Domains of Vowel Harmony

Paul Kiparsky

17.1 Underived stems

Languages with vowel harmony often have some internally disharmonic stems, typically in unassimilated loanwords (Turkish *formül*, Finnish *tyranni*), sometimes also in fully native or nativized vocabulary: Yokuts (Yok-Utian) /pisluː/ [p̀islu-ʔ] 'mouse' violates the language's regular rounding harmony (Kuroda 1967: 44–5).

One approach to disharmonic stems restricts harmony to morphologically derived environments (Clements and Sezer 1982; Bennink 1992; Polgárdi 1999: 119 for Turkish; Ringen and Kontra 1989 for Hungarian). Its drawback is that it does not characterize disharmonic stems as irregular, and thus fails to explain nativizations of disharmonic loanwords such as Turkish *bisküvit → büsküvüt* 'biscuit', *komünist → kominist* 'communist' (Clements and Sezer 1982) and Finnish *trotyyli → rotuli* 'TNT', and the preference in disharmonic words for unmarked vowels; see (Goldsmith 1990: 302) for Turkish and (Rebrus et al. 2013) for Hungarian.

An alternative is that morphologically simplex lexemes undergo harmony as a default that is defeasible by lexical prespecification (Kabak 2011; van der Hulst 2018: 206-14). Derivational phonological theories do this by leaving predictable harmonic values unspecified in lexical representations, with harmony applying in feature-filling mode; in the implementation of Hulst and van de Weijer 1995 pre-associated features cannot spread to any other vowel positions within the same morpheme. OT achieves the same result by faithfulness constraints of the type IDENT(F) and IDENT-STEM(F) which protect marked feature specifications of vowels in lexical representations, a device independently necessary to derive stem-outward harmony processes.

The smallest domain of constraint application is the stem. Strictly root-internal and affix-internal vowel harmony is unattested. Apparent root harmony in Tiv (Tivoid) and Ngbaka (Gbaya) is templatic morphology with spreading of underlying vocalic autosegments (Pulleyblank 1988; Archangeli and Pulleyblank 1994).

17.2 Directionality

Vowel harmony propagates either (1) cyclically from the innermost morphological constituent of a stem or word outwards, (2) from any vowel with the dominant feature value to all other vowels (Baković 2000), or (3) directionally rightwards or leftwards. Regressive harmony triggered by final syllables is found in Assamese (Indo-Aryan, Mahanta 2007), Pulaar (Fula, Paradis 1992), Punu (Bantu, Hyman 2002), and Karajá (Macro-Jê, Ribeiro 2003). Progressive harmony is less common; in Tutrugbu (Kwa, McCollum and Essegbey 2020) and in Shona (Bantu, Beckman 1997), height spreads left to right from stem-initial syllables.

Underspecification analyses derive directionality of spreading from the distribution of feature specifications. A harmony process spreads specified feature

values to positions where the feature is unspecified. In OT, this line of analysis is not available because constraints apply to output representations and there are no morpheme structure constraints or other devices available for distributing feature specifications. Stem control and directionality of harmony must then be driven in other ways, either by cyclic constraint evaluation (Baković 2000) or by positional faithfulness constraints (Beckman 1997).

17.3 Derived stems and the constituent structure of words

Words may contain subconstituents in which stems are grouped with suffixes into harmony domains to the exclusion of prefixes, as in Maasai (Nilotic, Wallace 1981; Levergood 1984; Quinn-Wriedt 2013 and Finnish, or with prefixes to the exclusion of suffixes, e.g. Kalabari Ijo (Ijoid, Akinlabi 1995) and Tuwuli (Kwa, Harley 2005, or with both, e.g. Shona (Beckman 1997) and Moro (Kordofanian, Ritchart and Rose 2017: 167-8). I conjecture that these domains constitute the stem level of the respective languages. In Kimaragang (Austronesian), /a/ spreads from right to left from suffixes to roots and from roots to certain prefixes. Kroeger (2010) suggests that this is a stem-level lexical process, since it is obligatory, categorical, structure preserving, and inapplicable to clitics and to a class of prefixes that independent criteria place in an outer layer of morphology.

Harmony can diagnose multiple domains within words. Lesley-Neuman (2007, 2012) finds three levels in Karimojong (Nilotic) words. Level 1 is the most highly integrated; several morphophonological processes are confined to it, and affixes in it adopt the root vowel's [ATR] specifications. Level 2 is the domain of suffix-controlled [+ATR] harmony. Level 3, at which pronominal prefixes and some adverbs are added, has no harmony. In Lango (Nilotic) vowel harmony applies to postposed possessive pronouns but not to postposed determiners, and is sensitive to syllable structure (Noonan 1992: 33-4). In Kinande (Bantu), vowel harmony converges with other diagnostics to establish Root, Stem, Macro-stem, and Word domains (Mutaka and Hyman 1990; Archangeli and Pulleyblank 2002).

