

## The Area Faithfulness approach to non-local assimilation\*

### (1) Proposal

- a. Harmony is the result of a non-local, violable surface relation to segments selected as heads by the constraint system.
- b. Designated head segments receive an additional faithfulness requirement.
- c. The assimilation system (proposed herein) is decoupled from the remainder of the phonology.

### 1. The Area Faithfulness relation

(2) Feature assimilation results from identity imposed upon a surface relation between segments.

(3) Each feature has independent area faithfulness relations.

(4) The grammar:

- a. establishes *area relations* between segments based on their properties.  
For every feature F, every segment is in an F-area.
- b. designates segments as *heads* based on their properties.  
Every F-area has a head.
- c. imposes faithfulness on the area relation.  
Every head is in a relation with the non-heads in its area.

(5) Illustration: Wolof (Ka 1994) ATR harmony with transparent high vowels.

(6) *Wolof vowel system*

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

(7) Wolof harmony is stem-controlled (van der Hulst and van de Weijer 1995, et seq.)

a.  $\sqrt{\text{now-le:n}}$   
come-2PLIMP

b.  $\sqrt{\text{tɔgg-le:n}}$   
cook-2PLIMP

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(8) *Wolof high vowel transparency*

a.  $\begin{matrix} + & + & + \\ \sqrt{\text{wo:r-ule:n}} \\ \text{be.trustworthy-2PLNEG} \end{matrix}$

b.  $\begin{matrix} - & + & - \\ \sqrt{\text{bɔkk-ule:n}} \\ \text{look.at-2PLNEG} \end{matrix}$

(9) *Illustration of the relation*: area boundaries are indicated with (parentheses), heads are boxed, Area Faithfulness-violating elements are {braced}

a.  $\begin{matrix} \sqrt{\text{now-le:n}} \\ | \quad | \\ ( \boxed{+A} \quad +A ) \\ \curvearrowright \end{matrix}$

b.  $\begin{matrix} \sqrt{\text{bɔkk-u le:n}} \\ | \quad | \quad | \\ ( \boxed{-A} \quad \{+A\} \quad -A ) \\ \curvearrowright \quad \curvearrowright \end{matrix}$

(10) Every arrow is an independent relation.

*Span Theory (McCarthy 2004), from which in large part this analysis is developed*

(11) Area Faithfulness retains the Span Theory method of establishing domains, and its concept of *heads*. The difference is in the constraints.

(12) Area Faithfulness: feature assimilation is restricted *surface-faithfulness*.

(13) Span Theory: features are *manifested* via headed *spans*.

(14) The grammar:

- a. designates segments as *heads*.
- b. divides segments into *spans* based on the configuration of heads.
- c. enforces *span-head-faithfulness* (satisfied if X keeps its value between input→output *and* is a head).

(15) O'Keefe (in press) permits transparency via non-association.

(16) *Illustration of spans*: span boundaries are indicated with (parentheses), heads are underlined. Non-associated elements are [bracketed].

a.  $\begin{matrix} \sqrt{\text{now-le:n}} \\ | \quad | \\ ( \underline{+A} \quad +A ) \end{matrix}$

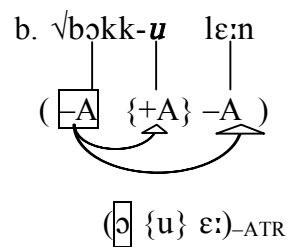
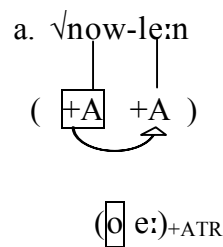
b.  $\begin{matrix} \sqrt{\text{bɔkk-u le:n}} \\ | \quad | \quad | \\ ( \underline{-A} \quad [+A] \quad -A ) \end{matrix}$

(17) The span is the relation.

