VOWEL HARMONY IN WOLOF

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ABSTRACT
Wolof is a Senegambian language of Senegal that displays vowel harmony. The vowel harmony system was previously analyzed by Omar Ka on an autosegmental level. Wolof vowels harmonize based upon the feature [ATR]. Harmonization reaches across morpheme and word boundaries. However, there are both neutral and opaque vowels in Wolof. Neutral vowels do not harmonize, but still allow the harmonization process to continue beyond them. Opaque vowels block harmonization. These features are analyzed using Optimality Theory. Two sets of constraints, agreement constraints and alignment constraints, are generally invoked in cases of vowel harmony. In Wolof, agreement constraints do not give the correct output when considering opaque vowels. Alignment constraints, however, account for normal vowel harmony, neutral vowels, and opaque vowels. Three other constraints are necessary to complete the analysis. The final analysis ranks the following constraints: Hi/ATR, IdentATR » AlignR[-ATR] » AlignR[+ATR], NoGap.

1. Introduction

Wolof is a language of Africa spoken primarily in Senegal and Gambia. It is one of the majority languages in these nations, spoken by 80% of the population, commonly used in trade. Wolof is in the Niger-Congo language family, Atlantic-Congo subgroup. It lies in the Northern branch and is subclassified as Senegambian and Fula-Wolof. There are approximately 3,612,560 speakers of Wolof in Senegal, the Gambia, and other nations where Wolof speakers have emigrated.

The data in this paper is based upon a phonological and morphological analysis of Wolof by Omar Ka (1993). Ka uses a nonlinear approach to analyze the phonology, focusing specifically on autosegmental phonology. While Ka looks at several aspects of Wolof phonology, this paper will focus on vowel harmony, described through the theoretical framework of Optimality Theory.

2. Preliminary Vowel Harmony

2.1 The Vowel System

The vowel system in Wolof consists of eight vowel phonemes which are distinguished by the features [high], [low], [back], [round], and [ATR]. The vowel phonemes are listed in Table 1.

Table 1: Vowel Phonemes

		- back	+ back	
		- round	- round	+ round
+ high	+ ATR	i		u
- high - low		e	ə	o
	- ATR	ɛ		ɔ
+ low			a	

Each of the vowels in this table, with the exception of [ə], also has a lengthened counterpart. There are phonological contrasts between long and short vowels. Long vowels appear in all contexts except before prenasals and geminates. In the orthography, long vowels are written as geminates.

The most pertinent feature for the description of vowel harmony in Wolof is the feature [ATR]. Each vowel in the system has a counterpart with the opposite value of [ATR]. There are three vowels which do not have an [ATR] counterpart. The first two are the [+high] vowels [i] and [u]. Their lengthened forms also do not have [ATR] counterparts. The third is the long vowel [aa]. Since the vowel [ə] has no long form, there is no [+ATR] counterpart for the [-ATR] vowel [aa]. The [ATR] vowel sets are shown in Table 2 below.

Table 2: ATR Vowel Counterparts

[+ATR]	[-ATR]
i	
ii	
u	
uu	
e	ɛ
ee	ɛɛ
o	ɔ
oo	ɔɔ
ə	a
	aa

2.2 Vowel Harmony

Vowel harmony is based upon the feature ATR. Within a root or a stem, each vowel has a matching value for the feature [ATR]. Roots and stems can be divided into [+ATR] and [-ATR] categories. The feature [ATR] must be lexically assigned to these roots, since there is no determiner within a normal stem that causes the [ATR] value. (1) and (2) show examples of [+ATR] and [-ATR] roots, respectively.

(1) tilim 'to be dirty'
jigeen 'woman'
junqoob 'crab'
fuddən 'henna'
xooyəl 'to dilute'

(2) cɛrɛ 'couscous'
lɛmpɔ 'tax'
xandɔɔr 'to snore'
maangɔ 'mango'
jafɛ 'to be expensive'

Harmony does not take place solely within the root of the word; instead, it extends to derived words and even across word boundaries. Suffixes in Wolof assimilate to the [ATR] value of the root to which they attach. (3) shows examples of suffixes which alternate depending on the root.

