Phonology Reading Group
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Vowel Harmony in Phuthi: A Challenge for Nevins (2010)?

Outline

- Very brief recap of vowel harmony in particular w.r.t. locality
- Presentation of Nevins' (2010) *Agree*-inspired computation of vowel harmony
- Description and analysis of progressive supercloseness harmony in Phuthi
- Description and analysis of regressive tenseness harmony in Phuthi
- Putting both patterns together → a paradox
- Conclusion

1 Vowel Harmony and Locality

Assimilation process whereby "a certain feature specification [...] on a vowel triggers a systematic alternation in vowels which are in ***direct neighbourhood*** on the syllabic or moraic level of representation with the result that the involved vowels look alike with respect to the active feature" (Krämer, 2003, p. 3).

The data from Turkish (1) provide an example. The accusative suffix must harmonise with the stem vowel for [±round] and [±back].

(1) *Turkish vowel harmony of accusative suffix* (Nevins, 2010, p. 24)

ip	ip-i	"rope/rope-ACC.SG"
kɨz	kɨz-ɨ	"girl/girl-ACC.SG"
yüz	yüz-ü	"face/face-ACC.SG"
pul	pul-u	"stamp/stamp-ACC.SG"
el	el-i	"hand/hand-ACC.SG"
köy	köy-ü	"villa/villa-ACC.SG"
son	son-u	"end/end-ACC.SG"

But:

- Transparent vowels:
  Finnish essive suffix alternates between *-na* ([+back]) and *-nä* ([−back]) depending on the value of the vowel to its left. However, /i/ seems to be invisible.

(2) *Finnish [±back] harmony* (Nevins, 2010, p. 69)

pöütä-nä	"table-ESS"
pouta-na	"fine-wather-ESS"
koti-na	"home-ESS"
pappi-na	"priest-ESS"

- Opaque segments/Parasitic harmony:
  Yawelmani nondirective [−high] gerundial suffix alternates between *-taw* ([−round]) and *-tow* ([+round]) depending on the vowel to its left. However, harmony only occurs when that vowel is also [−high], i.e. non-high vowels are opaque.

(3) *Yawelmani [±round] harmony* (Nevins, 2010, p. 124)

gob-tow	"take.care.of.an.infant-NONDIR.GER"
hoyoː-tow	"name-NONDIR.GER"
xat-taw	"eat-NONDIR.GER"
panaː-taw	"arrive-NONDIR.GER"
giy-taw	"touch-NONDIR.GER"
mut-taw	"swear-NONDIR.GER"
woːwul-taw	"stand.up-NONDIR.GER"

2 Nevins (2010)

Idea:
Neighbourhood (Locality/Closeness) exceeds the notion of simple one-dimensional linear distance. Rather it should be implemented as relativised distance analogous to distance in syntactic structure.
⇒ Phonology (at least vowel harmony) can be modelled according to three core tenets of the Minimalist Program:

1. It is interface-driven.
2. It comprises an operation of minimal search/efficient computation.
3. Cross-linguistic variation follows from the structure of the inventory rather than from violable principles.

Implementation:
He devises the *Harmonize* process (4) inspired by the syntactic operation *Agree* (Chomsky, 2000, et seq.) that is initiated when the target segments of vowel harmony bear an unvalued feature F which is uninterpretable at the interface. (*Harmonize* presupposes a strict ordering of segments a and b such that either a precedes b or b precedes a.)

(4) *Harmonize* (Nevins, 2010, p. 26)
   a. Find: x = the closest τ to the recipient y in direction δ
   b. Copy: the value of F on x onto y, where x, y are segments, F is a feature, τ is predicate over segments.