## 2. Formalizing the analysis

### 2.1 Areas

- (18) GEN: Candidates are divided, exhaustively, into *faithfulness areas*.
- (19) *Area*: An area is a string upon which Area Faithfulness for *some feature* applies.
- Edges: The edges of an area are denoted () and occur before the first element and after the last.
  - Head: Every area has a designated head, indicated with a box.
- (20) The *area relation* relates heads to non-heads.
- (21) Violable identity is applied to the relation.
- (22) Area-faithfulness-disobeying elements are indicated {}; this, however, has no formal status beyond indicating a violation of AF.
- (23) *Notation*<sup>1</sup>



### 2.2 Constraints

*AF Relation-establishing constraints:*

- (24) \*AREAS(F): One violation mark for every F-area intersection<sup>2</sup>, i.e. )( symbol
- \*AREAS(ATR): Minimize ATR areas.
- (25) ALL[F]HEAD(G): Every [F] is the head of a G-area. (= universal)
- ALL[+low]HEAD(ATR): all low vowels are heads of ATR areas.

<sup>1</sup> Consonants are left out of these examples for the sake of readability; 25a is perhaps more accurately rendered ( {n} o {w} {l} e: {n} )<sub>+ATR</sub>.

<sup>2</sup> For this talk, it is assumed that \*AREAS is limited to penalizing intersections at the word level. However, this could conceivably be modified to include smaller or larger morphological and syntactic constituents.

- (26) HEAD(F)IS[G]: Every F-area has a [G] head. (= existential)  
 a. HEAD(ATR)IS[+low]: all ATR areas have low vowel heads.
- (27) HEAD(F)ISLEFT/RIGHT: The head of an F-area is on the left edge/right edge.
- (28) STEMHEAD(F): If an F-area includes part of the stem, the head of that area is located in the stem. (Analogous to work by Fitzgerald 1997, Smith 2002)

*AF relation-enforcing constraint:*

- (29) AREAFAITH(F, G): A [F] is faithful to the head of its G-area.  
 a. AREAFAITH(+high, ATR): high vowels are faithful to ATR heads.

*IO relation-enforcing constraints:*

- (30) IDENT(F): Preserve input values of F.
- (31) IDENTHEAD(F): Preserve input values of F, for heads.
- (32) IDENTSTEM(F): Preserve input values of F, for stem segments.
- (33) These IDENT constraints exhibit stringency (Prince 1997):

/ɔ + e/	IDENT(F)	IDENTHEAD(F)	IDENTSTEM(F)
a. (ɔ ε)	*		
b. (o e)	*	*	
/√ɔ + e/	IDENT(F)	IDENTHEAD(F)	IDENTSTEM(F)
c. (ɔ ε)	*		
d. (o e)	*	*	*

- (34) Under the correct circumstances, (33b) and (33d) are harmonically bounded.
- (35) A note: This system results in a great deal of redundancy of violations; only the most crucial are indicated below.

### 2.3 Simple example: Degema

- (36) Degema (Archangeli and Pulleyblank 2006) vowels:

	+ATR		-ATR	
+high	i	u	ɪ	ʊ
mid	e	o	ɛ	ɔ
+low		ə		a

(37) Degema has complete stem-controlled harmony:

+    ++  
a. u-√pu-əm  
    closing

-    - -  
b. u-√fu-a  
    state of being white

(38) *Degema harmony*

/u-√u-a/ → (u <u>u</u> ə)	*AREAS (ATR)	AREAFAITH (+voc, ATR)	IDENT (ATR)	Comments
a. ~ (u)(u)(a)	<b>W</b> 0~2	0~0	<b>L</b> 2~0	no harmony
b. ~ ({u}uə)	0~0	<b>W</b> 0~1	<b>L</b> 2~1	transparency

