Izi Vowel Harmony and Selective Cyclicity[1]

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0. Introduction

In this paper, I provide an analysis of vowel harmony in Izi, an Igbo language spoken in the East-Central State of Nigeria. Using data from Meier, Meier, and Samuel (1975; hereafter MMB), I argue that harmony in complex verbal structures in Izi is inadequately accounted for within a level ordered model of lexical phonology (Kiparsky 1982, Mohanan 1982, etc...), claiming instead that harmony facts are best accommodated within a non-level ordered approach (cf. Halle and Vergnaud 1987, Halle and Kenstowicz 1991; Halle, Harris, and Vergnaud 1991).

In sections 1 and 2, I provide a description of the general pattern of the [ATR]-based vowel harmony system in Izi and motivate [+ATR] as the only value of the feature [ATR] present at the level of underlying representation. In section 3, data are presented demonstrating the inadequacy of a level-ordered treatment of vowel harmony in verbal structures. Finally, in section 4, I propose an alternative, non-level ordered analysis that derives the attested harmony facts via cyclic rule application at a single level. Crucially, particular morphemes in verbal structures are claimed to undergo a pass of the cyclic rules prior to concatenation, a phenomenon which I call selective cyclicity.

1. The general pattern

Izi has nine oral vowels: *i, i̧, e, ȩ, o, o̧, u, u̧, a* for which the feature [ATR] is contrastive among the non-low vowels. The distribution of these vowels is provided in (1) below. Figure (1a) reveals the general pattern of ATR harmony, showing that [+ATR] and [-ATR] non-low vowels do not co-occur in Izi words. As seen in (1b-c), however, the low vowel *a* does not appear to participate in the harmony system, surfacing with either [+ATR] or [-ATR] non-low vowels. Importantly, (1c) shows that *a* surfaces *between* [+ATR] or [-ATR] non-low vowels, suggesting that this vowel is transparent to the harmony process.

1. a) *Non-low vowels*

[+ATR]		*[-ATR]*	
byíbú	'to cut with teeth'	tu̧kó	'all'
ídyéré	'soldier ant'	égú̧	'field'
*ídyȩ́ré		*tu̧kó	

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b) *Low vowels at word edges: mixed harmony*

w/[+ATR] non-low vowels		w/[-ATR] non-low vowels	
ákpó	'palate'	ákpọ́	'skin'
kárírú	'to surpass in ability'	márú	'to know'
wòtá	'to take'	húmá	'to see'
íbyìnà	'tadpole'	ìnyà	'horse'
*íbyìná			

c) *Low vowels word-medially*

w/[+ATR] non-low vowels		w/[-ATR] non-low vowels	
ewali	'rabbit'	ìgbàkpọ̀	'pepper'
àxàxù	'old'	ògàzì	'guinea fowl'
*ewalị		*ịgbakpo	

2. Which value for ATR?

Given the general pattern of [ATR] harmony for non-low vowels in Izi words, it is important to consider the question of which value(s) of the feature [ATR] is/are active in the harmony system. With this in mind, consider the data in (2), where a base suffix *-rU* harmonizes with the vowel of a preceding root. In (2a), *U* surfaces as the [+ATR] *u* following [+ATR] root vowels, while in (2b), *U* surfaces as the [-ATR] *ụ* when preceded by [-ATR] root vowels. Note as well that in contrast to the data in (1) above, a root vowel *a* appears to trigger [-ATR] harmony in the base suffix, as seen in the form *ha-rù* 'leave'.

2.	a)	rì-rù	'eat'	b)	tsù-rụ̀	'pound'
		kè-rù	'tie'		ọ́ dù-rụ̀	'there is/are'
		kù-rù	'call'		ha-rụ̀	'leave'

This harmony pattern is further exemplified in (3). Here, the subject pronoun preceding the root and the base suffix exhibit [ATR] alternations, which appear to be conditioned by the [ATR] value of the root.