Tommo So (Dogon) has three kinds of vowel harmony: Height, Backness, and ATR (McPherson 2013, McPherson and Hayes 2016). They are practically confined to verbal derivation; inflection and noun morphology are hardly affected. Height harmony is optional and limited to the two innermost layers of the derivational verb morphology, comprising the factitive and reversive suffixes. Backness harmony applies through all five derivational suffix positions, obligatorily to the closest suffix and optionally thereafter. Both of these harmony processes apply with decreasing frequency outward, "petering out" until the end of their respective domains. ATR harmony, though, is obligatory up to and including the fourth suffix position, and then abruptly turns off at the last one, the Causative, which is perhaps the edge of the Stem level, since causativization is the only derivational process that is recursive and applicable to any verb.

Vértes (1977: 95) describes a similar attenuation of front/back harmony in Southern Khanty (Uralic) after the initial syllables of a word, more often with heavier suffixes. *e* and *i* in medial syllables may variably be (a) fully harmonic, both undergoing and transmitting back harmony, (b) fully opaque, remaining front and initiating a span of front central vowels, or (c) "blocking vowels" in the sense of Kramer (2003 and Ch. 21) which undergo harmony but do not transmit it:[1]

(1) (a) oḍoxtəḍɑ 'on his lap', (b) oxteḍɐ 'on', (c) oxtəḍɐ.

Since the corresponding back vowels *ɤ, ɯ, ʌ, a* occur only after back vowels, we conclude that harmony in these dialects is backing, rather than fronting. That *e, i, ə, ɐ* occurs in case (c) reveals that [–Back] is the default value.

Some vowel harmony systems show edge effects. Word-peripheral vowels can be exempt from harmony: initial augments in Kinande (Mutaka 1995; Archangeli and Pulleyblank 2002; Archangeli and Pulleyblank 2007: 364), final vowels in Shona (Beckman 1997), Kimatuumbi (Odden 1996), and other Bantu languages (Hyman 1999). In Vata (Kru), harmony proceeds leftwards from verb roots to monosyllabic prefixes, stopping at the final syllable of a polysyllabic prefix (Kaye 1982). Thus, in the disyllabic morpheme /kɔna/ (negative incompletive) only the syllable immediately preceding the verb root harmonizes, whereas harmony spreads leftwards from a [+ATR] aspect marker to a directly preceding subject pronoun; in this case, a span of two syllables to the left of the verb root is affected, In Akposso (Kwa), harmony spreads only one syllable to the left of the verb in a string of aspect prefixes, and from there to a subject prefix; in nouns it does not extend beyond the stem except for bound allomorphs of articles (Anderson 1999: 194, 205 ff.).

17.4   Compounds and quasi-compounds

Each member of a compound word usually constitutes a separate vowel harmony domain (Hulst and van de Weijer 1995: 501). Some languages, however, require all members of a word to harmonize, e.g. Degema (Edoid, Kari 2002), or distinguish harmonizing and non-harmonizing compound types. Fọlarin (1987) describes such a bifurcation in Yoruba (Volta-Niger), showing that the two compound types are structurally distinct, with a stratal analysis of the morphology that underpins the dual phonology (see further Ch. 15). In Finnish, suffixes harmonize with the last harmonic vowel of the stem. Morphologically non-compositional compounds and prefixed words may be treated as single stems. For example, *-metri* '-meter' tends to initiate its own harmony domain in words that denote instruments and measures, where it is transparently related to the first member of the compound (2a), and to be grouped into a single stem with the preceding element in formations like (2b), which are non-compositional within Finnish (*-lla, -ssa, -a* are case endings).

---

[1]Examples transliterated from Vértes' Uralic transcription system.

(2)   a. Front harmony preferred: *kronometri-llä, galvanometri-llä, kilometri-ä, nanometri-ä, heksametri-ssä, tetrametri-ssä*

