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Harmony and Metrical Structure in Palestinian Arabic

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1 Introduction

Examples of non-local phonological processes that are bound by prosodic domains are expected in the world's phonologies. In other words, we should anticipate cases where the metrical foot constrains vowel harmony. Intuitively, it seems like a natural interaction. However, the notion of vowel harmony bound by the metrical foot has only been sparsely proposed in the literature (Abu-Salim 1987, Hualde 1989). Both of these analyses antedate the most recent widely accepted framework in phonology, Optimality Theory (OT, Prince and Smolensky 1993). In this paper, I analyze an asymmetric instance of this expectation within OT, which to the best of my knowledge, has yet to be undertaken. This dependency is asymmetric because harmony is bound in only one direction by the metrical foot.

Following Abu-Salim (1987), I contend that regressive spreading of the feature class *color* is constrained by the metrical foot edge in Palestinian Arabic (PA). *Color* is defined as the feature class containing both [back] and [round] (Odden 1991, Selkirk 1991, Padgett 1995a). I account for this fact by adopting the constraint CRISPEDGE (Itô and Mester 1999), which was formulated as an

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extension of alignment. Conversely, progressive spreading is restricted by morpheme identity constraints. This is accounted for with IDENTSUFFIX (Noske 2000), which governs the input to output featural identity of the suffix.

Regarding the foot structure of PA, which is outlined first, I propose a new generalization that the preferred metrical foot is trimoraic. This claim is based upon the typologically possible foot structures in PA, where it shown that trimoraic feet are most common. Subsequently, I argue that this generalization is implemented into the grammar by way of a constraint requiring trimoraic feet.

The paper is organized as follows: Section 2 presents the relevant data with regard to the metrical structure and provides an analysis within OT. It is in this section that I propose that the preferred foot in PA is trimoraic. Section 3 presents an argument against using alignment to characterize harmony systems, which is based on a novel analysis of Somali [ATR] harmony. Section 4 describes the harmony patterns evident in PA, while Section 5 presents the analysis. There, I show that CRISPEDGE and IDENTSUFFIX adequately account for the harmony-metrical interaction. Before concluding, Section 6 presents some residual questions regarding the analysis and the phenomenon more generally.

2 Palestinian Arabic Stress

2.1 Data

PA makes a three-way distinction based on syllable weight that will become clear when the stress facts are considered below. The distinction made is between light (CV), heavy (CVC or CVV), and superheavy (CVVC or CVCC) syllables. Word-final position is the only place where superheavy syllables are licit. Otherwise, there are no other restrictions regarding the distribution of light and heavy syllables.

Stress in PA is quantity sensitive and looks from right-to-left (Abu-Salim 1987, Kenstowicz 1981, Kenstowicz and Abdul-Karim 1980). If the final syllable is superheavy then it always receives stress, as in (1a-d).

(1)	a.	da.rást	'I studied'
	b.	baa.béen	'two doors'
	c.	duk.káan	'shop'
	d.	bit.šúuf	'she sees'

If the condition in (1) is not met, if the final syllable is not superheavy, then stress looks leftward to the penult for a heavy syllable. In other words, if the final syllable is light or heavy and the penult is heavy or initial then it receives stress, as in (2a-d).

(2)	a.	mak.táb.to	'his library'
	b.	dár.bat	'she hit'
	c.	ka.táb.na	'we wrote'
	d.	baa.ra.kát.na	'she blessed us'

Finally, if the two conditions described above are not satisfied, then stress will continue to look leftward. For example, if the final syllable is not superheavy and the penult is either light or non-initial, then stress must consider the antepenult in order to find a suitable candidate for stress placement. The examples in (3a-d) all show the antepenult as initial and stressed.

(3)	a.	ká.ta.bu	'they wrote'
	b.	báa.ra.ko	'he blessed him'
	c.	ʔíd.fa.ʕu	'pay (pl. imperative)
	d.	bá.ka.re	'cow'

An obvious question that arises is what happens in words with four syllables, where the conditions in (1) through (3) are not met, and the preantepenult is heavy? Recall that in the above algorithm, stress avoided light syllables unless they were in initial position.[1] The examples in (4) show that the antepenult is the leftmost syllable able to bear stress. Crucially, even if the preantepenult is heavy, the antepenult still receives stress.