(5) *Single-pass search with all features harmonised* (Nevins, 2010, p. 27)

myVals V
myPosition P
myFeatsneeded F

while F is not empty:
· Go in direction δ and update P
· **if** P has a value for any f, $f \in F$:
· · Copy Val(P, f) to V
· · Remove f from F

Turkish

(6) *Turkish vowel harmony of accusative suffix* (Nevins, 2010, p. 24)

ip	ip-i	"rope/rope-ACC.SG"
kɨz	kɨz-ɨ	"girl/girl-ACC.SG"
yüz	yüz-ü	"face/face-ACC.SG"
pul	pul-u	"stamp/stamp-ACC.SG"
el	el-i	"hand/hand-ACC.SG"
köy	köy-ü	"villa/villa-ACC.SG"
son	son-u	"end/end-ACC.SG"

(7) *Turkish accusative suffixes must:*
Back- and Round-Harmonize: δ = left, F = [±back, ±round]

2.1 Transparent segments

A segment S can be excluded from the search domain (as potential sources) even though it provides a value for the feature for two reasons (claimed by Nevins to be the only possible and necessary reasons):

1. S in position P bears the relevant feature F but F is not contrastive on S (i.e. there exists no other segment S′ in the inventory that only differs from S w.r.t. F and can occur in P)

2. S in position P bears only the unmarked value of F (markedness is determined either language specifically, e.g. [+low] in Sibe, or contextually, e.g. [+round] in context [−back])

(8) *Adapted algorithm*
τ is either {all values of f_i, contrastive for f_i, marked for f_i}
myVals V
myPosition P
myFeatsneeded F

while F is not empty:
· Go in direction δ and update P
· **if** P has a value for any f, $f \in F$:
· · Copy Val(P, f) to V
· · Remove f from F

If no contrastive/marked value can be obtained, insertion of a default value takes place as a last resort in order to make the string interpretable.

Finnish

Finnish has no vowel that is different from /i/ only in the value for [back], hence [±back] is never contrastive on /i/.

(9) *Finnish [±back] harmony* (Nevins, 2010, p. 69)

pöütä-nä	"table-ESS"
pouta-na	"fine-wather-ESS"
koti-na	"home-ESS"
pappi-na	"priest-ESS"

(10) *Finnish essive suffix must:*
Back-Harmonize: δ = left, F = [contrastive: ±back]

2.2 Opaque segments/parasitic harmony

Opaque segments lead to an error of copying by means of not fulfilling an additional requirement R. In contrast to transparent segments, the algorithm exits after an unsuccessful attempt of copying.

(11) *Algorithm with conditional requirements* (**?**, p. 129)
τ is either {all values of f_i, contrastive for f_i, marked for f_i}
myVals V
myPosition P
myFeatsneeded F
myConditionalRequirements(F) = R

while F is not empty:
· Go in direction δ and update P
· **if** P of type τ for any f, $f \in F$:
· · **if** R is true of P:
· · · Copy Val(P, f) to V
· · · Remove f from F
· · **else**:
· · · **exit**

Again, if no value is obtained by the algorithm, default insertion takes place.

Yawelmani

The harmony process of the nondirective gerundial suffix in Yawelmani additionally requires the potential source to bear the value [−high].

(12) *Yawelmani [±round] harmony* (Nevins, 2010, p. 124)

gob-tow	"take.care.of.an.infant-NONDIR.GER"
hoyoː-tow	"name-NONDIR.GER"
xat-taw	"eat-NONDIR.GER"
panaː-taw	"arrive-NONDIR.GER"
giy-taw	"touch-NONDIR.GER"
mut-taw	"swear-NONDIR.GER"
woːwul-taw	"stand.up-NONDIR.GER"

(13) *Yawelmani nondirective gerundial suffix must:*
Round-Harmonize: δ = left, F = [±round & R = −high]

3 Phuthi

- Southern Bantu language of the Nguni branch spoken in and around Lesotho
- close contact with and heavy borrowing (in all areas of grammar) from non-Nguni language Sotho