      b. Back harmony preferred: *parametri-a, diametri-a*

Conversely, prosody can prompt semantically non-compositional compound analyses of long words, even when one or both parts have no independent existence (QUASI-COMPOUNDS). In Finnish, front endings occur marginally in monomorphemic back-vowel stems of four or more syllables that end in two neutral syllables, such as *parasiitti, pyramidi, hypoteesi, vitamiini, karamelli, klarinetti, bolsevikki, mannekiini, adjektiivi, manifesti.* As many researchers have noted, the reason for the front vowel option seems to be that they have the prosodic form of compounds. Although back endings are strongly preferred in most such words, and required by normative grammar, the more they look like compounds, the more frequent the front ending. To the extent that such words invite a folk-etymological (though semantically non-compositional) compound analysis, such as *kommervenkki* 'contraption', *arkkitehti* 'architect', and *harakiri*, they actually *prefer* front suffixes. In contrast, trisyllabic stems like *grafiitti, konvehti, fakiiri, bakteeri, kuriiri, kapteeni, kameli* nearly always get back suffixes (Elat.Sg. **kamelistä*, Adess.Sg. **kamelinä*), for they cannot be analyzed as quasi-compounds because Finnish allows no monosyllabic stems like *gra-, kon-, fa-, bak-, ku-, kap-, ka-.* For the same reason, four-syllable stems in which secondary stress is purely rhythmic, and moves to a fourth syllable if the third is light, never split into quasi-compounds, e.g. *hajallise-ssa* (**-ssä*) 'scattered' (iness.).

In Hungarian, on the contrary, the frequency of backing has been found to decrease simply with the *number* of neutral vowels that intervene between trigger and target (the Count Effect, (Ringen and Kontra 1989; Rebrus et al. 2017; Törkenczy 2019; Kimper 2011), with no prosodic effects reported. Finnish shows no Count Effect: front vowel endings are just as rare after stems like *positiivi, adessiivi* and *partitiivi* as after stems like *negatiivi, elatiivi* and *illatiivi*, where the back vowel trigger is closer to the potential harmony target, and practically impossible after trisyllables like *kameli* and *fakiiri*, where the back vowel is also closer, but which are too short to be structured as quasi-compounds. Why intervening *i* and *e* weaken harmony in Hungarian, but not in the prosodically and morphologically similar Finnish, is an interesting question. A speculative answer is that Hungarian has abstract underlying [+Back] *i* and *e* (in words like *híd* 'bridge'), so that front *i* and *e* vowels may be contrastively specified as [−Back] already in the word phonology, at least optionally, whereas Finnish has no such abstract contrast in its neutral vowels, which therefore remain unspecified and harmonically inert until the postlexical phonology.

17.5   Clitics

The separation between the lexical and the postlexical module in Lexical Phonology and Stratal OT establishes a distinction between the lexical word and the

postlexical word, also known as the clitic group. When harmony operates only in the lexical phonology, it is confined to lexical words, and does not extend to phrasal clitics (such as pronouns) that are postlexically added in the syntax; such languages include Yoruba (Archangeli and Pulleyblank 1989: 198), Toposa, Lango, Kalenjin (Dimmendaal 2002: 167-70), and Tuwuli (Harley 2005: 66).

When harmony operates also postlexically, phrasal clitics are included in its domain, as seen in Turkish (Kabak and Vogel 2001), Luo (Nilotic, (Dimmendaal 2002: 177)), and Degema (Kari 2007).

The Balto-Finnic languages offer a good sample of the range of variation. In Votic, phrasal clitics are outside of the front/back harmony domain, in that they retain back vowels after front stems (Ariste 1968: 34-35; Lauerma 1993: 107-114; Markus and Rozhanskiy 2014).

(3) a. clitics have fixed vocalism: *siit-tä=ssā* 'from then on', *tä-hä=sā* 'up to here', *vērissē=ssā* 'until Epiphany' (terminative), *tytö=ka* 'with the girl/daughter', *mehe=ka* 'with the man/husband' (comitative)

   b. suffixes harmonize: *pezä-zä* 'nest-inessive', *tüttö-ä* 'girl/daughter-partitive'

The division between clitics and suffixes is diagnosable by independent morphosyntactic criteria. Suffixes appear on each member of an NP in agreement with the head noun. Clitics appear just once on the head noun (except that the comitative may be added to adjectives that are focused as a separate phrase). Thus they are not part of the word in the lexical derivation, but syntactically inserted at the phrase level.

In other Balto-Finnic languages, phrasal clitics harmonize. Regularly so in Finnish. In Seto/Võru, abessive *-lda*, morphosyntactically a clitic since attaches to whole NPs, harmonizes, e.g. *tüü: ja leiväldä* 'without work and bread', *musta leiväldä* 'without black bread'. Cliticized function words ("simple clitics", Zwicky and Pullum 1977) are only subject to $e \sim \partial$ harmony. The negation *ei* gets a back vowel when it encliticizes to a back-vowel word, and the conjunction *õt* 'that' gets a front vowel when it encliticizes to a front-vowel word (which need not be syntactically related to it).[2]

(4) a. *kɨnəli‿ət...*   'said that'
    b. *küll‿et...*   'surely that'

Some speakers also harmonize the negation *ei* 'not' in its proclitic use:

(5) 'əi tóhi   'dare not'
   sìin‿əi‿ólə?   'there isn't any in it'

In these languages velar onsets tend to inhibit front harmony.[3] The Seto and Võru clitics /-ka/ 'with' and interrogative *-ku* have invariant back vowels,

---

[2]Seto data from Kiparsky and Pajusalu (2003a,b), (4b) from (Mägiste 1977: 116).