(4)	a.	ʕal.lá.ma.to	'she taught him'
	b.	mak.tá.bi.to	'his library'

In the next section, I provide Abu-Salim's (1987) analysis of the foot structure in PA and subsequently present an OT analysis that accounts for it.

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[1] I assuming that words must contain at least one stressed syllable, and that a word without stress would fail at some point in the process. An interesting observation is that words in PA do not carry more than one stress. The only place in the literature where secondary stress has been considered is Hayes (1995). Otherwise, Kenstowicz (1981), Kenstowicz and Abdul-Karim (1980), Abu-Salim (1987) all do not recognize secondary stress.

2.2 Analysis

Under Abu-Salim's (1987) analysis, the foot, which is trochaic in PA, contains the tonic syllable and all syllables to the right, as in the examples in (5a-d). The foot structure proposed there is further supported based on evidence of vowel shortening in PA.

(5)	a.	(yíf.ham)	'he understands'
	b.	ʕal(lá.ma.to)	'she taught him'
	c.	bit(šúuf)	'she sees'
	d.	baa.ra(kát.na)	'she blessed us'

Again, the foot structure I am assuming, as illustrated in (5), is adopted from Abu-Salim (1987).[2] It is my claim that the preferred foot structure in PA is trimoraic, as in the examples in (5b-d).[3] This assumption follows the stress algorithm presented above. If the final syllable is superheavy, then it receives stress and comprises the entire foot, as in (5c). The foot in (5c) is trimoraic. If the ultima, penult and antepenult are all light then stress falls on the antepenult, which results in a trimoraic foot, as in (5b). Finally, if the ultima is light and the penult is heavy, then stress falls on the penult, which also results in a trimoraic foot, as in (5d). These three cases all support the idea that the preferred foot in PA is trimoraic.

The only possible bimoraic foot is (**L**L), of which I have not seen cited. Furthermore, the only typological exceptions, beside (**L**L), are (**L**LH), (**H**H) and (**H**LH), which all have more than three moras. The most common 'exception' is (**H**H), as in (5a). The foot (**H**LH), to the best of my knowledge, only arises out of suffix concatenation, and I have yet to see examples of (**L**LH). Thus, typologically, the preferred foot appears to be trimoraic.

In the following section, I present an OT analysis of the stress system for PA described above. The notion of the trimoraic foot will become clear as the analysis proceeds below.

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[2] For alternative analyses, see Hayes (1995) and Kager (1999).

[3] My assumption here is that one mora is assigned to the vowel and one mora is assigned to each coda consonant. Syllable weight is blind to onset material, which I believe to be the standard assumption. For example, a syllable of the type CVC is bimoraic, in that one mora is assigned to the vowel and one to the coda consonant. A syllable of the type CVCC or CVVC is trimoraic.

2.3 OT Analysis
2.3.1 The relevant constraints

As it was argued for in Section 2.2, it appears that the preferred foot in PA is trimoraic. The most straightforward way to incorporate this generalization into an OT model is by creating a constraint requiring this foot structure. Thus, I introduce the constraint in (6), which I believe is not too distinct from FT-BIN, aside from the obvious difference. Violations of this constraint are calculated absolutely. Thus, a candidate with a bimoraic foot will fare as poorly as a candidate with nine moras in a foot, theoretically. There are, however, no consequences for the analysis here if it is calculated in an absolute or a gradient manner.

(6) $Ft_{\mu\mu\mu}$: Feet are trimoraic

Thus, the constraint in (6) directly encodes this claim into the grammar.[4] The exceptional cases that were mentioned at the end of Section 2.2 are not completely eliminated because of a central tenet of OT, constraint violability (see footnote 6 for a brief discussion). In other words, this constraint can be violated if it is outranked.

Furthermore, under the metrical analysis above, the foot contained the tonic syllable and all feet rightward. Thus, the right edge of the foot must align at the right edge of the word, motivating the constraint in (7).

(7) ALL-FT-R: Align all metrical feet at the right edge of the word

Finally, recall that the stress system of PA is quantity-sensitive. In other words, heavy and superheavy syllables attract stress. This motivates the weight-to-stress principle constraint presented in (8), whereby superheavy and heavy syllables attract stress. Unstressed (super)heavy syllables incur a violation.

