swarrow \searrow \\ -g o l - u n \end{smallmatrix}$				*
b. $\begin{smallmatrix} \text{[-ATR]} \\ \swarrow \searrow \\ -g ɔ l - u n \end{smallmatrix}$			*!	*
c. $\begin{smallmatrix} \text{[+ATR]} \text{ [-ATR]} \\ \quad \\ -g o l - u n \end{smallmatrix}$	*	*		

- (64) [-ATR][-ATR][+ATR]
 | | |
 a - d ɔ k - u n 'to climb this way'

	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [αATR]	IDENT-IO [αATR]
a. $\begin{smallmatrix} \text{[-ATR]} \\ \swarrow \searrow \\ -d ɔ k - u n \end{smallmatrix}$				*
b. $\begin{smallmatrix} \text{[+ATR]} \\ \swarrow \searrow \\ -d o k - u n \end{smallmatrix}$			*!	*
c. $\begin{smallmatrix} \text{[-ATR]} \text{ [+ATR]} \\ \quad \\ -d ɔ k - u n \end{smallmatrix}$	*	*		

The existence of non-alternating suffixes in Turkana rules out such a simple division between roots and affixes, however. In Turkana, not only roots but also suffixes can be phonologically privileged in the sense that they fail to assimilate and instead impose their [ATR] specification on surrounding segments. To capture this phenomenon, I suggest that suffix position be formally recognized as a position of phonological prominence and posit the positional faithfulness constraint IDENT-IO suffix [ATR] (65) which penalizes any change in the tongue root specification of a suffix vowel.¹⁵ Assuming that non-alternating suffixes are specified as either [+ATR] or [–ATR] in the input, they fail to assimilate to a preceding root in tongue root position if the positional faithfulness constraint IDENT-IO suffix [ATR] ranks above IDENT-IO root [ATR]. This is demonstrated in the following tableaux.

Tableau (66) presents the first word in which root and suffix have opposite tongue root specifications: the suffix is [+ATR] while the root is [–ATR]. In the output only the suffix value is maintained. The first candidate is disharmonic: the suffix and root vowels surface with their underlying [ATR] specification in violation of the alignment constraints. In the second candidate the location of the input features is reversed in the output. That is, the suffix is [+ATR] in the input, but [–ATR] in the output, and vice versa for roots. This candidate therefore violates both alignment constraints and both positional faithfulness constraints. The choice between the remaining harmonic candidates (66c) and (66d) follows from the ranking IDENT-IO suffix [ATR] $\gg$ IDENT-IO root [ATR]. In (66c) the root value wins over the suffix value and so the higher ranking of the two positional faithfulness constraints is violated. This leaves (66d) which violates the lower ranking positional faithfulness constraints and so is the better candidate. No ranking can as of yet be established between the alignment constraints and the suffixal faithfulness constraint, because the winning candidate (66d) is impeccable with regard to both.

- (65) IDENT-IO suffix [ATR]: Let β be an output segment in a suffix and α the input correspondent of β . If β is [α ATR], then α must be [α ATR].

¹⁵ Instead of proposing that there are two positions of privilege in Turkana (roots and suffixes), we could say that the rightmost specified morpheme in Turkana is dominant and spreads its value to the left. However, since the rightmost specified suffix can bear either [ATR] specification in the input, I currently see no way of formulating such a constraint.

(66) ALIGN, IDENT-IO suffix [ATR] >> IDENT-IO root [ATR]

$\begin{array}{c} [-\text{ATR}] \quad [-\text{ATR}] \quad [+ \text{ATR}] \\ | \quad | \quad | \\ \text{e} - \text{d} \text{e} \text{m} - \text{e} \quad \text{'way of taking'} \end{array}$

	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO suffix [ATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [-\text{ATR}] \quad [+ \text{ATR}] \\ \quad \\ \text{e} - \text{d} \text{e} \text{m} - \text{e} \end{array}$	*	**			
b. $\begin{array}{c} [+ \text{ATR}] \quad [-\text{ATR}] \\ \quad \\ \text{e} - \text{d} \text{e} \text{m} - \text{e} \end{array}$	*	**	*	*	✖
c. $\begin{array}{c} [-\text{ATR}] \\ \\ \text{e} - \text{d} \text{e} \text{m} - \text{e} \end{array}$			*!		*
d. $\begin{array}{c} [+ \text{ATR}] \\ \\ \text{e} - \text{d} \text{e} \text{m} - \text{e} \end{array}$				*	✖