(3) -le ~ -lɛ 'participant'
-o ~ -ɔ 'nominalizing'
-əl ~ -al 'benefactive'

There are two types of vowels in Wolof which affect the harmony process. Certain vowels in Wolof can be either neutral or opaque to the harmony process. Neutral vowels do not harmonize to the [ATR] value of the root, but maintain their own [ATR] value. However, vowels which follow them harmonize with the root across them. Opaque vowels also maintain their own [ATR] value despite the value of the root. Opaque vowels, however, affect the harmony process behind them. All vowels following an opaque vowel harmonize with that vowel rather than with the root. The neutral vowels in Wolof are [i] and [u], which have no [ATR] counterparts. When they are encountered in a word, they are automatically [+ATR], but any vowels following them still receive the [ATR] value of the root. There is one opaque vowel in Wolof and one opaque suffix. The vowel [aa] is always [-ATR] and changes all vowels following it to [-ATR] also. The suffix [-kat] 'agent' acts similarly. It is always [-ATR] and causes all vowels following it to be [-ATR]. The vowel [a] itself usually alternates, but this suffix is lexically specified as [-ATR].

2.3 Autosegmental Analysis of Vowel Harmony

Ka (1993) uses autosegmental theory to analyze the vowel harmony process. He posits four processes or rules to explain the patterns of vowel spread. First, Ka proposes the Morpheme Structure Constraint (MSC) which states that a high vowel in stem-initial position should be [+ATR] (p. 36). Second, he has a vowel Harmony Rule, which states that the autosegment [+ATR] is spread from to left to right to all unassociated vowels within a domain (p. 36). Third, Ka posits a high default rule, which specifies that all non-linked high vowels should be [+ATR] (p. 36). Ka's fourth rule states that a [-ATR] value is given by default to any segment left unassociated. Example (4) shows a derivation with the neutral vowel [u] in the suffix, and example (5) shows a derivation with the opaque suffix [-kat].

(4)

tAxUlEEn	UR
N/A	MSC
N/A	Harmony Rule
[+A] tAxulEEn	High Default
[-A] [+A] [-A] tax u lɛɛn	Default Rule
taxulɛɛn	'you did not cause'

(5)

[-A] lIgEEy-kat-AM	UR
[+A] [-A] lig EEy kat Am	MSC
[+A] [-A] lig eey kat Am	Harmony Rule
N/A	High Default
[+A] [-A] [-A] lig eey kat am	Default Rule
ligeeykatam	'his/her worker'

3. An OT Analysis of Vowel Harmony

Using Optimality Theory, an analysis of Wolof is still best done on the autosegmental level. Those who study vowel harmony in Optimality Theory argue over the use of Alignment constraints (Archangeli 1999; Archangeli & Pulleyblank 2002), which would be done at the autosegmental level, versus the use of Agreement constraints (Baković 2000; Beckman 1997). Beckman argues against alignment in Shona because of the relationship of unparsed feature specifications in the input and the output. Features which do not appear in the output are either underlying in the output or not available in the output, neither of which works in Shona (1997:32). In Turkana, Baković claims that Alignment does not explain why low vowels are opaque right-to-left, but not left-to-right (2000:198). In an initial analysis of Wolof, Alignment seems to cover the data most completely, despite these claims. Specific arguments against Alignment must be dealt with another time, though there are other possible analyses of Wolof. An account of Wolof using Span Theory rather than Alignment is given by Michael O'Keefe (2006), while Pulleyblank (1996) gives a very complete Alignment analysis of Wolof.

Two constraints in Wolof are constant despite the use of Alignment or Agreement. The first of these constraints is HI/ATR.

(6) HI/ATR: Every [+high] vowel must also be [+ATR] (Archangeli & Pulleyblank 2002:145)

Because the two high vowels in Wolof [i] and [u] do not have [-ATR] counterparts, this constraint is never violated. It is posited to prevent the insertion of a [-ATR] vowel in an output form, and also maintains the neutrality of these vowels in [ATR] harmony.