(8) WSP: (Super)Heavy syllables attract stress

2.3.2 The ranking

In this section, I present the proposed constraint ranking for the metrical analysis presented in Section 2.2 using the constraints defined in Section 2.3.1 above. The

[4] The repercussions of this approach to ternary stress systems have yet to be addressed and require further inquiry. This approach could bring insight into such systems (Bruce Hayes p.c.).

first example illustrates a word-final superheavy syllable, which always attracts stress. This is presented in (9).

(9)

/darast/	ALL-FT-R	$Ft_{\mu\mu\mu}$	WSP
a. (dá.rast)		*!	*
b. ☞ da(rást)			
c. (dá)rast	*!	*	*

Suboptimal candidate (9a), which illustrates total parsing and subsequently four moras in the foot, is eliminated on a violation of $Ft_{\mu\mu\mu}$. Furthermore, candidate (9c), which parses only the initial syllable, violates both ALL-FT-R and $Ft_{\mu\mu\mu}$ and thus loses in the evaluation. Optimal (9b), which both stresses the superheavy syllable and aligns the right edge of the foot with the right edge of the word, satisfies the high-ranked constraints. Crucially, notice that the foot must be aligned at the right edge, and the superheavy syllable must be stressed, as in the optimal candidate (9b).

Next, consider the examples presented in (4), where it was noted that the leftmost syllable able to bear stress is the antepenult, regardless of the weight of the preantepenult.

(10)

/ʔallamato/	ALL-FT-R	$Ft_{\mu\mu\mu}$	WSP
a. (ʔál.la.ma.to)		*!	
b. ☞ ʔal(lá.ma.to)			*
c. ʔal.la(má.to)		*!	*
d. ʔal(lá.ma)to	*!	*	*
e. (ʔál.la)ma.to	*!*		

Suboptimal candidates (10a), (10c) and (10d) all violate $Ft_{\mu\mu\mu}$. Suboptimal candidate (10d) fails to align the right edge of the foot at the right edge of the word and also fails to parse a trimoraic foot. Violating both ALL-FT-R and $Ft_{\mu\mu\mu}$, it loses in the evaluation. Suboptimal (10e) manages to parse a trimoraic foot; however, it fails to align the foot at the right edge of the word. The optimal candidate (10b) parses a trimoraic foot that is aligned at the right edge of the word, despite not stressing the heavy preantepenult. This motivates the relative ranking of $Ft_{\mu\mu\mu}$ » WSP, as it appears that parsing a trimoraic foot takes precedence over stressing a heavy syllable.

The evaluation in (11) presents another case where the antepenult is not the initial syllable and a heavy syllable appears in preantepenult position. In this case, however, it is not the antepenult that receives stress, but the penult because it is heavy and thus attracts stress. This contrasts with (10), where the penult was light and non-initial and it was unable to carry stress.

(11)

/baarakatna/	ALL-FT-R	$Ft_{\mu\mu\mu}$	WSP
a. (báa.ra.kat.na)		*!	*
b. ☞ baa.ra(kát.na)			*
c. (báa.ra)kat.na	*!*		*

The candidate in (11a), where all the syllables are parsed, loses on a violation of $Ft_{\mu\mu\mu}$. Suboptimal (11c) fails to align the foot at the right edge of the word and thus violates ALL-FT-R. Again, the foot should be trimoraic and aligned at the right edge. Candidate (11b) stresses the heavy penult and parses the final light syllable. Satisfying the two high-ranked constraints, (11b) wins in the evaluation, despite a violation of WSP, which is incurred based on a failure to assign stress to the heavy preantepenult.

The last evaluation presented in this section is intended to illustrate that trimoraic feet, although preferred, are not absolute in PA. The example is *ti-ktub-i* 'you (FEM.SG) write'. [5]

(12)

/ti-ktub-i/	ALL-FT-R	$Ft_{\mu\mu\mu}$	WSP
a. ☞ (túk.tu.bi)		*	
b. (túk.tu)bi	*!		
c. tik(tú.bi)		*	*!