(39) Basic harmony ranking: {\*AREAS, AREAFAITH} >> IDENT

(40) *Degema stem control*

/u-√u-a/ → (u <u>u</u> ə)	STEMHEAD (ATR)	*AREAS (ATR)	ALL[+voc] HEAD(ATR)	IDENT (ATR)	Comments
a. ~ (u <u>u</u> a)	<b>W</b> 0~1	0~0	2~2	<b>L</b> 2~1	affix-control
b. ~ (u)(u)(a)	0~0	<b>W</b> 0~2	<b>L</b> 2~0	<b>L</b> 2~1	no harmony

(41) Total, stem-controlled harmony:

{STEMHEAD(G), \*AREAS(G), AREAFAITH} >> {ALL[F]HEAD(G), IDENT[G]}

### 3. Predictions of the analysis

(42) Successful predictions:

- a. *Opacity*
- b. *Transparency*
- c. *Parasitism*
- d. *Non-markedness-driven disharmony*

#### 3.1 Opacity: Akan

(43) Akan (Dolphyne 1988) low vowel opacity:

	+ATR		-ATR	
+high	i	u	ɪ	ʊ
-high, -low	e	o	ɛ	ɔ
+low			a	

(44) Akan has no low +ATR vowel: \*[+low, +ATR]

(45) Akan exhibits stem-controlled ATR harmony:

+ +	- -
a. o-√tu	b. ɔ-√tɔ
3SG-dig	3SG-bake

(46) Low vowels are opaque:

- - +	- - -
a. ɔ-a-√tu	b. ɔ- a-√tɔ
3SG-PERF-dig	3SG-PERF-bake

(47) Akan opacity

/o-a-√u/ → (ɔa)(u)	*[+low, +ATR]	ALL[+low] HEAD(ATR)	*AREAS (ATR)	IDENT (ATR)	Comments
a. ~ (oæu)	W 0-1	W 0-1	L 1-0	1-1	harmony
b. ~ (o)(a)(u)	0-0	0-0	W 1-2	L 1-0	no harmony

(48) Basic harmony ranking: { \*AREAS, AREAFAITH } >> IDENT

(49) (an) opacity ranking: { Markedness, HEAD } >> { AREAFAITH, \*AREAS } >> IDENT

### 3.2 Transparency: Wolof

(50) Wolof vowel system

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

(51) Wolof high vowel transparency

+ + +	- + -
a. √wo:r-ule:n	b. √bɔkk-ule:n
be.trustworthy-2PLNEG	look.at-2PLNEG

(52) Wolof transparency

/√ɔ-ue/ → (ɔ){u}ε	*AREAS (ATR)	*[+hi, -ATR]	IDENT (ATR)	AREAFTH (+hi,ATR)	Comments
a. ~ (ɔ)(ue)	W 0-1	0-0	L 1-0	L 1-0	opacity
b. ~ (ɔ)uε	0-0	W 0-1	W 1-2	L 1-0	u-harmony

(53) Transparency: Markedness, \*AREAS >> AREAFAITH(transparent segments)

### 3.3 Parasitic harmony: Yawelmani Yokuts

(54) Yawelmani (Archangeli 1984, et seq.): rounding harmony, dependent on height

(55) Short vowels<sup>3</sup> in Yawelmani:

+high	i	u
-high	(e) a o	

(56) Yawelmani rounding harmony occurs only between vowels of the same height:

		Stem	-PERFPROG
a.	'lead'	dub	dub <u>mu</u>
b.	'find'	bok'	bok'mi
c.	'eat'	xat	xatmi
			-POTENTIAL
d.	'find'	bok'	bok' <u>ol</u>
e.	'procure'	max	max <u>al</u>
f.	'recognize'	hud	hudal

(57) In (56a) both stem and suffix are high; in (56d,e), both are low.

(58) COINCIDE(F, G): The edges of an F-area coincide with the edges of a G-area<sup>4</sup>.