The behavior of low vowel roots requires us to expand the analysis. These forms also bear on the ranking of the alignment constraints and the suffixal faithfulness constraint. Low vowels in roots do not assimilate to a following [+ATR] suffix. Assimilation fails to apply because of the markedness constraint *LO/ATR which prohibits the association of the feature value [+ATR] with [+low] vowels (Archangeli and Pulleyblank 1994). If this constraint is ranked above the alignment constraints it prevents [+ATR] from spreading from the suffix to a root vowel in case the root vowel is [+low].^{16,17}

(67) evaluates candidates that are based on the low vowel root /-ram/ 'beat' which is followed by the [+ATR] gerund suffix /-e/. The [+ATR] harmonic candidate (67a) is ruled out, because it violates the markedness constraint *LO/ATR. If ALIGN were ranked above IDENT-IO suffix [ATR], as shown in tableau (67), the disharmonic candidate (67b) would lose out to the [-ATR] harmonic candidate (67c), because it violates the higher ranking alignment constraints. (67c) would hence be optimal even though it violates suffix faithfulness. The correct form is (67b), however. (The thumbs-down icon marks a form that wrongly emerges as the winner.)

¹⁶ Low vowels are opaque to [+ATR] spreading. Their opacity follows from the constraint NOGAP which is ignored in this paper.

¹⁷ IDENT-IO [low] must also rank above ALIGN, because low vowels do not raise to become compatible with a [+ATR] feature.

- (67)
- | | | | |
|--------|--------|--------|------------------|
| [-ATR] | [-ATR] | [+ATR] | |
| | | | |
| ε | r a m | - e | 'way of beating' |

	*LO/ATR	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO suffix [ATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a.	*!				*	**
b.		*	**			
c.				*		*

This suggests that faithfulness to an underlying suffix value is actually of higher importance than alignment, or IDENT-IO suffix [ATR] $\gg$ ALIGN. Low vowel roots, then, reveal that the suffixal faithfulness constraint must rank above alignment, since an underlyingly specified suffix never assimilates to a preceding root. The correct ranking of the constraints is displayed in tableau (68).

- (68) IDENT-IO suffix [ATR], *LO/ATR $\gg$ ALIGN $\gg$ IDENT-IO root [ATR]

	IDENT-IO suffix [ATR]	*LO/ATR	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a.		*!			*	**
b.			*	**		
c.	*!					*

Next let us consider words that consist of a [+ATR] root and a [-ATR] suffix. To summarize our earlier findings briefly: if the root contains a mid vowel, it assimilates in [-ATR] to the following suffix. No assimilation takes place, however, if the root contains a high vowel. Instead, the root surfaces as [+ATR], while the suffix is realized as [-ATR]; i.e., the surface form is disharmonic.

I begin with an account of mid vowel roots which follow the already established pattern. A [+ATR] mid root vowel assimilates to a following suffix in [-ATR], because of the ranking IDENT-IO suffix [ATR] $\gg$ ALIGN $\gg$ IDENT-IO root [ATR]. Candidates (69a) and (69b) are disharmonic, violating ALIGN. (69c) violates IDENT-IO suffix [ATR] and so

loses out to (69d) which violates the lower ranking constraint IDENT-IO root [ATR].

- (69) $\begin{array}{c} [-\text{ATR}] \quad [+ \text{ATR}] [-\text{ATR}] \\ | \quad | \quad | \\ \text{a} - \text{g} \text{ o } \text{l} - \text{o} \text{ r}^{18} \end{array}$ 'to close out'

	IDENT-IO suffix [ATR]	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [+ \text{ATR}] \quad [-\text{ATR}] \\ \quad \\ - \text{g} \text{ o } \text{l} - \text{o} \text{ r} \end{array}$		*	*		
b. $\begin{array}{c} [-\text{ATR}] \quad [+ \text{ATR}] \\ \quad \\ - \text{g} \text{ o } \text{l} - \text{o} \text{ r} \end{array}$	*	*	*	*	**
c. $\begin{array}{c} [+ \text{ATR}] \\ \diagup \quad \diagdown \\ - \text{g} \text{ o } \text{l} - \text{o} \text{ r} \end{array}$	* ₁				*
d. $\begin{array}{c} [-\text{ATR}] \\ \diagup \quad \diagdown \\ - \text{g} \text{ o } \text{l} - \text{o} \text{ r} \end{array}$				*	*

[+ATR] high vowel roots do not assimilate to a following [−ATR] suffix, but surface as [+ATR] in this environment. I assume that this form of regressive spreading is excluded because of the markedness constraint *HI/RTR (Archangeli and Pulleyblank 1994) which prohibits the association of the feature values [+high] and [−ATR] and which ranks higher than the alignment constraints.^{18, 19, 20} If the faithfulness constraint IDENT-IO suffix [ATR] also ranks higher than the alignment constraints, the suffix and root vowels will surface with their underlying feature values. Consider tableau (70). The root in this tableau is specified as [+ATR] in the input, while the suffix is [−ATR]. The [−ATR] harmonic candidate (70a) is ruled out because it violates the markedness constraint *HI/RTR. The [+ATR] harmonic candidate (70b) violates the suffixal faithfulness constraint. This leaves the disharmonic candidate (70c) as the winner.