Here, neither of the candidates ((12a) and (12c)) that have right aligned feet are trimoraic. Thus, although preferred, trimoraic feet are not absolute in PA. The desire to align the foot at the right edge takes priority over parsing a trimoraic foot. Suboptimal candidate (12b) loses on not aligning the foot at the right edge, despite parsing a trimoraic foot. This motivates the relative ranking ALL-FT-R » $Ft_{\mu\mu\mu}$. (12a) and (12c) tie on $Ft_{\mu\mu\mu}$, and subsequently (12c) is eliminated on WSP. The proposed ranking for the metrical foot in PA is presented in (13), where

[5] The change in vowel quality is the focus of the rest of the paper.

alignment of the metrical foot at the right edge of the word takes precedence over trimoraic feet, which in turn takes precedence over stressing heavy syllables.[6]

(13) ALL-FT-R » $Ft_{\mu\mu\mu}$ » WSP

In the next section, I analyze data from Somali, whereby the use of alignment appears inadequate to account for the [ATR] harmony exhibited. It is from this argument that I adopt a SPREAD approach to vowel harmony in OT, and subsequently use it to account for the harmony facts discussed below for PA.

3 Vowel Harmony in OT

3.1 Alignment Analysis

Data from Somali (Saeed 1999), an East African Cushitic language, shows that alignment may not the best means to characterize vowel harmony in OT.[7] In Somali, vowels within words share identical values for the feature [ATR], as in [ɪdɑn] 'permission' and [idæn] 'incense burner'. Furthermore, if there is a [+ATR] vowel in a sentence, then [ATR] spreads to all vowels in the sentence. In (14), all the underlying vowels are [-ATR], and thus all the vowels in the sentence surface as [-ATR]. In (15), the vowels of *dibi* are underlyingly [+ATR], motivating [+ATR] harmony throughout the sentence. The 'dominant' feature, as Saeed (1999) describes it, is [+ATR].

(14) *waa sáan farás*
[wɑ: sɑ:n fɑrɑs]
'it is a horse's hide'

(15) *waa sáan dibî*
[wæ: sæ:n dibi]
'it is a bull's head'

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[6] The foot type (**H**LH) is evident. However, under the ranking in (13), this candidate, which exhibits a five mora foot, would be eliminated in favor of H(**L**H). I am forced to argue that there is another constraint involved along the lines of *STRESS, which would disallow ultima heavy syllables and ultima and penult light syllables from receiving stress, unless in initial position. I would particularly like to thank Luigi Burzio and Bruce Hayes for recognizing this shortfall and subsequent discussion.

[7] A ten vowel system exists in Somali, with the [+ATR] vowels /i e æ ö ʉ/ and the [-ATR] vowels /ɪ ɛ ɑ ɔ u/ (Saeed 1999). This is not the standard [± ATR] distinction; however, so long as it is consistent, there exists no repercussions for the analysis here.

Using alignment, we would be forced to align the feature [ATR] at the sentential boundaries. This would necessitate a constraint along the lines of ALIGN (S, ATR). Alignment at the sentential edges for prosodic purposes does not seem ideal. In fact, Saeed (1999) does not examine the distance of [ATR] spreading beyond the sentence, which is thus unknown. This further motivates the desire for some other mechanism to drive harmony in OT.

3.3 Spreading Analysis

Instead of using an alignment approach to harmony in OT, I adopt SPREAD (Kirchner 1993[8], Padgett 1995b). This constraint is defined as every feature is linked to every possible segment in some domain (Padgett 1995b). If SPREAD is undominated, then unrestricted spreading is expected. Again, recall that in Somali, if a [+ATR] vowel exists in a sentence, then all of the vowels surface as [+ATR], as in (15). The ranking I propose for [ATR] spreading in Somali is presented in (16).

(16) SPREAD [ATR], IDENT [+ATR] » IDENT [-ATR]

Because spreading is essentially unconstrained in Somali, we expect SPREAD to be undominated. In (16) it is tied with IDENT [+ATR] to ensure that it is the [+ATR] vowel that triggers harmony. In order for harmony to be licit, IDENT [-ATR], which governs the retention of identity between input and output [-ATR] vowels, must be dominated.

In the next section, I present the facts of vowel harmony in PA, and show that *color* harmony can be either progressive or regressive. In the following section, Section 5, I provide an OT analysis for harmony in PA.