- other segmental processes: affrication, labialisation, strengthening and nasalisation (no interaction with vowel harmony)
- two contrastive tones high and low, giving rise to six surface patterns: level high, falling high, rising high, rising falling high, low-ish and low (no interaction with vowel harmony)
- vowel lengthening of penultimate syllable of the prosodic phrase signalling the right edge of this phrase

(14) *Phuthi vowel inventory* (Donnelly, 2009, p. 66, my feature specifications)

i̙	u̙	superclose high	[+ATR, +high, −low]
i	u	high	[−ATR, +high, −low]
e	o	high mid (tense)	[+ATR, −high, −low]
ɛ	ɔ	low mid (lax)	[−ATR, −high, −low]
a		low	[(−ATR), −high, +low]

- acquisition of superclose vowels [i̙] and [u̙] from Sotho
  ⇒ [i̙,u̙] almost exclusively occur in lexical items of Sotho origin or are induced via harmony with such items (Donnelly, 2009)
- tense/lax distinction in mid vowels [e,o] nearly completely predictable with lax vowels [ɛ,ɔ] conditioned by edge position and harmony process
  ⇒ [ɛ,ɔ] allophones of [e,o]

⇒ The distinction of superclose high vs. high vowels and high mid vs. low mid vowels has resulted from the introduction of a contrast in tongue root position (Donnelly, 2009), i.e. the feature [±ATR], from Sotho. The harmony patterns are – as claimed by Donnelly (2009) – not borrowings from Sotho but rather innovations made possible by the newly acquired feature.

4 Progressive supercloseness harmony

High vowels in suffixes are tense (superclose) if the rightmost stem-vowel is a tense high (superclose) vowel. The harmony spans all adjacent suffixes (15-a) unless they contain a non high vowel which is opaque and blocks further rightward harmonisation (15-b).

(15) *Supercloseness harmony* (Donnelly, 2009, p. 85–88, stems underlined by me)

a.	kú-bi̙t-ísi̙i̙s-a	to call intensively
	kú-dzin-ísiis-a	to dress intensively
	kú-bi̙t-u̙l:l-a	to be disrespectful to one's name
	kú-dzin-úl:l-a	to get undressed
	kú-thu̙s-ísi̙i̙s-a	to help intensively
	kú-gubh-isíis-a	to dig intensively
	bá-thu̙s-u̙u̙wɛ	they have been helped
	tí-kgújh-uuwɛ	they have been dug up
b.	bá-ya-bi̙t-él-iis-a	they help call for
	bá-ya-bi̙t-án-iis-a	they help call each other
	bá-ya-thu̙s-él-iis-a	they cause to help for
	bá-ya-thu̙s-án-iis-a	they cause each other to get help

If the stem contains a mid or low vowel no supercloseness in the suffix is observed even though the mid vowel is tense (16).

(16) *No harmony with non-high stem vowels* (Donnelly, 2009, p. 88)

kú-yét-iis-a	to make, do
tí-yét-uuwɛ	they have been made
kú-khókh-íís-a	to help take out
bá-khókh-úúwɛ	they have been taken out
kú-val-íis-a	to help close
tí-val-úuwɛ	they have been closed

⇒ Progressive [+ATR]-harmony parasitic on [+high]

Analysis

All high suffix vowels bear an unvalued feature [_ATR] that initiates a leftwards search for an appropriate value. An additional requirement is that the donor segment bears the value [+high]. The *Harmonize* algorithm thus has the properties in (17).

(17) *Phuthi high-vowel suffixes must:*
ATR-Harmonize: δ = left, F = [±ATR & R = +high]

→ Only high vowels are potential sources due to [R = +high].
→ All [−high]-vowels specified for [±ATR] halt the algorithm.
→ Only rightmost high stem-vowels induce harmony since rightmost non-high stem-vowels terminate the search even if there is a high vowel further left in the stem.
→ If a search fails to provide a value for [__ATR] the default value "–" is inserted.