¹⁸ The underlying form of this suffix is /-ar/. The variant [-or] results from low vowel raising. Since I do not present a formal account of low vowel raising in this paper, I use a mid vowel in the input representation of this and other low vowel suffixes.

¹⁹ High vowels are also opaque which follows from the high ranking of NOGAP.

²⁰ Note that IDENT-IO [high] must also dominate ALIGN, because high vowels do not lower to become compatible with a [−ATR] feature.

- (70) IDENT-IO suffix [ATR], *HI/RTR $\gg$ ALIGN $\gg$ IDENT-IO root [ATR]

$\begin{array}{c} [-\text{ATR}] \quad [+ \text{ATR}] \quad [-\text{ATR}] \\ | \quad | \quad | \\ \text{a} - \text{b} \text{ u } \text{k} - \text{o} \text{ r} \end{array}$
 'to pour out'

	IDENT-IO suffix [ATR]	*HI/RTR	ALIGN-R [α ATR]	ALIGN-L [α ATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [-\text{ATR}] \\ \\ - \text{b} \text{ u } \text{k} - \text{o} \text{ r} \end{array}$		*!			*	*
b. $\begin{array}{c} [+ \text{ATR}] \\ \\ - \text{b} \text{ u } \text{k} - \text{o} \text{ r} \end{array}$	*!					*
c. $\begin{array}{c} [+ \text{ATR}] \quad [-\text{ATR}] \\ \quad \\ - \text{b} \text{ u } \text{k} - \text{o} \text{ r} \end{array}$			*	*		

It is important to notice in this context that only the regressive spreading of [−ATR] from a suffix to a [+ATR] high root vowel is excluded. By contrast, [−ATR] can spread from a [−ATR] root to a high prefix vowel or to alternating high suffix vowels. It can also spread from a [−ATR] suffix to a following alternating high suffix vowel. I argue in section 5 that [−ATR] spreading cannot displace an underlying [+ATR] specification on a high vowel, but can only provide a [−ATR] specification if no [+ATR] specification is present in the input. High vowels that assimilate in [−ATR] can therefore not be specified as [+ATR] in the input.

Last, I would like to consider words that contain two suffixes with opposite tongue root specifications. In tableau (71), the [+ATR] gerund marker follows an invariant [−ATR] suffix. It is interesting to note that each of these two suffixes surfaces with its underlying [ATR] value. What keeps these suffixes from assimilating to each other? In (71a) all vowels associate with the [+ATR] feature of the gerund suffix. We established earlier that both the markedness constraint *LO/ATR and the faithfulness constraint IDENT-IO suffix [ATR] dominate ALIGN. Since candidate (71a) violates both constraints, it is impossible to determine which of these two constraints is decisive in ruling out this form. In (71b) the gerund suffix agrees with the preceding suffix in [−ATR]. In (71c) each suffix surfaces with its underlying specification. Since there is no markedness constraint that prohibits the association of the feature value [−ATR] with mid vowels this must follow from the ranking IDENT-IO suffix [ATR] $\gg$ ALIGN.²¹

²¹ No examples are available in which the [+ATR] gerund suffix follows an invariant [−ATR] mid or high vowel suffix.

(71)

$\begin{array}{c} [-\text{ATR}] \quad [-\text{ATR}] \quad [-\text{ATR}] \quad [+ \text{ATR}] \\ | \quad | \quad | \quad | \\ \text{e} - \text{m} \text{ a} \text{ t} - \text{a} \text{ r} - \text{e} \end{array}$

'way of clearing out'

	IDENT-IO suffix [ATR]	*LO/ATR	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [+ \text{ATR}] \\ \quad \quad \quad \\ \text{e} - \text{m} \text{ a} \text{ t} - \text{a} \text{ r} - \text{e} \end{array}$	*	**			*	***
b. $\begin{array}{c} [-\text{ATR}] \quad [-\text{ATR}] \\ \quad \quad \quad \\ \text{e} - \text{m} \text{ a} \text{ t} - \text{a} \text{ r} - \text{e} \end{array}$	*!		**	**		*
c. $\begin{array}{c} *! \quad [-\text{ATR}] \quad [-\text{ATR}] \quad [+ \text{ATR}] \\ \quad \quad \quad \\ \text{e} - \text{m} \text{ a} \text{ t} - \text{a} \text{ r} - \text{e} \end{array}$			***	***		