4 Vowel Harmony in Palestinian Arabic

Kenstowicz (1980) and Abu-Salim (1987) described the harmony in PA as the spreading of the feature [round]. In actuality, it is the features [round] and [back] that spread together. Because this dialect of Arabic has a five vowel system /i e a o u/, the two features must pattern together. In order to be [+round], the vowel must also be [+back]. This is presented in (17).

[8] Note that Kirchner (1993) used *SPREAD, which disallowed feature spreading.

(17)		+high	-high	
	+round	u	o	+back
	-round	i	e a	-back

Furthermore, these two features have a tendency to pattern together in cross-linguistically-documented harmony systems (Stevens, et. al 1986, Odden 1991, Selkirk 1991, Padgett 1995a). The features [round] and [back] thus have a privileged status in patterning together, as opposed to other combinations, say [back] and [low] or [back] and [nasal] (Padgett 1995a).

I follow Padgett in assuming Feature Class Theory (FCT), a departure from the Feature Geometric systems. Under this system, features no longer cohabitate under particular nodes, but are rather united in sharing certain properties. This approach eliminates say the 'place' node in the Feature Geometry framework, and instead features like Coronal, Labial, Dorsal and Pharyngeal are all grouped together based upon sharing a common property of *placeness*. By removing these features from underneath particular nodes, it allows subsets of feature classes to spread together, like [round] and [back]. This feature class has been termed *color*.[9] Below, I consider the facts of vowel harmony; more specifically, I analyze *color* harmony in PA and provide an OT analysis in the following section.

4.1 Facts

Color spreads either progressively or regressively if the root initial vowel has *color* (i.e. *u*), and the target vowel is [+high] and does not have *color* (i.e. *i*). Progressive harmony is represented in (18c) and (18d). The underlined vowels are epenthetic, and following Abu-Salim (1987), their underlying representation is *i*.

[9] Colleen Fitzgerald brings up two interesting points. First, why is the target vowel not simply considered a copy vowel? I am following the previous analyses of this phenomenon, where it was explicitly assumed to be harmony. Second, is why *o* does not trigger *color* harmony, since in following the literature, I am assuming *color* to include [round] and [back]? Crucially, the target vowel must be [+high], and thus the facts of harmony in PA exclude *color* triggered by *o* from spreading to *e*, because *e* is not [+high]. I am also assuming that vowel height is not harmonized here.

(18) Progressive Harmony

a. ʔáki̱l — ‘food’
b. ǰísi̱r — ‘bridge’
c. fúru̱n — ‘oven’
d. ʕúru̱s — ‘wedding’

Notice that in (18a) and (18b), the root initial vowel does not have *color* and thus does not trigger harmony. However, in (18c) and (18d), the root initial vowel is *u*, which triggers harmony to the epenthetic high vowel. Regressive harmony to the prefix is represented in (19c) and (19d).

(19) Regressive Harmony

a. yí-fham — ‘he understands’
b. tí-lbis — ‘she wears’
c. yú-drus — ‘he studies’
d. tú-ktub — ‘she writes’

The examples in (19a) and (19b) do not show harmony to the prefix vowel, which is a licit target, being *i*. Harmony is not triggered crucially because the root initial vowel does not have *color*. The examples in (19c) and (19d) illustrate harmony, because the root initial vowel has *color*.

In conclusion, harmony is triggered in PA by root initial vowels that have *color*, which can spread either progressively (18) or regressively (19) to a [+high] target vowel. In the next section, I present a descriptive analysis of how harmony interacts with the metrical foot and suffix identity.

4.3 Analysis

Color does not spread leftward past the tonic syllable, which represents the left edge of the foot (Abu-Salim 1987). Thus, looking at the examples in (20a) and (20b), it is clear that the distance of regressive harmony is bound by the metrical foot edge. In (20b), harmony spreads to the prefix, which is located within the metrical foot because it is the tonic syllable. In (20a), however, the prefix vowel does not undergo harmony because it is not located within the metrical foot.

Furthermore, notice in (20c) that harmony does not spread to the suffix, even though it is located within the metrical foot. I claim this is due to morpheme identity constraints. This is not unreasonable, seeing as how PA has both *-i* and *-u* suffixes. Thus, harmony is likely blocked to retain this lexical contrast.

(20) a. bi-t-(šúuf) 'she sees'
b. (tú-k.tub) 'she writes'
c. (tú-k.tu.b-i) 'you (FEM.SG) write'

In the next section, I analyze these harmony facts within an OT framework, showing that OT can adequately account for this asymmetrical dependency between harmony and the metrical foot.