[3]In Finnish, *-kko* can even back stem-final *-ä*, e.g. *emakko* 'sow', *venakko* 'Russian woman', *erakko* 'hermit', *kesakko* 'freckle' (from *emä, venä-, erä, kesä*), but *sisäkkö* 'maid' (from *sisä-*).

e.g. *tüü:ga* 'with work', *püssüga* 'with a gun' (Mägiste 1977: 166), *sõõt-ku* 'are you eating?'. In Votic, even 2Pl. imperative *-ka/-ga* is invariant. In the closely related Ingrian (Lower Luga dialect), terminative *-ssā* behaves as in Votic, but comitative *-ka/-kä* surprisingly harmonizes. By a range of criteria these two endings occupy an intermediate position between case suffixes and clitic postpositions in Votic and Ingrian (Markus and Rozhanskiy 2014).

In poetic and nonstandard varieties of Finnish, the short forms *mä, sä* of the 1/2Sg. pronouns optionally procliticize and undergo harmony, e.g. *ma tulin* 'I came' (pro standard colloquial *mä tulin*), vs. *mä menin* 'I went', *mä kävin* 'I went (and left again)'. They also harmonize with their host when enclitic: *En oo ma näiltä mailta* 'I'm not from these parts'; 3Sg. *hän* is however invariant even in these varieties.

17.6   Discontinuous harmony within words

In Karimojong the [+ATR] frequentive morpheme *-éenéne-* is transparent to ATR vowel harmony. In (6) it is intruded into the middle of an [–ATR] harmony span (Lesley-Neuman 2012: 36).

(6) ɛ̀-   tɔ-   dɔ́ŋ   **-éenéne-**   tàè
    2SG CAUS pinch -frequently- IND.PRES.PERF
    'he has frequently caused to pinch'

This can be seen as instance of ENDOCYCLICITY (Hyman and Orgun 2005) or INTROFIXATION (Kiparsky to appear), which resolves conflicts between semantic/morphosyntactic scope and morphological selection by inserting a morpheme into an already formed morphological structure. In (6) the frequentive morpheme scopes over the event, hence is semantically interpreted after the perfect morpheme is composed with the root. But morphotactics requires it to be placed immediately after the root. In the derivation, the aspect morpheme is first added to the root, with which it is semantically composed and phonologically harmonizes, and the frequentive is then introfixed between them and semantically composed with them, creating disharmony.

Kimatuumbi likewise has disharmony by introfixation of an aspectual morpheme (Odden 1996: 51, 102). Word-final morphemes with high vowels are exempt from the language's otherwise regular [ATR] vowel harmony. The perfective suffix is one such morpheme. After polysyllabic stems, its allomorph -ʊ- is infixed into the verb, keeping its [–ATR] quality and thereby forming a little disharmonic island within the [+ATR] word, as in (7c):

(7)   a. n-télek-ɪ́ 'cook', ʊ-tóp-ɪ́ 'fatness'

      b. chóla 'draw', nɪ-chól-ɪte 'draw-PERF'

      c. béleka 'bear', nɪ-bél-ʊ-ke 'bear-PERF'

In Bari (Nilotic), the invariant [+ATR] adverbial morphemes *-ki'-*, *-ji'-* (/-kin-/, /-jin-/) interrupt harmonic [–ATR] domains, see (8a,c) (Spagnolo 1933: 152-3, van der Hulst 2018: 357-8).

(8) a. dɛra-ki'-ɛ
cook-DAT-LOC/INSTR
'for cooking in'

b. remi-ki'-e
stab-DAT-LOC/INSTR
'for stabbing in'

c. lalaŋa-ji'-ɛ
jump-away-LOC/INSTR
'for jumping away on'

d. sunyu-ji'-e
send-away-LOC/INSTR
'for sending away with'

The translations suggest that the disharmonic adverbials outscope the Locative/Instrumental applicative suffixes, which supports an introfixation analysis.