3.	a)	ó rì-rù jí	he ate yam
	b)	ọ́ tsù-rụ̀ jí	he pounded yam

The data in (2-3) point toward a harmony process in which a bidirectional rule spreads the feature [ATR] from the root. Returning to the issue of which value of [ATR] is active in the system, three possibilities present themselves: 1) Only [-ATR] is present underlyingly; 2) Both [+ATR] and [-ATR] are present at UR; 3) Only [+ATR] is present at UR. I will argue that of these, only (3) provides a maximally simple account of the data.

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First, let us consider the case of [-ATR] as the active or underlyingly present feature in the system. If [-ATR] is present at UR, forms such as *ha-rʋ̀* 'leave' might be accounted for in terms of a rule spreading the [-ATR] feature specified for the root *ha* to the following base suffix. However, this analysis provides no explanation for why non-complex forms such as *ewali*, and no forms such as *ewali* or *ewali*, surface in the language. Given a rule spreading [-ATR], the former is incorrectly ruled out, and, assuming even unidirectional spread, examples of at least one of the incorrect forms are predicted to be found.

If both [+ATR] and [-ATR] are present at UR, forms such as *ewali* can be accounted for by the prelinking of [+ATR] to *e* and *i* and that of [-ATR] to *a*. Under such an analysis, however, one is forced to argue that it is accidental that forms such as *ewali* and *igbakpo* are not found in the language, and that only forms such as *kárírú* and *ògàzì* are. Furthermore, the pre-linking of both features still permits illicit combinations of non-low vowels in a form, since nothing prevents the prelinking of [-ATR] to *e* and *a* together with the prelinking of [+ATR] to *i* in unattested trivocalic forms such as *ewali*.

In contrast, if only [+ATR] is present at UR in Izi, a systematic account of harmony in forms such as those in (1) is readily available. Assuming prelinking[2], only two rules are needed: 1) a rule spreading [+ATR] bidirectionally to non-low vowels; and 2) a redundancy rule assigning [-ATR] to all vowels unspecified for [ATR] after [+ATR] Spread applies. The first of these rules is provided in (4).

4. a) *[+ATR] Spread*

```
    +lo        +lo
     |          |
 μ  (μ)  μ  (μ)  μ
  \        |      /
   \       |     /
    \      |    /
     \    \+A/  /
```
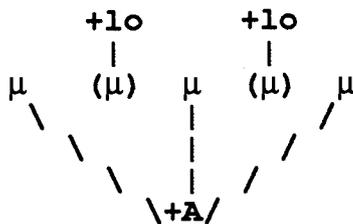
Note that [+lo] vowels are not targets for the rule. Here, I follow Archangeli and Pulleyblank (1992) in positing the following grounded condition for Izi:

5. *LO/RTR Condition:*

    If +LO then -ATR
    If +LO then not +ATR

The condition in (5) prohibits the association of [+ATR] to vowels specified for the feature [+lo]. The second rule necessary for accounting for the harmony facts is provided by the [-ATR] redundancy rule in (6). This rule simply inserts the feature [-ATR] on vowels unspecified for [ATR].

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[2]Nothing in this analysis rests crucially on the issue of prelinking or free [+ATR] at UR. This question is orthogonal to the issue at hand.

6. [-ATR] Insertion:

$$\mu \quad \rightarrow \quad \underset{\underset{\text{-ATR}}{|}}{\mu}$$
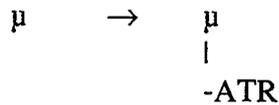
Application of the [-ATR] Redundancy rule is vacuous for *a*, since *a* exhibits no [ATR] alternations. Crucially, however, [-ATR] Insertion must apply after [+ATR] Spread. That is, [-ATR] is not present at the point in the derivation at which [+ATR] harmony is derived in forms such as *ewali*. As seen in (7), [+ATR] can spread from the initial *e* (or the final *i*) to the other non-low vowel without crossing a [-ATR] association line. In forms such as *byíbú*, only [+ATR] spread applies. And in forms such as *t̪úkó*, [-ATR] harmony is derived via [-ATR] Insertion for both vowels. Note that by positing only [+ATR] as underlying, the transparency of *a* is straightforwardly accounted for. This is shown in the derivations in (7).