5 OT account of Colour spreading in Palestinian Arabic

I continue to adopt SPREAD, as it was defined in Section 3.2. Instead of Spread targeting [ATR], however, it will instead target the feature class *color*.[10] The additional constraints, along with SPREAD, are presented in (21a) and (21b).

(21) a. IDENT-σ^1 (Beckman 1997)
Initial vowels of the root retain their featural specifications.

b. IDENT-IO [color]
[color] in the input corresponds to an identical value for [color] in the output.

The constraint in (21b) governs the input to output correspondence of the feature class *color*. (21a) follows Beckman (1997), in that certain positions are inherently privileged. Operative under the notion of Positional Faithfulness, the constraint in (21a) targets root initial vowels and governs the retention of their input featural specifications. This constraint is needed because, to recall from above, it is the root initial vowel that triggers harmony and does not undergo harmony. It should be clear that SPREAD and IDENT-σ^1 must dominate IDENT-IO in order to allow vowel harmony to be triggered by the root initial vowel. This is presented in the evaluation in (22).

[10] A crucial point to FCT, as outlined in Padgett (1995a), is that constraints targeting feature classes are gradient.

(22)

/ ʕurs /	SPREAD	IDENT-σ¹	IDENT-IO
a. (ʕú.ris)	*!		
b. ☞ (ʕú.rus)			
c. (ʕí.ris)		*!	*

The evaluation in (22) presents foot internal progressive spreading, as in the examples in (18c) and (18d). Notice that both syllables are contained within the foot and there is no suffixation. Because the root initial vowel has *color* and the target vowel is [+high], *color* is allowed to spread. The example in (22a), which shows no harmony is eliminated on a fatal violation of SPREAD. The example in (22c) shows the root initial vowel undergoing [-round] and [-back] spreading and is eliminated on a violation of IDENT-σ¹. The optimal candidate, (22b), shows foot internal spreading from the root initial vowel to the epenthetic vowel.

Next, I will consider cases where regressive harmony is constrained by the metrical foot. What happens when extrametrical material exists left of the foot? Recall that leftward spreading is bound by the foot, as in (20a). I claim that spreading is not permissible beyond the left edge because of the constraint CRISPEDGE, defined in (23).

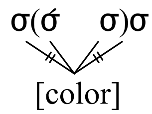
(23) CRISPEDGE (Itô & Mester 1999)
Let /A/ be the terminal substring in a phonological representation, B a category of type PCat and /A/ = B (the content of B). Then B has crisp edges iff A *is-a* B: $\forall$ A(/A/ = |B| $\supset$ /A/ $\equiv$ B).

Featural association lines crossing prosodic boundaries are illicit by this constraint. The obvious definition relevant here is to associate the feature class *color* with the edge of the foot. Recall that the right edge of the foot is always aligned with the right edge of word, and thus, it will not effect progressive spreading. It will, however, bar regressive spreading of *color* past the left edge of the metrical foot. The definition of CRISPEDGE relevant here is formulated in (24).

(24) CRISPEDGE (*color*, Ft)
Multiply-linked *color* associations across the edge of the metrical foot are prohibited

A schematic of CRISPEDGE, showing that any *color* associations crossing the edge of the foot is a violation, is presented in (25). Notice that syllables external to the foot are not subject to *color* harmony by way of CRISPEDGE.

(25)



In order for CRISPEDGE to prevent *color* from spreading across foot boundaries, it must rank high. The interaction of CRISPEDGE in evaluation is presented in the tableau in (26).

(26)

/ bi-t-šuuf /	CRISPEDGE	SPREAD	IDENT-IO
a. ☞ bit(šúuf)		*	
b. but(šúuf)	*!		*

High-ranked CRISPEDGE eliminates candidate (26b), which satisfies SPREAD by harmony spreading to all vowels. Thus, (26a) is selected as optimal despite its violation of SPREAD. Next, I will consider restrictions on the suffix undergoing harmony.