17.7   Phrasal harmony

Most vowel harmony processes apply within the limits of a word, but vowel harmony processes that apply across word boundaries are robustly attested (Downing and Krämer, Ch. 30 of this volume). Many of these have the hallmarks of phonetic coarticulation. Commonly the harmonic feature spills over into an adjacent word, usually leftward, optionally, gradiently, and only part way through the phrasal domain to an extent that depends on the rate of speech (Hyman 2002). Nez Perce harmony triggered by dominant vowels applies obligatorily throughout a word, but between words only in rapid speech to the immediately preceding syllable. And whereas lexical harmony distinguishes between dominant and recessive *i*, its phrasal analogue treats them alike (Aoki 1966: 761, Kaplan 2008). In Ngiti, [+ATR] spreads one syllable to the left "in any two words which follow one another in rapid succession withing a breath group" (Kutsch Lojenga 1994: 78). Akan [+ATR] harmony "peters out" for several syllables to the left of a triggering [+ATR] vowel (Clements 1981: 154). Nawuri has both a one-syllable progressive [ATR] harmony and a Akan-type gradient regressive [+ATR] harmony within small phrases (Casali 2002).

(9) e-kɔɔli   a-fulee   [èkóó⁺lɨ́ɨ́fùléèʔ]
PROG-he.receive NOUNCLASS-money

'He is collecting money.'

Koromfe (Gur) backness/roundness harmony produces non-high "stable" vowels within the phonological word and, and high, "unstable" vowels within phonological phrases (Rennison 1987). Kinande [+ATR] harmony operates optionally and gradiently within DPs (Mutaka 1995; Archangeli and Pulleyblank 2002; Downing and Krämer, Ch. 20 below).

Some phrasal harmony processes, however, appear to be as categorical and structurally conditioned as anything in lexical phonology. Urhobo (Edoid) has obligatory ATR harmony in small phrases (Aziza 2008, 2016). Vata has, in addition to its obligatory, bidirectional, and unrestricted word-internal ATR harmony, an optional leftwards cross-word ATR assimilation process, with certain vowel height restrictions. It *must* cross a word boundary, iterating across sequences of monosyllabic words but stopping at the final syllable of a longer

word (Kaye 1982). In Luo, [+ATR] spreads leftward to the preceding word within DPs and VPs, at least in some cases categorically (Swenson 2015).

Phrasal harmony processes offer insight into syntactic and prosodic constituency. In Akan (Kwa) the domain of assimilation is the maximal phonological phrase (Kügler 2015). [+ATR] spreads leftward from verbs to their objects but not to subjects, revealing a VP constituent. In Gua (Kwa) cross-word ATR harmony operates within minimal phonological phrases, with syntactic constituency playing a smaller role (Obiri-Yeboah and Rose 2022). The domain of Somali (Nilotic) ATR harmony has been claimed to be the clause (Hall et al. 1974; Andrzejewski 1955; Saeed 1999: 261), but recent studies identify it as a prosodic unit smaller than a phrase, albeit larger than a phonological word, with variation (Nilsson and Downing 2019; Downing and Krämer, this volume).

In Sawila (Alor), initial *i* causes subsequent /a/ to be pronounced as [ɛɑ]. This applies both within a word and across a word boundary, e.g. /liˈja ˈnanu/ *lɪjɛnɛanʊ* (Kratochvíl 2014).

In Wolof (Atlantic-Congo), ATR harmony applies between a lexical head and associated functional material within XP, even if other constituents intervene (Sy 2005). In (10a) the [–ATR] verb *joxee* requires the [–ATR] forms *ba* 'when' and *ma* 'me' across intervening [+ATR] *góór gë*, and the [+ATR] verb *yónné* requires the corresponding [+ATR] forms *bë, më* across intervening [–ATR] *xale ba*.[4]

(10) a. **ba   ma** góór gë **joxee** tééré ba
       when 1SG man the GIVE   book the
       'when the man gave me the book'

    b. **bë   më** xale ba **yónné** tééré ba
       when 1SG child the SEND   book the
       'when the child sent me the book'

Sande (2022) describes two cases of discontinuous vowel harmony similar to Wolof's in Guébie (Kru) and Atchan (Kwa), both from Côte d'Ivoire. She observes that discontinuous harmony in all three languages arises by syntactic displacement of the target of harmony away from an originally adjacent trigger, and proposes an analysis within a cyclic, interleaved model of the syntax/phonology interface which explains this generalization. Her account reduces Wolof's typologically anamalous phrasal ATR harmony process to the interaction of unremarkable syntax and local vowel harmony. It jibes well with the analysis of word-internal discontinuous harmony by post-phonological morpheme introfixation mentioned in section 17.6 above.

17.8   Conclusion

Because of its unbounded character, vowel harmony is a useful probe into word and sentence structure. It provides empirical evidence for morphological theories such as Distributed Morphology and Minimalist Morphology, which countenance

---

[4]Following Sy, I cite examples in Wolof orthography, where *i, u, é, ó, ë* are [+ATR] vowels and *e, a, o, à* are [–ATR] vowels.

morphemes and hierarchical constituency in words, and challenges theories such as Paradigm Function Morphology and Word-based morphology, which posit flat "a-morphous" word structure. Of special theoretical interest is discontinuous harmony, where phonology interacts cyclically with both the morphological and syntactic derivation.

