The Morphology of Bidirectional Vowel Harmony

In Warlpiri and Telugu, vowel harmony operates leftwards from suffixes to roots but rightwards from stems to suffixes. Tunen has the mirror image of such bidirectional harmony with prefixes. Such systems confirm that roots are non-cyclic constituents, as assumed in Lexical Phonology and Stratal OT, and provide evidence against Distributed Morphology's view that all nouns are derived from roots by abstract nominalizers.

Vowel harmony (VH) arises when syntagmatic markedness constraints of the form (1b) dominate antagonistic faithfulness and context-free markedness constraints (1a,c).

(1) a. Faithfulness constraints:
(i) MAX[μF] (Archangeli 2002, Coetzee 2006, Wheeler 2005),
(ii) IDENT-STEM(F),
(iii) IDENT-σ_1(F)... (positional faithfulness, Beckman 1997).
Input [αF] does not correspond to output [–αF], (i) where [αF] is the marked value of F, (ii) in a stem, (iii) in an initial syllable.

b. Syntagmatic markedness: *[V,αF][V,–αF] (with no intervening V or F)

c. Context-free markedness (minimizing segment complexity):
(i) *[αF], (ii) *$\begin{bmatrix}\alpha\text{F}\\ \beta\text{G}\end{bmatrix}$, where αF is the marked value of F.

We formalize the featural markedness as privileged visibility to constraints: each faithfulness constraint that applies to the feature F has a counterpart that applies specifically to the marked value μF (Kiparsky 1994). This captures most advantages of unary and particle representations with binary features. (1) has no harmony-specific machinery, such as global AGREE (McPherson 2016, McCollum 2020), SPREAD (Kaun 1995), SHARE (McCarthy 2011), target-centric Search-and-Copy (Nevins 2010, Ozburn 2019), ATB (Kramer 2003, Rose 2004, Rhodes 2012), and no theoretically problematic ALIGN constraints (Ringen 1989, Cole 1994, Pulleyblank 1996, McCarthy 2004). By eliminating symmetric IDENT and global AGREE, we avoid the "Majority Rule" problem (Lombardi 1999, Baković 2000) and the "Sour Grapes" problem (Wilson 2003, McCarthy 2004).

If roots, unlike stems, are not cyclic domains, then stem faithfulness does not determine the directionality of cyclic VH in root+affix combinations; by (1ai) and (1b) either constituent can harmonize with a marked feature of the other. This predicts a mix of dominant and stem-outward harmony where roots combine with their first affix in dominant-recessive fashion, outputting a derived stem which then cyclically passes its harmonic feature outward to subsequently added affixes.

Warlpiri (Pama-Nyungan, Australia) has three vowels *i, a, u*. VH limits the co-occurrence of *i* and *u* within stems, and generates *i*∼*u* alternations in suffixes, enclitics, and verb roots. It is both progressive and regressive, depending on morphology (Nash 1979, Harvey 2005, Zentz 2011), in both cases driven by (2), instantiating (1b).

(2) *[–Round, +High] [+Round, +High]

Regressive VH labializes a root-final sequence of *Ci* syllables before suffixal *Cu*:

(3)			*-rnu* (Past)	*-rni* (Nonpast)	*-ka* (Imperfect)
a.	/pangi/	'dig'	pangu-rnu	pangi-rni	pangi-ka
b.	/kipi/	'winnow'	kupu-rnu	kipi-rni	kipi-ka
c.	/yirra/	'place'	yirra-rnu	yirra-rni	yirra-ka
d.	/yurrpa/	'grind'	yurrpa-rnu	yurrpa-rni	yurrpa-ka
e.	/nyunji/	'kiss'	nyunju-rnu	nyunji-rni	nyunji-ka

Nominal stems and verbal stems (suffixed roots) trigger *progressive i∼u* harmony, where *a* patterns with *u* in selecting *u*, rather than *i*; contrast (3a,b,c) with (4c,f).

(4)			
a.	maliki-kirli-rli-lki-ji-li	'dog-PROP-ERG-then-me-they'
b.	kurdu-kurlu-rlu-lku-ju-lu	'child-PROP-ERG-then-me-they'
c.	minija-kurlu-rlu-lku-ju-lu	'cat-PROP-ERG-then-me-they'
d.	wanti-mi-jiki	'fall-still'
e.	ya-nu-juku	'went-still'
f.	wanti-ja-juku	'fell-still'

Labial consonants block progressive VH (e.g. *ŋamirni-puraji* 'your uncle'), but they are transparent to regressive VH, as (3b) illustrates. The non-alternating vowel in regressive harmony is *u*, as in the first syllable of /nyunji/, versus alternating /kipi/ (3b), whereas in progressive harmony it is *i*, which occurs in suffixes and clitics with fixed *i* in the first syllable, e.g. *-kirli* 'exactly' *-yi* 'continuative' (Nash 1979: 83, 96).

We require the following ranking of the Warlpiri instantiations of (1b) and (1a.i-ii):

(5) *[–Round][+Round] > IDENT-STEM(Round) > MAX[μF]

Nouns, being free forms, are stems. The ranking (1aii) > (1ai) entails that (1b) is satisfied by delabialization when a stem is involved. In (6b), harmony operates leftward in the first cycle, on the stem of the form root+suffix, and then continues rightward (M = Morphology).

(6) a. $[\text{maliki}]_{\text{N}} \xrightarrow{\text{M}} [[\text{maliki}]_{\text{N}}\text{-kurlu}]_{\text{N}} \xrightarrow{(2),(1aii)} [[\text{maliki}]_{\text{N}}\text{-kirli}]_{\text{N}}$ 'dog-PROP'

b. $[\text{kiji-rnu}]_{\text{V}} \xrightarrow{(2),(1ai)} [\text{kuju-rnu}]_{\text{V}} \xrightarrow{\text{M}} [[\text{kuju-rnu}]_{\text{V}}\text{-nji}]_{\text{V}} \xrightarrow{(2),(1aii)} [[\text{kuju-rnu}]_{\text{V}}\text{-nju}]_{\text{V}}$
(... → *kúju-rnu-njù-nu* 'went and threw')

The properties of progressive and regressive VH follow. Progressive harmony, being unrounding, has no effect on vowels that are already unrounded underlyingly, and regressive harmony, being rounding, has no effect on vowels that are already rounded underlyingly. Labial consonants block progressive harmony because they share a labial feature with the following rounded vowel.

Telugu (Dravidian) likewise has regressive *i∼u* VH in root+suffix combinations (7a), and progressive VH in the outer layer of verb morphology (P/N suffixes) and in the nominal system (7b); (Ramarao 1976, Sastry 1987). As in Warlpiri, *a* is opaque.

(7)			
a.	/kudurcu-i/	kudirci	'having arranged'
b.	/gadi-ku/	gadiki	'to the room'

The morphologically governed cyclic bidirectional harmony system of Tunen (Bantu) is abstractly similar, but involves the nominal system. Bound noun class prefixes impose their own marked [+ATR] feature on the bound pronouns they combine with, and themselves take on the ATR value of their nominal stems (Dugast 1971, Mous 2016, McCollum 2020). In all three languages, the phonology shows that monomorphemic nouns are stems and monomorphemic verbs are roots.