Progressive harmony will always occur foot-internally, adopting the metrical system for PA outlined in Section 2. Thus, why does the suffix not undergo spreading? I attribute this to suffix identity. Originally, it was my claim that harmony was constrained by both edges of the foot, whereby the final mora (a single vowel suffix) was always foot external. Thus, this explained why the suffix was immune to harmony. However, it also predicted that if a heavy suffix was concatenated, the suffix vowel would be subject to harmony. In these cases, the coda material of the suffix would be external to the foot, while the suffix vowel would still be internal to the foot. This is not the case, as in (27).

(27) a. (bú.ʔum.r-ik) ‘he orders you (f.sg.)’
b. *(bú.ʔum.r-uk)

Notice that the suffix, which is claimed to be foot internal, is resistant to *color* spreading, as illustrated by the incorrect form in (27b). This is apparently due to morpheme identity restrictions. I attribute this immunity to harmony to the fact that lexically PA has both the suffixes *-i* and *-u*, and that harmony would compromise this lexical contrast. The constraint presented in (28) is from Noske (2000).

(28) IDENTSUFFIX
Input-Output featural identity of suffixes must be retained.

In order for the suffix to be immune to harmony, IDENTSUFFIX must rank high enough to prevent SPREAD from causing harmony to spread to the suffix. This is illustrated in the tableau in (29).

(29)

/yi-drus-i/	IDENT SUFFIX	CRISP EDGE	SPREAD	IDENT-IO
a. ☞ (yúd.ru.si)			*	*
b. (yúd.ru.su)	*!			**
c. (yíd.ru.si)			**!	

In (29), we expect the prefix vowel to undergo harmony, while the suffix vowel to remain immune to spreading. Suboptimal (29b) loses on a violation of IDENTSUFFIX, as the suffix vowel undergoes spreading. The candidates in (29a) and (29c) both satisfy IDENTSUFFIX and CRISPEDGE; however, (29c) loses on multiple violations of SPREAD. Thus, (29a), which exhibits spreading to the prefix but not to the suffix, wins despite a minimal violation of SPREAD. This violation is incurred because the suffix vowel does not undergo harmony. Finally, the ranking I propose for *color* harmony in PA is presented in (30).

(30) IDENTSUFFIX, CRISPEDGE » SPREAD » IDENT-IO [colour]

6 Residual Issues

In this section, I pose two residual questions that require further research. First, why is foot-internal material, which is intuitively more prominent, more susceptible to spreading than foot-external material in PA as evident above? A possible explanation comes from Kaun (1995) who argues that harmony lengthens the exposure to some 'perceptually vulnerable' [±F]. If this perceptually vulnerable feature is internal to the foot, an already prominent position, then the lengthening of exposure to this feature within a prominent position only seems to increase the likelihood that it will be perceived. This is only speculation and requires further research. More analyses of the type of phenomenon described above, which I believe is to be expected, will help us to further our understanding of this question.

Second, is it the foot edge or tonic syllable that limits spreading? The possibility exists that it could be the tonic syllable, the most prominent position that constrains harmony. In order to answer this question, an example whereby spreading is constrained by the edge of the foot not bearing stress must be documented. For example, leftward spreading constrained by the left edge of an iambic foot would help to us to understand the nature of the relationship described above. Here, harmony was constrained at the left edge of a trochaic foot, which does not shed light on the question.

7 Conclusion

I have argued that *color* harmony in PA is governed asymmetrically. Regressively, it is bound by the left edge of the foot and progressively by morpheme identity in the suffix. This morpheme identity, I believe, retains a lexical contrast among suffixes in PA. The fact that leftward spreading past the left edge of the foot/tonic syllable is illicit appears quite clear. However, whether it is the foot edge or tonic syllable that is constraining the harmony remains unclear. I have also shown how this dependency can be accounted for in an OT framework by adopting CRISPEDGE and reformulating it to apply to foot edges.

Another implication is the concept of a trimoraic foot as proposed here, and its possible effects and repercussions on ternary stress systems. It was my argument that the preferred foot in PA is trimoraic based on a language internal typology. This idea was implemented into the grammar by formulating a constraint that required that feet be trimoraic. It followed from a central tenet of OT, namely constraint violability, that this was not an absolute in the language, although preferred, and could be violated. In conclusion, this paper set out to analyze the *color* harmony system of PA and its interactions with the metrical system. It elucidated what seems to be an expected dependency and showed how an OT framework adequately accounts for it.

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