Bibliography

Akinlabi, Akinbiyi. 1995. ATR harmony in Kalabari Ijo. In *Issues in African languages and linguistics: Essays in honour of Kay Williamson*, (eds.), E. Nolue Emenanjo and Ozo-mekuri Ndimele, 70–81. Aba: National Institute for Nigerian Languages.

Anderson, Coleen N. 1999. ATR vowel harmony in Akposso. *Studies in African Linguistics* 28:185–214.

Andrzejewski, Bogumił Witalis. 1955. The problem of vowel representation in the Isaaq dialect of Somali. *Bulletin of the School of Oriental and African Studies* 17:567–580.

Aoki, Haruo. 1966. Nez Perce vowel harmony and Proto-Sahaptian vowels. *Language* 42:759–767.

Archangeli, Diana and Douglas Pulleyblank. 1989. Yoruba vowel harmony. *Linguistic Inquiry* 20:173–217.

Archangeli, Diana and Douglas Pulleyblank. 1994. *Grounded phonology*. Cambridge, MA: MIT Press.

Archangeli, Diana and Douglas Pulleyblank. 2002. Kinande vowel harmony: Domains, grounded conditions and one-sided alignment. *Phonology* 19:139–188.

Archangeli, Diana and Douglas Pulleyblank. 2007. Harmony. In *Cambridge handbook of phonology*, (ed.), Paul de Lacy, 353–378. Cambridge: Cambridge University Press.

Ariste, Paul. 1968. *A grammar of the Votic language*. Indiana University Publications, Uralic and Altaic Series, vol. 68. Bloomington, IN and The Hague: Indiana University and Mouton.

Aziza, Rose O. 2008. Neutralization of contrast in the vowel system of Urhobo. *Studies in African Linguistics* 37:1–19.

Aziza, Rose O. 2016. The vowel system of Urhobo. In *Convergence: English and Nigerian languages: A festschrift for Munzali A. Jibril*, (ed.), Ozo-mekuri

Ndimele, The Nigerian Linguists Festschrift Series, vol. 6, 731–740. M and J Grand Orbit Communications.

Baković, Eric. 2000. *Harmony, dominance, and control*. PhD dissertation: Rutgers University, New Brunswick, NJ.

Beckman, Jill N. 1997. Positional faithfulness, positional neutralization, and Shona vowel harmony. *Phonology* 14:1–46.

Bennink, Clemens. 1992. Harmony and disharmony in Turkish. *Linguistics in the Netherlands* 25–36.

Casali, Roderic F. 2002. Nawuri ATR harmony in typological perspective. *Journal of West African Languages* 29:3–43.

Clements, G. N. and Engin Sezer. 1982. Vowel and consonant disharmony in Turkish. In *The structure of phonological representations*, (eds.), Harry van der Hulst and Norval Smith, vol. 2„ 213–255. Dordrecht: Foris.

Clements, George N. 1981. Akan vowel harmony: A nonlinear analysis. *Harvard Studies in Phonology* 2:108–177.

Dimmendaal, Gerrit Jan. 2002. Constraining disharmony in Nilotic: What does an optimal system look like? *Journal of African Languages and Linguistics* 23:153–181.

Fọlarin, Antonia. 1987. Lexical and phrasal phonology of Yoruba nouns. *Kansas Working Papers in Lingustics* 12:43–66.

Goldsmith, John. 1990. *Autosegmental and metrical phonology*. Oxford and Cambridge, MA: Blackwell.

Hall, Beatrice, R. Michael R. Hall, Martin Pam, Amy Myers, Stephen Antell and Godfrey Cherono. 1974. African vowel harmony systems from the vantage point of Kalenjin. *Afrika und Übersee* 57:241–267.

Harley, Matthew W. 2005. *A descriptive grammar of Tuwuli, a Kwa language of Ghana*. PhD dissertation: SOAS, London.

van der Hulst, Harry. 2018. *Asymmetries in vowel harmony*. Oxford: Oxford University Press.

Hulst, H.G. van der and J. van de Weijer. 1995. Vowel harmony. In *The handbook of phonological theory*, (ed.), J.A. Goldsmith, 495–534. Oxford: Blackwell.

Hyman, Larry M. 1999. The historical interpretation of vowel harmony in Bantu. In *Bantu historical linguistics: Theoretical and empirical perspectives*, (eds.), Jean-Marie Hombert and Larry M. Hyman, 239–95. Stanford: CSLI Publications.