Having presented an analysis of suffix harmony within Positional Faithfulness theory, I would like to return to the issue of underspecification. I established earlier that spreading from roots to prefixes can be accounted for in one of two ways: either we assume that prefixes are unspecified for [ATR] in the input and that spreading is feature filling, or we assume that prefixes are specified in the input and that spreading is feature changing; i.e., the alignment constraints as well as the faithfulness constraint IDENT-IO root [ATR] dominate the general faithfulness constraint IDENT-IO [ATR]. Only the second feature-changing approach is available to account for regressive spreading from suffixes to roots. Since [ATR] is a contrastive feature in roots, they must bear a specification for [ATR] in the input. Regressive spreading from suffixes to roots is therefore clearly feature-changing. While the feature-changing nature of regressive spreading from suffixes to roots can be presented as an argument against underspecified input representations in general and for the use of positional faithfulness constraints in particular, the behavior of alternating suffixes strongly speaks in favor of underspecified input representations and against the exclusive use of positional faithfulness constraints.

I suggested earlier that suffix faithfulness ranks above root faithfulness in Turkana. Under this assumption it is impossible to maintain that alternating suffixes are specified for [ATR] in the input. If alternating suffixes were specified as [−ATR] in the input, they would trigger regressive [ATR] harmony (72). If alternating suffixes were specified as [+ATR] in the input, they would trigger regressive [+ATR] harmony (73). Under the ranking IDENT-IO suffix [ATR] >> ALIGN >> IDENT-IO root [ATR], the second candidate in each tableau would wrongly emerge as optimal.

- (72) $\begin{array}{c} [-\text{ATR}] \quad [+ \text{ATR}] \quad [-\text{ATR}] \\ | \quad | \quad | \\ \text{e} - \text{k} \text{ } \text{or} - \text{ot} \end{array}$ 'Samburu person, sg.'

	IDENT-IO suffix [ATR]	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [αATR]	IDENT-IO [αATR]
a. $\begin{array}{c} [+ \text{ATR}] \\ \\ \text{e} - \text{k} \text{ } \text{or} - \text{ot} \end{array}$	*!				**
b. $\begin{array}{c} [-\text{ATR}] \\ \\ \text{e} - \text{k} \text{ } \text{or} - \text{ot} \end{array}$				*	*
c. $\begin{array}{c} [-\text{ATR}] \quad [+ \text{ATR}] \quad [-\text{ATR}] \\ \quad \quad \\ \text{e} - \text{k} \text{ } \text{or} - \text{ot} \end{array}$		*	*		

- (73) $\begin{array}{c} [-\text{ATR}] \quad [-\text{ATR}] \quad [+ \text{ATR}] \\ | \quad | \quad | \\ \text{a} - \text{d} \text{ } \text{ok} - \text{u} \text{ } \text{n} \end{array}$ 'to climb this way'

	IDENT-IO suffix [ATR]	*HI/RTR	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [αATR]	IDENT-IO [αATR]
a. $\begin{array}{c} [-\text{ATR}] \\ \\ \text{a} - \text{d} \text{ } \text{ok} - \text{u} \text{ } \text{n} \end{array}$	*	*				*
b. $\begin{array}{c} [+ \text{ATR}] \\ \\ \text{a} - \text{d} \text{ } \text{ok} - \text{u} \text{ } \text{n} \end{array}$					*	*
c. $\begin{array}{c} [-\text{ATR}] \quad [-\text{ATR}] \quad [+ \text{ATR}] \\ \quad \quad \\ \text{a} - \text{d} \text{ } \text{ok} - \text{u} \text{ } \text{n} \end{array}$			*	*		

Alternating suffixes are a dilemma then, because they show that there is no perfect correlation between the phonological behavior of a segment, i.e., whether it alternates or not, and the position in which it occurs. Some suffixes are phonologically privileged in the sense that they fail to alternate and impose their [ATR] specification on surrounding segments, while other suffixes are not privileged and so alternate. Positional Faithfulness theory, which establishes a connection between the phonological behavior of a segment and the morphological position in which it occurs, cannot account for this phenomenon.

As a solution to this problem I propose that we consider suffix position a locus of phonological privilege in Turkana and draw a representational distinction between alternating and non-alternating suffixes: non-alternating suffixes are specified for [ATR] in the input, while alternating suffixes are unspecified for this feature. If alternating suffixes are unspecified for [ATR] underlyingly, they cannot cause regressive assimilation because they have no value to spread. Given the constraint hierarchy established so

far, underspecification draws the correct distinction, then, between suffixes that act as spreaders and suffixes that do not.