(59) To get / $\sqrt{u}$ -ia/  $\rightarrow$  [uua]: qualitatively, this needs to happen:

a. Establish the height areas via STEMHEAD and high-ranked ID(hi) as:

height:  $\boxed{ui}_{+hi}$   $\boxed{a}_{-hi}$

b. Apply COINCIDENCE to make the rounding areas the *same*:

height:  $\boxed{ui}_{+hi}$   $\boxed{a}_{-hi}$   
 rounding:  $\boxed{u\{i\}}_{+rd}$   $\boxed{a}_{-rd}$

c. Enforce AREAFAITH(round) so that /i/ harmonizes for rounding:

height:  $\boxed{uu}_{+hi}$   $\boxed{a}_{-hi}$   
 rounding:  $\boxed{uu}_{+rd}$   $\boxed{a}_{-rd}$

<sup>3</sup> The vowel system of Yawelmani has a number of complicating factors and generally requires further analysis, particularly regarding the well-known issue of long vowel lowering. However, the short vowels in the language are one of the clearest available cases of parasitism.

<sup>4</sup> This constraint is similar in concept, if not implementation, to Cole and Kisseberth's (1994) PARASITIC.

(60) *Yawelmani parasitic harmony*

$/\sqrt{u-ia}/ \rightarrow uua =$	$(\begin{array}{ c } \hline \text{u} \\ \hline \text{u} \\ \hline \end{array})_{+hi} (\begin{array}{ c } \hline \text{a} \\ \hline \text{a} \\ \hline \end{array})_{-hi}$ $(\begin{array}{ c } \hline \text{u} \\ \hline \text{u} \\ \hline \end{array})_{+rd} (\begin{array}{ c } \hline \text{a} \\ \hline \text{a} \\ \hline \end{array})_{-rd}$	IDENT (hi)	COINCIDE (rd, hi)	*AREAS (round)	IDENT (round)
a. $\sim uuo =$	$(\begin{array}{ c } \hline \text{u} \\ \hline \text{u} \\ \hline \end{array})_{+hi} (\begin{array}{ c } \hline \text{o} \\ \hline \text{o} \\ \hline \end{array})_{-hi}$ $(\begin{array}{ c } \hline \text{u} \\ \hline \text{u} \\ \hline \end{array})_{+rd}$	0~0	<b>W</b> 0~1	<b>L</b> 1~0	<b>W</b> 1~2
b. $\sim uia =$	$(\begin{array}{ c } \hline \text{u} \\ \hline \text{u} \\ \hline \end{array})_{+hi} (\begin{array}{ c } \hline \text{a} \\ \hline \text{a} \\ \hline \end{array})_{-hi}$ $(\begin{array}{ c } \hline \text{u} \\ \hline \text{u} \\ \hline \end{array})_{+rd} (\begin{array}{ c } \hline \text{a} \\ \hline \text{a} \\ \hline \end{array})_{-rd}$	0~0	<b>W</b> 0~1	1~1	<b>L</b> 1~0

(61) Basic parasitism ranking, F on G: COINCIDE(F, G) >> \*AREAS(F), IDENT(F)

(62) Crucial point: since both AREAFAITH(high) and IDENT(high) can be satisfied, the two high vowels can be vacuously parsed into a single [+high] area.

3.4 Non-markedness-driven disharmony

(63) Standard claim (e.g. Kiparsky 1982): disharmony is incompatibility with harmonizing feature

(64) True for Akan and Wolof and the majority of languages, but not universal

(65) Menominee (Archangeli and Pulleyblank 1994) +ATR and -ATR low vowels:

a. masku:tæ:w  
prairie

b. si:piah  
river-LOC

(66) But affix-triggered ATR harmony skips low vowels:

+ - +  
a. ni- $\sqrt{t}si:p\underline{a}hk-im$   
'cook-NOM'

- - -  
b.  $\sqrt{t}si:p\underline{a}hk-uw$   
'he cooks'