The second constraint which is undominated is IDENTATR. Every stem is lexically specified for ATR, and that specification must appear in the output form.

(7) IDENTATR: Every vowel in the input with the value [αATR] must have a corresponding vowel in the output with the value [αATR]. (Kager 1999:275)

In order for stems to maintain their ATR value, this faithfulness constraint must be ranked above any other markedness constraint. HI/ATR is a markedness constraint, but the two constraints do not interact. The input of roots with high vowels can either be underspecified or specified as [+high]. In either case the correct output will be derived, as shown in Tableaux (1) and (2). As a result, Hi/ATR and IdentATR are not crucially ranked with respect to one another.

(1) Underspecified Input: HIATR, IDENTATR

Input /tIlIm/ 'to be dirty'	Hi/ATR	IdentATR
a. tɪlɪm	*!*	
☞ b. tilim		

(2) Lexically Specified Input: HIATR, IDENTATR

Input /tilim/	Hi/ATR	IdentATR
a. tɪlɪm	*!*	*!*
☞ b. tilim		

Any constraints which follow these two represent a choice between Agreement constraints and Alignment constraints. The initial attempt to use agreement constraints in Wolof was unsuccessful because of the interaction between opaque and neutral vowels. Neutral vowels cause a double violation of agreement constraints, since agreement is violated once for the neutral vowel and again for the following vowel. Suffixes which harmonize to the neutral vowel violate agreement only once, as shown in Tableau (3). The incorrect winner is shown with the thumbs-down symbol.

(3) AGREEATR

Input /tax-UlEEn/ 'you did not cause'	AGREEATR
a. taxulɛɛn	**!
👎 b. taxuleen	*

Since all neutral vowels in Wolof are [+ATR], this violation can be reversed by outranking AGREEATR with a constraint against [+ATR], as in Tableau (4). For neutral vowels, this additional constraint works well. Because [+ATR] vowels are less preferred, the correct candidate is selected even though it violates AGREEATR twice.

(4) Neutral Vowels: *[+ATR] » AgreeATR

Input /tax-UlEEn/	*[+ATR]	AGREEATR
☞ a. taxulɛɛn	*	**
b. taxuleen	**!	*

However, this analysis does not work when considering opaque suffixes with a [+ATR] root. For the correct output form to be selected, all suffixes following the root must agree with the root until the opaque suffix. After the opaque suffix, all other suffixes should agree with that suffix. However, with this set of constraints, less violations apply when every vowel except the root vowel agrees with the [-ATR] opaque suffix rather than the [+ATR] root, as is shown in Tableau (5). The thumbs-down symbol shows the incorrect winner.

(5) Opaque Suffix: *[+ATR] » AgreeATR

Input /sedd-Al-E-kat-Am/ 'his/her share-giver'	*[+ATR]	AGREEATR
a. seddəlekatam	**!*	*
☟ b. seddalɛkatam	*	*

In order to account for both neutral vowels and opaque vowels, Alignment constraints are necessary. Two basic Alignment constraints are posited to support both neutral and opaque vowels.

(8) ALIGN ([-ATR], R, PrWd, R): The right edge of every [-ATR] feature is aligned with the right edge of some Prosodic Word.

(9) ALIGN ([+ATR], R, PrWd, R): The right edge of every [+ATR] feature is aligned with the right edge of some Prosodic Word.

These constraints allow the [ATR] value of the root to spread across the word to the right edge of the word. Ranking ALIGNR[-ATR] above ALIGNR[+ATR] blocks spreading of the root in favor of the opaque suffix, since all opaque vowels are [-ATR]. Tableau (6) shows a completely harmonious root with ALIGNR[+ATR] satisfied.

(6) ALIGNR[+ATR]

Input /sofOOr-Am/ [+A] 'his/her driver'	ALIGNR[+ATR]
☞ a. sofoorəm [+A]	
b. sofooram [+A] [-A]	*!