Note, however, that we still have to explain why alternating suffixes undergo assimilation. Consider in this connection the forms in tableau (74). The suffix in this tableau is unspecified for tongue root position in the input. In (74a) the [+ATR] root feature associates with the suffix vowel in violation of the faithfulness constraint IDENT-IO suffix [ATR]. In (74b), by contrast, the suffix vowel is unassociated. The suffixal faithfulness constraint is satisfied in this form, but alignment is violated. Since IDENT-IO suffix [ATR] ranks above alignment, candidate (74b) should be optimal.²²

(74)

[-ATR]	[+ATR]	
e	k o r	O t

'Samburu person, sg.'

	IDENT-IO suffix [ATR]	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. [+ATR] ↙↘ e - k o r - o t	*!				**
b. [+ATR] ↙↘ e - k o r - O t		*			*

The correct form is (74a), however, in which the suffix vowel agrees with the preceding root. This problem is solved if we appeal to the constraint INTERPRETABILITY which was introduced earlier in conjunction with the behavior of prefixes. As demonstrated in (75), if INTERPRETABILITY ranks above suffix faithfulness we can ensure that unspecified suffixes receive a value for [ATR] through spreading. Candidate (75a) has an unspecified vowel in the output and so violates INTERPRETABILITY. In candidate (75c) a [-ATR] feature has been inserted onto the suffix vowel. This form violates the suffixal faithfulness constraint IDENT-IO suffix [ATR] and the alignment constraints. The harmonic candidate (75b) in which the suffix vowel associates with the root value is therefore the winner even though it violates suffix faithfulness.

²² The same problem exists if the root is specified as [-ATR]. The feature [-ATR] cannot spread to an unspecified suffix vowel, because the suffixal faithfulness constraint dominates alignment. A suffix vowel would therefore remain unspecified after a [-ATR] root and after a [+ATR] root.

(75) INTERPRETABILITY $\gg$ IDENT-IO suffix [ATR]

$\begin{array}{c} [-\text{ATR}] \quad [+ \text{ATR}] \\ | \quad | \\ \text{e} - \text{k o r} - \text{O t} \end{array}$ 'Samburu person, sg.'

	INTER PRET	IDENT-IO suffix [ATR]	ALIGN-R [α ATR]	ALIGN-L [α ATR]	IDENT-IO root [α ATR]	IDENT-IO [α ATR]
a. $\begin{array}{c} [+ \text{ATR}] \\ \diagup \quad \diagdown \\ \text{e} - \text{k o r} - \text{O t} \end{array}$	*!		*			*
b. $\begin{array}{c} [-\text{ATR}] \\ \diagup \quad \diagdown \\ \text{e} - \text{k o r} - \text{o t} \end{array}$		*				**
c. $\begin{array}{c} [+ \text{ATR}] \quad [-\text{ATR}] \\ \diagup \quad \diagdown \\ \text{e} - \text{k o r} - \text{o t} \end{array}$		*	*	**		**

I conclude that we have to allow a three-way contrast in suffixes in the input ([+ATR], [−ATR], [0ATR]), to obtain three suffixal alternation patterns (invariant [+ATR], invariant [−ATR] and alternating) from a single ranking of the constraints. These data, then, argue strongly for the grammar-sensitive use of underspecification (Inkelas 1994; Noske 1995; Pulleyblank 1997).

Assuming, then, that alternating suffixes are unspecified for [ATR] in the input, the last issue to consider is what happens if an unspecified mid vowel suffix occurs between a [+ATR] high vowel root and a [−ATR] suffix. The vowel in the unspecified mid vowel suffix agrees with the [ATR] value that is specified in the following suffix. This fact is still unaccounted for under the present ranking. Since spreading to an unspecified suffix vowel violates IDENT-IO suffix [α ATR], progressive spreading from a root to an unspecified suffix is as bad as regressive spreading from a specified suffix. Regressive spreading in such cases can only be explained if we assume that ALIGN-L [α ATR] ranks above ALIGN-R [α ATR]. This is shown in the following tableau. In candidate (76a) all vowels associate with the [+ATR] value of the root. This form violates the suffix faithfulness constraint twice. In candidate (76b) all vowels associate with the [−ATR] feature of the suffix. This form violates suffix and root faithfulness, as well as the markedness constraint *HI/RTR. In (76d), the mid suffix vowel associates with the [+ATR] feature of the root. In (76c) the mid suffix vowel associates with the [−ATR] feature of the suffix. If ALIGN-R and ALIGN-L [α ATR] were unranked with respect to each other, either form should be permissible. Instead we find that candidate (76c) is the optimal form. This shows that ALIGN-L [α ATR] must supersede ALIGN-R [α ATR].