7.

Input	+ATR Spread	-ATR Ins.	Output	
		-A |		
ewalI | +A	ewali | / +A	ewali | / +A	ewali	'rabbit'
kariru | +A	kariru | / +A	kariru | | / -A +A	kárírú	'to surpass'
tUkO	tUkO	tuko | / -A	t̪úkó	'all'

Further arguments for the presence of only [+ATR] at UR in Izi are found in Muadz (1988) and Gerfen (1990). Interestingly, Archangeli and Pulleyblank (1992) invoke similar arguments in favor of [+ATR] and not [-ATR] as the active, underlying F-element in Akan, a language with the same nine vowel system found here.

3. The level-ordering paradox

As shown schematically in (8), Izi verbal structures are comprised by: 1) an obligatory root; 2) one or more optional extensor suffixes; and 3) a base affix which either precedes the root or follows the root and any extensor suffixes. Following MMB (1975), the root and affixes together are referred to as the verb stem.

8. [Base Affix - Root - Extensor Affix - Base Suffix]

a) Root   Extensor   Base Affix   Obj. Pronoun
    rì-   gbú-   á   !yá
    eat   all   it
    "Eat it all"

Of specific interest here is the behavior of the base suffix -rU. As seen in (2-3) above, -rU harmonizes with the vowel(s) of a preceding root. Recall as well that the subject pronoun in (3c) also harmonizes with the root. Thus, under the assumptions of a level-ordered model of phonology (cf. Kiparsky 1982, Mohanan 1982, Halle and Mohanan 1985, etc...), we conclude that both subject pronouns and -rU are visible to and thus targets for ATR harmony at the level at which the rule spreading [+ATR] applies. Let us call this stratum 1.

Now consider the case of what MMB term "extensor suffixes". Twenty-seven of these are listed, and in all but two cases, they show no [ATR] alternations in their vowel(s). As shown in (9), the specified [ATR] value of a non-low extensor suffix vowel is not conditioned by the preceding root.

9. [-ATR] extensor suffix following [+ART] stem

a) jè-nùkà   work too much

    rí-nùkà   eat too much

    jè-hùnù   go + "what again?"

b) subj. root   ext   base   obj.
    pro.   aff.   pro.
    ò   rí-   kpọ́-   ọ́   !ya
    he   ate   really   it
    'he really ate it'

b') subj. base   root   ext.   base   adj.
    pro.   aff.   aff.
    ọ́   ọ̀-   tsú-   kpọ́-   ọ́   !nkọ́
    it   cut   really   sharp
    'it really cuts, is really sharp'

[+ATR] extensor following [-ATR] stem

c) byà-dò   come because of

    mà-dzù   know all

d)   verb   base
    noun   root   ext.   affix
    mkpùkpù   mà-   dzú-   rù...
    village   knows   all
    'all the village knows...'

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A level ordered model provides an account for this if we assume that the lack of [ATR] alternations in extensor suffixes is attributable to the fact that these are added at a stratum at which the rule spreading [+ATR] is no longer applicable: minimally, stratum 2. Figure (10) provides a simplified illustration of a phonologically level-ordered account of this phenomenon, with the Bracket Erasure Convention (Kiparsky 1982) applying at the end of each stratum.

10) STRATUM 1   (base affix -rU)   (extensor fu̩) 'also'

Morphology   →   [Ó [rí [rÚ   [O [OjE [a
[+ATR] SPREAD   →   [ó rì rù̩]   [ó ójé   a]
& BEC

STRATUM 2
Morphology   →   n/a   [ó ójé fù̩   a]
Phonology   →   n/a   n/a
&BEC
Output   →   [ó rì-rù̩]   [ó ójé-fù̩- a]
                        'he ate...'   'he is going also'

Disregarding for the moment the obvious question of whether the base suffix -a in the from ó ó-jé-fù̩-a is present at level 1, the above account becomes problematic when the Base suffix -rU surfaces to the right of an extensor. As (11) shows, -rU harmonizes with the immediately preceding extensor. Thus, while extensors themselves are not targets for rules deriving [ATR] harmony, they appear to both 1) trigger harmonic spread to a following base suffix; and 2) block harmony between a stem and the base suffix -rU.