5 Regressive tenseness harmony

Mid vowels at the right edge of the word have to be lax and require all leftwards adjacent mid vowels to be lax as well (18-a) unless a non-mid vowel intervenes (18-b).

(18) *Edge-controlled tenseness harmony* (Donnelly, 2009, p. 88, 93)

a.	bá-yɛ́ɛ́t-ɛ	they should make
	kú-yeet-a	to make
	bá-khɔ́ɔ́kh-ɛ	they should take out
	kú-khóókh-a	to expel
b.	tí-yét-uuwɛ	they have been made
	bá-khókh-íiyɛ	they have taken out
	bá-khókh-úúwɛ	They have been taken out

Mismatch of prosodic word right-edge (signalled by lengthening of penultimate) and harmonic domain right-edge with the suffixes "-nyana" (diminutive), "-kati" (augmentative) and "ákga"[1] (hedging relative) (19).

[1]Donnelly (2009) provides no data for the hedging relative suffix. Hence, the examples here lack data for this suffix as well.

(19) *Mismatching domain-edges* (Donnelly, 2009, p. 95)

sí-kɔ́lɔ́-nyaana	tiny school
sí-kɔ́lɔ́-kaati	huge school
í-kɛ́rɛ́kɛ́-nyaana	tiny church
í-kɛ́rɛ́kɛ́-kaati	huge church

Optionality of tenseness with diminutive/augmentative plus locative "-eni" (20)

(20) *Optional harmony* (Donnelly, 2009, p. 96–97)

é-kérék-eeni	in/on/at a church
ɛ́-kɛ́rɛ́kɛ́-nyán-eeni	in/on/at a tiny church
é-kéréke-nyán-eeni	in/on/at a tiny church
ɛ́-kɛ́rɛ́kɛ́-kát-eeni	in/on/at a huge church
é-kéréke-kát-eeni	in/on/at a huge church

⇒ Regressive [−ATR]-harmony parasitic on [−high, −low]

Analysis

(21) *Phuthi mid-vowels must:*
ATR-Harmonize: δ = right, F = [±ATR & R = {−high, −low}]

- word-final mid-vowel: finds no value for [__ATR] ⇒ default: [−ATR]
- non-final mid-vowel: finds no value or is halted by high or low vowel ⇒ default: [+ATR]

Problem:
Mid-vowels are defective w.r.t. [±ATR] and initiate a search algorithm but – contrary to the progressive harmony – there is no inherently specified source segment. Rather, the relevant harmonic feature [ATR] of the mid-vowels somehow changes its value depending on their position or that of neighbouring mid-vowels.

Solution:
Allophony rule (22) laxens word-final mid-vowels (analogous to German word-final devoicing).

(22) *Word-final mid-vowel laxing*
[_ATR] ⟶ [−ATR]/[−high, −low, __]#

Mismatch as in (19) is either a consequence of a mismatch between the harmony domain and the domain of penultimate lengthening or can be attributed to three further laxing rules in (23).

(23) *Additional laxing rules*
a. [_ATR] ⟶ [−ATR]/[−high, −low, __]-nyana
b. [_ATR] ⟶ [−ATR]/[−high, −low, __]-kati
c. [_ATR] ⟶ [−ATR]/[−high, −low, __]-ákga

Optionality seems to be a matter of idiolectal variation (**?**, footnote 76, p. 96) that could be derived by the three correction rules in (24).

(24) *Correction rules*

a. [−ATR] ⟶ [_ATR]/[−high, −low, __]-nyana-eni
b. [−ATR] ⟶ [_ATR]/[−high, −low, __]-kati-eni
c. [−ATR] ⟶ [_ATR]/[−high, −low, __]-ákga-eni

All rules must crucially apply before *Harmonize*.