(76) ALIGN-L [α ATR] $\gg$ ALIGN-R [α ATR]

$\begin{array}{ccccc} [-\text{ATR}] & [+ \text{ATR}] & & [-\text{ATR}] & \\ | & | & & | & \\ \text{a} & \text{bun} & \text{-E-} & \text{re} & \\ & & & & \text{'come, sg.'} \end{array}$

	IDENT-IO suffix [ATR]	*HI/RTR	ALIGN-L [α ATR]	ALIGN-R [α ATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [+ \text{ATR}] \\ \swarrow \quad \searrow \\ \text{-bun-e-re} \end{array}$	**!					**
b. $\begin{array}{c} [-\text{ATR}] \\ \swarrow \quad \searrow \\ \text{-bun-e-re} \end{array}$	*	*			*	**
c. $\begin{array}{c} [+ \text{ATR}] \quad [-\text{ATR}] \\ \quad \swarrow \quad \searrow \\ \text{-bun-e-re} \end{array}$	*		*	**		*
d. $\begin{array}{c} [+ \text{ATR}] \quad [-\text{ATR}] \\ \swarrow \quad \searrow \\ \text{-bun-e-re} \end{array}$	*		**!	*		*

5. FAITHFULNESS, ALIGNMENT AND THE MARKEDNESS CONSTRAINT *HI/RTR

This section discusses certain complications that arise from the interaction of the markedness constraint *HI/RTR with the alignment and faithfulness constraints. I established in the previous section that regressive [−ATR] spreading is subject to the constraint *HI/RTR which rules out the co-occurrence of these two features. With *HI/RTR dominating ALIGN, there is no spreading of [−ATR] from an invariant suffix to a [+ATR] high root vowel. This was shown in tableau (70).

The ranking *HI/RTR $\gg$ ALIGN also explains why an alternating high vowel suffix that occurs between a [+ATR] root and a [−ATR] invariant suffix surfaces as [+ATR]. If the markedness constraint dominates spreading, it is the output candidate with the fewest violations of the markedness constraint that is preferred, as shown in (77). All vowels in (77a) are associated with the [+ATR] value of the root. This form violates the suffixal faithfulness constraint twice, but satisfies *HI/RTR. All vowels in (77b) are associated with the [−ATR] feature of the suffix. This form violates IDENT-IO suffix [ATR] only once, but has two violations of the markedness constraint and the constraint on root faithfulness. The remaining candidates tie on IDENT-IO suffix [ATR]. Candidate (77c) violates *HI/RTR, however, which is satisfied by candidate (77d), making it the winner.

- (77)
- $\begin{array}{c} [-\text{ATR}] \quad [+ \text{ATR}] \quad [-\text{ATR}] \\ | \quad \diagup \quad | \\ \text{a} - \text{k} - \text{i} \text{ d o} - \text{U} \text{n} - \text{e} \text{t} \end{array}$
'birth'

	IDENT-IO suffix [ATR]	*HI/RTR	ALIGN-R [αATR]	ALIGN-L [αATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. $\begin{array}{c} [+ \text{ATR}] \\ \\ - \text{i} \text{ d o} - \text{u} \text{n} - \text{e} \text{t} \end{array}$	**					**
b. $\begin{array}{c} [-\text{ATR}] \\ \\ - \text{i} \text{ d o} - \text{u} \text{n} - \text{e} \text{t} \end{array}$	*	**			**	***
c. $\begin{array}{c} [+ \text{ATR}] \quad [-\text{ATR}] \\ \quad \diagup \quad \\ - \text{i} \text{ d o} - \text{u} \text{n} - \text{e} \text{t} \end{array}$	*	*!	**	**		*
d. $\begin{array}{c} [+ \text{ATR}] \quad [-\text{ATR}] \\ \quad \diagup \quad \\ - \text{i} \text{ d o} - \text{u} \text{n} - \text{e} \text{t} \end{array}$	*		*	***		*

[−ATR] high vowels are not entirely excluded in Turkana, however. They are found in three environments: (a) [−ATR] high vowels are found in roots if the root is unsuffixed or if an alternating suffix is attached to the root; (b) [−ATR] high vowels are found in alternating prefixes and suffixes that are attached to a [−ATR] root; (c) [−ATR] high vowels are found in suffixes that are attached to an invariant [−ATR] suffix. The only form of [−ATR] spreading that is excluded, then, is spreading from an invariant suffix to a preceding high vowel.