11. *-rU following extensor suffixes*

a) [-rU] surfacing as [+ATR]

subj.	root	ext.	base		subj.	root	ext.	base
pro.			aff.		pro.			aff.
mú	*byà-*	*dò-*	*rù*		*ó̩*	*nma-*	*dò-*	*rú* ...
I	came	because			he	tell	because of	
		of...	

'he told X because of...'

b) [-rU] surfacing as [-ATR]

subj.	root	ext.	base	exclamation
pro.			aff.	
í	*jè-*	*hù̩nù̩-*	*rù̩*	*àwé*
you	go	what		exclamation

'where on earth did you go?!'

subj.	root	ext.	base	noun		subj.				base
pro.			aff.			pro.	root	ext.	ext.	affix
ó	kpù-	kwadù-	rụ	íshí		ànyi	mè-	èbè-	wà-	rụ
he	shave	still		head		we	do	all	already	
'he still shaved his head'						'We have done it all, finished it'				

Paradoxically, then, if the absence of [+ATR] Spread to extensor suffixes is accounted for by adding extensors at a stratum after which harmony rules apply, no explanation is available for why the *U* of the base suffix *-rU* should harmonize with the vowel(s) of a preceding extensor suffix and *not* with the vowel(s) of the verb root. Put simply, it appears that extensor suffixes must be added at level 2 in order to prevent [ATR] from spreading to extensor suffix vowels, while at the same time, they must be added at level 1 in order to account for the spreading of [+ATR] onto a following base suffix.

One possible approach to such a problem is to introduce a loop, as in Halle and Mohanan (1985), thus allowing stratum 2 morphology access to stratum 1 phonology. Such an approach, however, fails to account for why extensor suffixes remain opaque to [ATR] harmony. That is, if this mechanism makes stratum 1 phonology accessible to a stratum 2 morpheme, it is not altogether clear why [ATR] alternations never surface in extensors themselves.

More problematic is that a loop does little to account for how a stratum 2 suffix can be affixed inside of a stratum 1 base suffix. If infixation is considered, it becomes necessary to account for how the infix is able to be inserted between morpheme boundaries that are erased by the Bracket Erasure Convention at the end of stratum 1. Furthermore, neither infixation nor a loop can account for cases in which a [-ATR] extensor follows a [+ATR] stem. That is, an analysis involving infixation and a loop predicts the surfacing of incorrect forms such as *yè-wà-ru* 'already add manure'. As seen in (12), [ATR] harmony should obtain on stratum 1 between the [+ATR] root and the base suffix, deriving [...yèru] after Bracket Erasure at the end of the stratum. The extensor that is then somehow infixed at stratum 2 should not trigger any change in the [ATR] value of the base suffix, unless some mechanism is introduced that removes the [+ATR] specification derived at stratum 1 and replaces it with [-ATR]. That is, the extensor should appear to be transparent to harmony applying between the root and the base suffix.

12.
STRATUM 1

Input	$\rightarrow$	[yE
Phonology	$\rightarrow$	[ye
Morphology	$\rightarrow$	[ye[rU
[ATR] Vowel Harmony	$\rightarrow$	[ye [ru
BEC	$\rightarrow$	[yeru]

STRATUM 2

Morphology	$\rightarrow$	[ye <wa> ru]
Phonology	$\rightarrow$	n/a
BEC	$\rightarrow$	[yewaru]
Output	$\rightarrow$	*yè-wà-ru

It might be argued that a solution lies in the postulation of a third stratum. That is, one

might claim that [+ATR] Spread occurs at strata 1 and 3, but not at stratum 2, where extensors are added. Two problems arise for such an approach. First, this analysis would violate the Continuity of Strata Hypothesis (Mohanan 1982, 1986), in which it is claimed that the domain of a rule may not contain non-adjacent strata. Secondly, there are some forms in Izi for which extensors are found *both* before and after the base suffix *-rU*, as seen in (13).