(67) *Simplified Menominee transparency*

$/\sqrt{ia + i}/ \rightarrow (i\{a\}i)$	*AREAS (ATR)	AREAFTH (-hi,ATR)	IDENT (ATR)	AREAFTH (+hi,ATR)	<b>Comments</b>
a. $\sim (i\underline{a})(i)$	<b>W</b> 0~1	0~0	<b>L</b> 1~0	<b>L</b> 1~0	opacity
b. $\sim (i\underline{a}i)$	0~0	0~0	<b>W</b> 1~2	<b>L</b> 1~0	a-harmony

(68) Non-markedness-driven transparency:

AREAFAITH (undergoers) >> IDENT >> AREAFAITH(transparent segment)

(69) Bari (Steinberger and Vago 1987) has alternating [a] and [æ]:

- a.  $\sqrt{\text{mug-g}\text{æ}}$  cover-INDEF  
b.  $\sqrt{\text{m}\text{ɔ}\text{g-ga}}$  hold-INDEF

(70) But in stems, [a] can disagree with the rest of the stem and trigger –ATR:

- – +  
a.  $\text{t}\text{ɔ-}\sqrt{\text{kade}}$   
NOM-different ‘difference’

(71) For ease of illustration, let us simply assume a “markedness-decoupled Akan” (simplified Bari): 10 vowel system, low vowels are opaque

(72) *Markedness-decoupled Akan opacity*

/o-a- $\sqrt{\text{u}}$ / → (ɔa)(u)	ALL[+low] HD[ATR]	*AREAS (ATR)	IDENT (ATR)	Comments
a. ~ (oæu)	<b>W</b> 0~1	<b>L</b> 1~0	1~1	a-harmony
b. ~ (o{a}u)	<b>W</b> 0~1	<b>L</b> 1~0	L 1~0	transparency
c. ~ (o)(a)(u)	0~0	<b>W</b> 1~2	<b>L</b> 1~0	no harmony

(73) Non-markedness-driven opacity: {HEAD, AREAFAITH} >> \*AREAS >> IDENT

#### 4. Comparison to other theories

(74) *Table: which theories can account for which issues*

	Opacity	Transparency	Parasitism	Non-markedness-driven disharmony
Span Theory	✓	✗	✗	see 1
Spans (O’Keefe)	✓	✓	✗	✗
Optimal Domains	?	✓	✓	✗
Agreement	see 2	see 3	see 3	✗
Autosegmental	✓	✓	see 4	?
<b>Area faithfulness</b>	✓	✓	✓	✓

Note 1: In principle, nothing would rule out adopting a constraint of the form “segments of type F end a span”; non-markedness-driven *transparency*, however, will be impossible since FAITHHEADSPAN is violated equally by being transparent and by being an undergoer.

Note 2: Without significant restrictions beyond the basic agreement framework, opacity in such analyses will introduce the “majority rule” problem noted by Lombardi (1999).

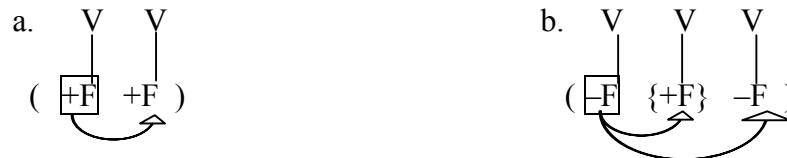
Note 3: Agreement implementations of transparency would take the form “agree with the next X”; parasitism would take the form “agree with the next X unless some Y intervenes”. Thus two different systems altogether would be required.

Note 4: Parasitism is not a problem for autosegments, but it requires fixed feature geometries, which have been noted to cause a number of problems.

## 5. Conclusion

In this talk I have argued that:

(75) The one-to-many *area faithfulness relation* is the basis for non-local processes of feature assimilation.



(76) This relation has an asymmetry between undergoers of assimilation and constraint-selected *heads*.

(77) Surface *faithfulness* imposed upon the area relation implements surface similarity.

(78) Markedness is entirely independent of the feature assimilation mechanism.

(79) The account significantly increases the number of predictable systems.

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