Hyman, Larry M. 2002. Is there a right-to-left bias in vowel harmony? In *Phonologica 2002*, (eds.), John Rennison, Friedrich Neubarth, and Markus Pöchträger. Berlin: Mouton de Gruyter.

Hyman, Larry M. and C. Orhan Orgun. 2005. Endocyclicity and paradigm non-uniformity. In *Morphology and the web of grammar: Essays in memory of Steven G. Lapointe*, (eds.), C. Orhan Orgun and Peter Sells. Stanford: CSLI Publications.

Kabak, Baris and Irene Vogel. 2001. The phonological word and stress assignment in Turkish. *Phonology* 18:315–360.

Kabak, Barış. 2011. Turkish vowel harmony. In *The Blackwell companion to phonology,*, (eds.), Marc van Oostendorp, Colin J. Ewen, Elizabeth Hume, and Keren Rice, vol. 5, 2831–2854. Malden, MA. & Oxford: Wiley-Blackwell.

Kaplan, Aaron. 2008. *Noniterativity is an emergent property of grammar*. PhD dissertation: University University of California, University Santa Cruz.

Kari, Ethelbert Emmanuel. 2002. Distinguishing between clitics and affixes in Degema, Nigeria. *African Study Monographs* 23:91–115.

Kari, Ethelbert Emmanuel. 2007. Vowel harmony in Degema, Nigeria. *African Study Monographs* 28:87–97.

Kaye, Jonathan Derek. 1982. Harmony processes in Vata. In *The structure of phonological representations, volume 2*, (eds.), Harry van der Hulst and Norval Smith, 385–452. Dordrecht: Foris.

Kimper, Wendell A. 2011. Locality and globality in phonological variation. *Natural Language & Linguistic Theory* 29:423–465.

Kiparsky, Paul. to appear. *Stratal OT: Paradigms and opacity*. CSLI Publications.

Kiparsky, Paul and Karl Pajusalu. 2003a. Seto vowel harmony and the typology of disharmony. MS, Stanford and Tartu.

Kiparsky, Paul and Karl Pajusalu. 2003b. Towards a typology of disharmony. *The Linguistic Review* 20:217–41.

Krämer, Martin. 2003. *Vowel harmony and Correspondence Theory*. Berlin: Mouton De Gruyter.

Kratochvíl, František. 2014. Sawila. In *The Papuan languages of Timor, Alor, and Pantar*, (ed.), Antoinette Schapper, vol. 1, 351–438. Berlin: De Gruyter.

Kroeger, Paul. 2010. Vowel harmony in Kimaragang as a lexical rule. In *Reality exploration and discovery: Pattern interaction in language & life. (Festschrift for K.P. Mohanan)*, (eds.), Linda Uyechi and Lian Hee Wee, 75–88. Stanford, California: CSLI Publications.

Kügler, Frank. 2015. Phonological phrasing and ATR vowel harmony in Akan. *Phonology* 32:177–204.

Kuroda, Sige-Yuki. 1967. *Yawelmani phonology*. Cambridge, MA: MIT Press.

Kutsch Lojenga, Constance. 1994. *Ngiti: A Central Sudanic language of Zaire*. Köln: Rüdiger Köppe.

Lauerma, Petri. 1993. *Vatjan vokaalisointu [Votic vowel harmony]*. Suomalais-Ugrilaisen Seuran Toimituksia, vol. 214. Helsinki: Suomalais-Ugrilainen Seura.

Lesley-Neuman, Diane. 2007. *ATR harmony in Karimojong: Justification for a stratal Optimality Theory*. PhD dissertation: University of Colorado, Boulder, Colorado.

Lesley-Neuman, Diane. 2012. Morpho-phonological levels and grammaticalization in Karimojong: A review of the evidence. *Studies in African Linguistics* 41:1–61.

Levergood, Barbara. 1984. Rule governed vowel harmony and the strict cycle. *NELS* 14:33–55. Available at: https://scholarworks.umass.edu/nels/vol14/iss1/17.

Mägiste, Julius. 1977. *Setukaistekstejä [Seto texts]*. Suomalais-Ugrilaisen Seuran Toimituksia, vol. 159. Suomalais-Ugrilainen Seura.

Mahanta, Shakuntala. 2007. *Directionality and locality in vowel harmony: With special reference to vowel harmony in Assamese*. PhD dissertation: Universiteit Utrecht.

Markus, Elena and Fedor Rozhanskiy. 2014. Comitative and terminative in Votic and Lower Luga Ingrian. *Linguistica Uralica* 4:241–257.

McCollum, Adam G. and James Essegbey. 2020. Initial prominence and progressive vowel harmony in Tutrugbu. *Phonological Data and Analysis* 3:1–37.