To explain this phenomenon I assume that the markedness constraint *HI/RTR does not express an absolute prohibition on the occurrence of the feature values [+high] and [−ATR], but a preference: Turkana favors high vowels that bear the unmarked value [+ATR]. If there is a [+ATR] feature in the underlying representation a high vowel associates with it as long as association does not violate the line-crossing constraint (Goldsmith 1976). However, if there is no [+ATR] feature in the input or if association would result in crossed association lines, a high vowel associates with an underlying [−ATR] feature. That is, it is better for a high vowel to associate with a [−ATR] feature value that is part of the underlying representation than for a [+ATR] feature to be inserted into the representation. Translated into optimality theoretic terms this means that the featural faithfulness constraint DEP-IO [ATR] in (78) which requires every [ATR] feature of the output to have a correspondent in the input must rank higher than the markedness constraint *HI/RTR.

Consider the candidates in tableau (79) which are based on the [−ATR] root /-mɔ/ ‘enemy’ and an unspecified high vowel suffix. If the suffix vowel remains without a feature specification, as in (79a), INTERPRETABILITY is violated which ranks higher than IDENT-IO [ATR]. Candidate (79a) is therefore excluded from the competition. The remaining candidates both

violate the suffixal faithfulness constraint. Candidate (79c) also violates the markedness constraint *HI/RTR and would therefore be inferior to candidate (79b), if the featural faithfulness constraint DEP-IO [ATR] were ranked below the markedness constraint. With DEP-IO [ATR] ranking above the markedness constraint, however, the optimal candidate is (79c) which is simply marked with respect to the constraint *HI/RTR (Smolensky 1993; McCarthy and Prince 1994).

- (78) DEP-IO [ATR]: Every [ATR] feature of the output has a correspondent in the input.

- (79) DEP-IO [ATR] $\gg$ *HI/RTR

[-ATR][-ATR]
| |
e - m ɔ - l t 'enemy, sg.'

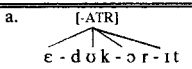
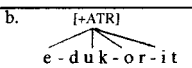
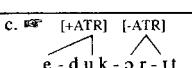
	INTER PRET	IDENT- IO suffix [ATR]	DEP-IO [ATR]	*HI/RTR	ALIGN-L [αATR]	ALIGN-R [αATR]	IDENT- IO [ATR]
a. [-ATR] $\wedge$ e - m ɔ - l t	*!					*	
b. [-ATR] [+ATR] $\wedge$ e - m ɔ - i t		*	*!		**	*	*
c. ~~***~~ [-ATR] $\wedge$ e - m ɔ - l t		*		*			*

Next consider an example in which a [+ATR] root is followed by an invariant [−ATR] suffix and an alternating high vowel suffix. The high vowel in the alternating suffix agrees with the preceding invariant suffix in [−ATR]. These cases are interesting because they decide on the ranking of the suffixal faithfulness constraint and the markedness constraint *HI/RTR which are as of yet unranked. Tableau (80) compares the three candidates which are most relevant for determining the relationship between IDENT-IO suffix [ATR] and *HI/RTR. In (80a) all vowels associate with the [−ATR] feature of the invariant suffix. This amounts to a single violation of IDENT-IO suffix [ATR] and two violations of the markedness constraint *HI/RTR. In (80b) all vowels associate with the [+ATR] feature of the root. This amounts to two violations of IDENT-IO suffix [ATR], while the markedness constraint is satisfied. In (80c), finally, the vowel of the alternating suffix associates with the [−ATR] feature of the preceding invariant suffix. IDENT-IO suffix [ATR] is violated only once in this case and so is the markedness constraint *HI/RTR. If *HI/RTR were ranked above IDENT-IO suffix [ATR], candidate (80b) would be the winner since it satisfies the

markedness constraint. The optimal form is (80c), however. This shows that IDENT-IO suffix [ATR] dominates *HI/RTR. Under this ranking, candidate (80b) is ruled out as a possible output because it violates the suffixal faithfulness constraint twice. And candidate (80a) loses out to candidate (c), because it violates the markedness constraint twice.