The crucial ranking of ALIGNR[-ATR] above ALIGNR[+ATR] is shown in (7). The opaque suffix here is allowed to block the spreading of the root, even though ALIGNR[+ATR] is violated, so that ALIGNR[-ATR] will be maintained. This Tableau also shows in (c) that ALIGNR disallows backwards spreading. When the [-ATR] value spreads to the right and to the left, it maintains ALIGNR[-ATR], but causes an additional violation of ALIGNR[+ATR]. This is a fatal violation, which eliminates candidate (c), though this candidate would have already been eliminated for the violation of HI/ATR.

(7) AlignR[-ATR] » AlignR[+ATR]

Input / yobbU-waalE / [+A] [-A] 'to carry away in addition'	AlignR[-ATR]	AlignR[+ATR]
☞ a. yobbuwaalɛ [+A] [-A]		**
b. yobbuwaale [+A] [-A] [+A]	*!	**
c. yobbʊwaalɛ [+A] [-A]		***!

In order to allow for transparent vowels, there is a constraint NoGap, which is ranked low on the constraint hierarchy.

(10) NoGap: Multiply linked features cannot skip elements (Yip 2002).

This constraint is violable, so a [+high] vowel can be skipped in order to maintain the alignment of the [-ATR] root and still satisfy Hi/ATR. Tableau (8) shows this process with the constraints Hi/ATR, AlignR[-ATR], AlignR[+ATR], and NoGap.

(8) Hi/ATR » AlignR[-ATR] » AlignR[+ATR], NoGap

Input /sɛppI-wOOn/ 'took out of a liquid'	Hi/ATR	Align-R [-ATR]	Align-R [+ATR]	NoGap
[+A] ☞ a. sɛppiwɔɔn [-A]			*	*
b. sɛppiwoon [-A] [+A]		*!*		
c. sɛppɪwɔɔn [-A]	*!			

With these constraints, both neutral and opaque vowels are accounted for. Tableaux (4) and (5) above are repeated here as (9) and (10) respectively, with the five alignment constraints posited. These constraints allow both types of vowels to surface in their correct output forms.

(9) Neutral Vowels: HI/ATR, IDENTATR » ALIGNR[-ATR] » ALIGNR[+ATR], NOGAP

Input /tax-UlEEn/ 'you did not cause'	HI/ATR	IDENTATR	ALIGNR [-ATR]	ALIGNR [+ATR]	NOGAP
a. taxʊlɛɛn [-A]	*!				
b. təxuleen [+A]		*!			
[+A] ☞ c. taxulɛɛn [-A]				*	*
d. taxuleen [-A] [+A]			*!*		

(10) Opaque Suffixes: HI/ATR, IDENTATR » ALIGNR[-ATR] » ALIGNR[+ATR], NOGAP

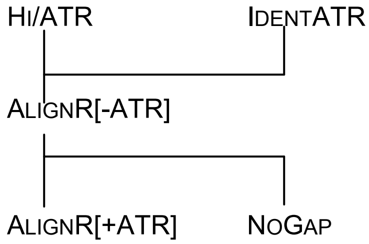
Input /sedd-Al-E-kat-Am/ 'his/her share-giver'	HI/ATR	IDENTATR	ALIGNR [-ATR]	ALIGNR [+ATR]	NOGAP
☞ a. seddəlekatam [+A] [-A]				**	
b. sɛddalɛkatam [-A]		*!			
c. seddalɛkatam [+A] [-A]				***!*	

There are several other constraints which could be posited here to account for the autosegmental level of [ATR]. In his analysis of Wolof, Pulleyblank uses MAX, DEP, MAXPATH, and DEPPATH (Pulleyblank 1996:328). These constraints forbid deleting or inserting values of [ATR] which are not lexically specified. The constraints given in this paper account for the data, but may not be complete. The constraints posited by Pulleyblank will add additional data and account for forms not considered in this paper, creating a more complete analysis. Future considerations would determine the ranking of Pulleyblank's constraints with the ones here posited.

4. Conclusion

There are five main constraints which control [ATR] vowel harmony in Wolof. The [ATR] value of the root is lexically assigned. There are two vowels [i] and [u] which are transparent to harmonization processes, and one vowel [aa] and a suffix [-kat] which are opaque to harmonization. The final ranking of the constraints used to analyze this vowel harmony process is as follows:

(11)



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