13.
a)

[ì	mà-	nù-	rù-	phǫ́-...]	'you know only too well'
pro.	root	ext	base aff.	ext.	

b)

[o	pfù-	è-	rù-	phǫ̀...]	'just as he spoke...'
pro.	root	ext.	base aff.	ext.	

3. An Alternative Approach

In the discussion above, it is clear that level-ordering fails in two important respects: 1) it does not account for how the infixation of extensors can occur after Bracket Erasure has applied; and 2) it makes incorrect predictions regarding surface forms such as *yè-wà-rụ*. Note also that the data present a problem regarding the role of *a* in the harmony system. In figure (1) above, *a* is transparent to [ATR] harmony, as evidenced by pairs such as *ewali* and *ìgbàkpò*. Yet both *yè-wà-rụ* and *ha-rù* suggest that *a* triggers [-ATR] harmony. Thus, *a* behaves in a paradoxical fashion; that is, *a* must not trigger [-ATR] harmony in forms such as those in (1), yet appears to trigger [-ATR] harmony in forms such as *yè-wà-rụ*.

The next question to be addressed is thus: why does *a* appear to block the [+ATR] spread expected from the root *yè* to the base suffix *-rU*, triggering instead [-ATR] harmony with base suffix vowel? One possibility is to posit that [-ATR] is prelinked to the *a* in the extensor *wa*. [+ATR] Spread to the base suffix would thus be ruled out as a case of crossing association lines. This solution is problematic for two reasons. First, this suggests not only that two types of *a* are present in the language--one prelinked to [-ATR] and the other unspecified underlyingly for [-ATR]--but also that this type of [-ATR] prelinking obtains idiosyncratically within the class of morphemes which do not exhibit [ATR] alternations in their vowels. That is, morphemes such as *ewali* never exhibit prelinking, while morphemes such as *wa* do.

Secondly, the problem of *a* triggering [-ATR] harmony is not limited to *a* itself. That is, as seen in figures (4) and (6) respectively, [ATR] specifications of extensor vowels are not conditioned by preceding roots and are opaque to [+ATR] spread from a root to the base suffix -*rU*. The relevant generalization is thus not that *a* is sometimes opaque to [+ATR] spread, but rather, that the class of extensor suffixes itself is opaque to the spreading of [+ATR]. Under this analysis, I argue that no [-ATR] specifications need be introduced at UR in the language. Extensors, as with all of the forms in (1), are either specified for [+ATR] or unspecified for [ATR] at the level of underlying representation. As shown below, [-ATR] vowels in extensor suffixes surface as a result of the global rule of [-ATR] insertion.

I claim, then, that Izi morphemes can be divided into two basic classes with respect to ATR harmony: 1) Group A morphemes which i) trigger ATR harmony and ii) never exhibit ATR alternations in their vowels; and 2) Group B morphemes which i) do not trigger ATR harmony

and ii) exhibit predictable ATR alternations in their non-low vowels. In terms of the discussion of verb stems here, roots and extensors are constitute Group A morphemes, while base affixes pertain to Group B.

Interestingly, if a level-ordered approach is abandoned, [ATR] harmony can be derived cyclically at one phonological level, that is, the word level (cf. Halle, Harris, and Vergnaud 1991). This analysis requires the cyclic application of the rules of [+ATR] Spread and [-ATR] Insertion in (4) and (6) above, respectively. Crucially, however, while all morphemes in the verb stem are cyclic, Group A morphemes such as roots and extensor suffixes undergo a pass of the cyclic rules prior to concatenation, a pass which I call *selective cyclicity*. As a result, these morphemes are already specified for the feature [ATR] at the point of concatenation in the verb stem, and each constitutes a domain which both triggers harmony and is opaque to [+ATR] Spread.