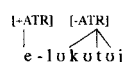
(80) IDENT-IO suffix [ATR] $\gg$ *HI/RTR

[-ATR][+ATR][-ATR]
 | | |
 e - d u k - ɔ r - i t 's/he builds over there'

	IDENT-IO suffix [ATR]	*HI/RTR	ALIGN-L [αATR]	ALIGN-R [αATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a. 	*	**!			*	**
b. 	**!					***
c. 	*	*	**	**		**

We are finally ready to reconsider the underlying representation of prefixes. In the previous section it was mentioned that prefixes cannot be specified as [+ATR] in the input. If prefixes were specified as [+ATR] in the input the vowels of a following [-ATR] high vowel root would associate with the [+ATR] value of the prefix because the markedness constraint *HI/RTR ranks above ALIGN and the faithfulness constraint IDENT-IO root [ATR]. This is illustrated in the following tableau. The root is specified as [-ATR], while the prefix is [+ATR]. (81a) violates INTERPRET and IDENT-IO root [ATR] because the root vowels are specified as [-ATR] in the input but are unspecified on the surface. In (81b) and (81c), the root vowels are associated with the underlying [-ATR] feature in the output. These forms violate the markedness constraint. In (81d), finally, the root vowels associate with the [+ATR] value of the prefix. (81d) is therefore the only candidate that satisfies both INTERPRET and the markedness constraint and so should emerge as optimal. The correct output is (81c), however. I conclude from this that prefixes are either specified as [-ATR] or unspecified in the input. Knowing the full ranking of the constraints, we can exclude that [+ATR] is present in prefixes underlyingly.

(81)



	INTERPRET	*HI/RTR	ALIGN-L [αATR]	ALIGN-R [αATR]	IDENT-IO root [ATR]	IDENT-IO [ATR]
a.	***			***	***	***
b.		***	*	***		
c.		***				*
d.					***	***

It is in the treatment of high vowels that the advantage of an Optimality-Theoretic approach to Turkana vowel harmony over an approach within Lexical Phonology emerges (Kiparsky 1982, 1985). The markedness constraint *HI/RTR governs only the regressive spreading of [–ATR] from suffixes. It has no effect on the progressive spreading of [–ATR] from an invariant suffix to a following alternating suffix. It also has no effect on the regressive or progressive spreading of [–ATR] from roots to alternating affixes. If we posit *HI/RTR as a co-occurrence constraint in Turkana, it would govern underlying representations and also the lexical application of any phonological rule by virtue of structure preservation. *HI/RTR would thus effectively rule out the association of [–ATR] with any high vowel in the lexical phonology of Turkana. This is clearly the wrong result. We can therefore not appeal to the universal markedness constraint *HI/RTR to explain the opacity of high vowels to regressive [–ATR] spreading.

Under the Optimality-Theoretic approach the universal markedness constraint *HI/RTR is fully present in the grammar of Turkana, even though it is violated in some output forms. Its effect is only observed when the dominating constraints DEP-IO [ATR], INTERPRET, and IDENT-IO suffix [ATR] are not relevant. Given the basic tenet of Optimality Theory that all constraints are ranked and violable, the Turkana pattern in which a universal markedness constraint has a limited applicability is expected.

6. CONCLUSION

This paper has presented evidence from Turkana that faithfulness to an underlying suffix value ranks higher than faithfulness to an underlying root value. This claim is based on the existence of a set of invariant suffixes.

Invariant affixes are not a novelty, but are found in other languages as well, such as Kalenjin (Hall et al. 1974; Ringen 1989), Turkish (Clements and Sezer 1982, p. 231), Warlpiri (Nash 1979), and Hungarian (Vago 1980), to mention just a few. What sets Turkana apart from these languages is that it has invariant suffixes of either harmony class and that these suffixes spread their underlying tongue root specification onto preceding root and prefix vowels. The invariant suffixes of Turkana are therefore characterized by two of the properties Beckman (1997) lists as typical of linguistically salient positions: they resist and they trigger the application of a phonological process. Suffix position must therefore be recognized as linguistically privileged in Turkana. This conclusion is incorporated into the present analysis by positing a positional faithfulness constraint IDENT-IO suffix [ATR] which ranks higher than the faithfulness constraint IDENT-IO root [ATR].

A second, important conclusion that must be drawn from this study is that alternating suffixes are unspecified for tongue root position in the input. Lacking an inherent [ATR] specification, they harmonize with the preceding root. Underspecification plays a crucial role in this account, then, since it draws a representational distinction between alternating and non-alternating suffixes. Ironically, it is precisely the difference between alternating and non-alternating morphemes that positional faithfulness constraints are supposed to account for: morphemes in privileged positions fail to alternate if IDENT-Position (F) is ranked higher than C; morphemes in non-privileged positions alternate if IDENT (F) is ranked lower than C. An account that uses only positional faithfulness constraints fails, however in a case like Turkana in which alternating and non-alternating morphemes belong to the same class of morphemes; i.e., suffixes. So does an account that relies only on the use of underspecified representations and feature-filling rules. It is only when positional faithfulness constraints are combined with underspecified input representations that a full account of vowel harmony in Turkana is possible.

I leave it to future research to show what role underspecification ultimately plays in Optimality Theory.

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