McPherson, Laura. 2013. *A grammar of Tommo So*. The Hague: Mouton De Gruyter.

McPherson, Laura and Bruce Hayes. 2016. Relating application frequency to morphological structure: The case of Tommo So vowel harmony. *Phonology* 33:125–167.

Mutaka, Ngessimo and Larry Hyman. 1990. Syllables and morpheme integrity in Kinande reduplication. *Phonology* 7:73–120.

Mutaka, Ngessimo Mathe. 1995. Vowel harmony in Kinande. *Journal of West African Languages* 25:41–55.

Nilsson, Morgan and Laura J. Downing. 2019. Somali vowel qualities and vowel harmony domains. URL http://morgannilsson.se/ppt/2019-06-24-Paris.pdf, slides from NACAL 47 @LACITO, Paris, June 2019.

Noonan, Michael. 1992. *A grammar of Lango*. Berlin and New York: Mouton de Gruyter.

Obiri-Yeboah, Michael and Sharon Rose. 2022. Vowel harmony and phonological phrasing in Gua. *Natural Language and Linguistic Theory* 40:159–193.

Odden, David. 1996. *The phonology and morphology of Kimatuumbi*. Oxford: Clarendon Press.

Paradis, Carole. 1992. *Lexical phonology and morphology: The nominal classes in fula*. New York, London: Garland.

Polgárdi, Krisztina. 1999. Vowel harmony in Turkish. *The Linguistic Review* 16:187–204.

Pulleyblank, Douglas. 1988. Underspecification, the feature hierarchy, and Tiv vowels. *Phonology* 5:299–326.

Quinn-Wriedt, Lindsey Taylor. 2013. *Vowel harmony in Maasai*. PhD dissertation: University of Iowa.

Rebrus, Péter, Péter Szigetvári and Miklós Törkenczy. 2013. Dark secrets of Hungarian vowel harmony. In *Sound, structure and sense: Studies in memory of edmund gussmann*, (eds.), Eugeniusz Cyran, Henryk Kardela, and Bogdan Szymanek, Lublin. Wydawnictwo KUL. URL https://www.researchgate.net/publication/279750289_Dark_secrets_of_Hungarian_vowel_harmony.

Rebrus, Péter, Péter Szigetvári and Miklós Törkenczy. 2017. Asymmetric variation. In *Sonic signatures*, (eds.), Geoff Lindsey and Andrew Nevins, 163–187. Amsterdam/Philadelphia: John Benjamins.

Rennison, John Richard. 1987. On the vowel harmonies of Koromfe (Burkina Faso, West Africa). In *Phonologica 1987*, (eds.), Wolfgang U. Dressler, Hans C. Luschützky, Oskar E. Pfeiffer, and John Rennison, 239–46. Cambridge: Cambridge University Press.

Ribeiro, Eduardo Rivail. 2003. Directionality in vowel harmony: The case of Karajá (Macro-Jê). *Berkeley Linguistics Society* 28:475–85.

Ringen, Catherine O. and Miklós Kontra. 1989. Hungarian neutral vowels. *Lingua* 78:181–191.

Ritchart, Amanda and Sharon Rose. 2017. Moro vowel harmony: Implications for transparency and representations. *Phonology* 34:163–200.

Saeed, John. 1999. *Somali*. Amsterdam: John Benjamins.

Sande, Hannah. 2022. Accounting for discontinuous vowel harmony in Guébie. Talk in Stanford Linguistics Department, April 26th 2022.

Spagnolo, Lorenzo M. 1933. *Bari grammar*. Verona: The Nigrizia Printing Press School.

Swenson, Janel. 2015. ATR quality in the Luo vowel system. *CanIL EWP* 1:101–145.

Sy, Mariame. 2005. Ultra long-distance ATR agreement in Wolof. *Proceedings of the Annual Meeting of the Berkeley Linguistics Society* 31:95–105.

Törkenczy, Miklós. 2019. Hungarian vowel harmony: Beyond the standard data set. Presented at MIT Phonology Circle, 10/16/2019.

Vértes, Edith. 1977. *Morphonematische Untersuchung der ostjakischen Vokalharmonie [Morphophonological investgation of Ostyak vowel harmony]*. Budapest: Akadémiai Kiadó.

Wallace, B.F. 1981. The morphophonemics of the Maasai verb. In *Nilo-Saharan: Proceedings of the First Nilo-Saharan Linguistics Colloquium, Leiden, September 8-10, 1980,*, (eds.), Thilo C. Schadeberg and M. Lionel Bender, 75–88. Dordrecht and Cinnaminson: Foris.

Zwicky, Arnold M. and Geoffrey K. Pullum. 1977. Cliticization vs. inflection: English N'T. *Language* 59:502–513.