Focussing on the issue of extensor suffixes, the effects of selective cyclicity are two-fold. In [-ATR] extensors, vowels will be linked to [-ATR] by the application of [-ATR] Insertion prior to concatenation. In the case of [+ATR] extensors, [+ATR] spread will spread [+ATR] to any unspecified non-low vowel in the extensor suffix prior to concatenation. In both cases, the spreading of [+ATR] from a preceding root will thus be prevented after concatenation, as this would require the crossing of [ATR] association lines. In this way, the opacity of extensor suffixes to the spreading of [+ATR] from a verb root to a base suffix following an intervening extensor is accounted for. Of course, a [+ATR] extensor will spread [+ATR] to the following base suffix *-rU*, since *-rU* is by hypothesis cyclic, and nothing blocks the spread of [+ATR] from the extensor. This accounts for the ability of extensor suffixes to trigger harmony on a following base suffix. Relevant derivations are provided in (14).

14.
(a)

```
INPUT              [mU [ [ [byA]   do] rU] ]
                            |      |
                           -A     +A

(1st cycle)
+ATR SPREAD           n/a
-ATR INS.             n/a

(2nd cycle)        [mu [ [ [byA]   do] rU] ]
                            |      |
                           -A     +A

+ATR SPREAD           n/a
-ATR INS.             n/a

(3rd cycle)
+ATR SPREAD        [mu [ [ [bya] do] ru] ]
                            |    | /
                           -A   +A

-ATR INS.             n/a
```

```
(4th cycle)

+ATR SPREAD        n/a
-ATR INS.          [mu   [[[bya] do]ru]]
                      |_____|  | /
                            -A   +A

OUTPUT             mu bya-do-ru
                   'I came-because of-base suff...'
```
b)
```
INPUT                      [I [[[je]  hunu] rU]]
                                |      |/
                               +A     -A
```

(1st and 2nd cycles)
```
+ATR SPREAD                n/a
-ATR INS.                  n/a
```

(3rd cycle)
```
+ATR SPREAD                n/a
-ATR INS                   [I  [[[ jE]   hUnU] rU]]
                                    |      |/___/
                                   +A     -A
```

(4th cycle)
```
+ATR SPREAD                    [i[[[ je]   hunu]  ru]]
                                  \   |     | |    /
                                   \  |     |/__/
                                   +A     -A

-ATR INS.                  n/a
BEC &
OUTPUT                     i je-hunu-ru
                           'you go-what-base suff.'
```

Note that in both (10a-b), the first and second cyclic passes of the harmony rules are inapplicable due to the selectively cyclic application of [+ATR] Spread and [-ATR] insertion prior to concatenation. Note as well in (10a) that the redundant assignment of [-ATR] to the *a* of the root *bya* is crucial to blocking the bidirectional spread of [+ATR] from the extensor to the personal pronoun *mU*, which exhibits predictable ATR alternations, depending on the ATR value of the verb root. Similarly, in (10b), the insertion of [-ATR] on the extensor suffix vowel blocks the spreading of [+ATR] from the root, and [-ATR] is linked to the base suffix as a result of [-ATR] insertion. In (10b), I follow Archangeli and Pulleyblank (1992) in allowing [-ATR] Insertion to be realized via the association of an association line linking the base suffix vowel to the token of [-ATR] already present in the representation, thus avoiding a violation of the OCP (McCarthy 1986, Yip 1988).

4. Conclusion

In this paper, I have argued for a non-level ordered approach to ATR harmony in Izi verb

stems. In particular, I have shown that only the feature [+ATR] need be motivated as present at UR in the language, and that the harmony facts can be accounted for in terms of two rules: 1) a rule spreading underlying tokens of the feature [+ATR], and 2) a rule inserting the feature [-ATR] after [+ATR] Spread has applied. I have shown that a level ordered account of Izi vowel harmony gives rise to bracketing paradoxes and fails to make correct predictions regarding the distribution of [+ATR] and [-ATR] vowels in Izi words. Instead, I argue that harmony can be derived on a single, phonological level, with the proviso that verb roots and extensor suffixes undergo a pass of the rules spreading [+ATR] and inserting [-ATR] prior to their concatenation at the word level, a phenomenon which I have termed selective cyclicity.

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