6 The challenge: putting it all together

Recap:

(25) *Phuthi high-vowel suffixes must:*
ATR-Harmonize: δ = left, F = [±ATR & R = +high]

(26) *Phuthi mid-vowels must:*
ATR-Harmonize: δ = right, F = [±ATR & R = {−high, −low}]

Determining the order of application

kú-lí̩kél-iis-a "to make stand aside"

(27) *Ordering: (25) precedes (26)*

1. [−ATR] [+ATR] [__ATR] [__ATR] [−ATR]
[+h,−l] [+h,−l] [−h,−l] [+h,−l] [−h,+l]
→ High-vowel searches leftwards, skips "é", encounters [+ATR] on "í̩"
→ copying succeeds because R is met

2. [−ATR] [+ATR] [__ATR] [±ATR] [−ATR]
[+h,−l] [+h,−l] [−h,−l] [+h,−l] [−h,+l]
→ Mid-vowel searches rightwards, encounters [±ATR] on "ii"
→ copying fails because R is not met
→ default rule inserts [+ATR]

3. [−ATR] [+ATR] [±ATR] [±ATR] [−ATR]
[+h,−l] [+h,−l] [−h,−l] [+h,−l] [−h,+l] *

(28) *Ordering: (26) precedes (25)*

1. [−ATR] [+ATR] [__ATR] [__ATR] [−ATR]
[+h,−l] [+h,−l] [−h,−l] [+h,−l] [−h,+l]
→ Mid-vowel searches rightwards, skips "ii", encounters [−ATR] on "a"
→ copying fails because R is not met
→ default rule inserts [+ATR]

2. [−ATR] [+ATR] [±ATR] [__ATR] [−ATR]
[+h,−l] [+h,−l] [−h,−l] [+h,−l] [−h,+l]
→ High-vowel searches leftwards, encounters [±ATR] on "é"
→ copying fails because R is not met
→ default rule inserts [−ATR]

3. [−ATR] [+ATR] [±ATR] [−ATR] [−ATR]
[+h,−l] [+h,−l] [−h,−l] [+h,−l] [−h,+l] ✓

Thus: (26) > (25)

bá-khókh-íiyɛ “they have taken out”

(29) *Ordering: (25) precedes (26)*

1. [−ATR] [__ATR] [__ATR] [__ATR]
   [−h,+l] [−h,−l] [+h,−l] [−h,−l]
   → Word-final mid-vowel laxing (22) applies
2. [−ATR] [__ATR] [__ATR] [±ATR]
   [−h,+l] [−h,−l] [+h,−l] [−h,−l]
   → high-vowel searches leftwards, skips “ó”, encounters [−ATR] on “a”
   → copying fails because *R* is not met
   → default rule inserts [−ATR]
3. [−ATR] [__ATR] [±ATR] [±ATR]
   [−h,+l] [−h,−l] [+h,−l] [−h,−l]
   → Mid-vowel searches rightwards, encounters [−ATR] on “ii”
   → copying fails because *R* is not met
   → default rule inserts [+ATR]
4. [−ATR] [±ATR] [±ATR] [±ATR] ✓
   [−h,+l] [−h,−l] [+h,−l] [−h,−l]

(30) *Ordering: (26) precedes (25)*

1. [−ATR] [__ATR] [__ATR] [__ATR]
   [−h,+l] [−h,−l] [+h,−l] [−h,−l]
   → Word-final mid-vowel laxing (22) applies
2. [−ATR] [__ATR] [__ATR] [±ATR]
   [−h,+l] [−h,−l] [+h,−l] [−h,−l]
   → mid-vowel searches rightwards, skips “ii”, encounters [−ATR] on “ɛ”
   → copying succeeds because *R* is met
3. [−ATR] [±ATR] [__ATR] [±ATR]
   [−h,+l] [−h,−l] [+h,−l] [−h,−l]
   → High-vowel searches leftwards, encounters [−ATR] on “ó”
   → copying fails because *R* is not met
   → default rule inserts [−ATR]
4. [−ATR] [±ATR] [±ATR] [±ATR] *
   [−h,+l] [−h,−l] [+h,−l] [−h,−l]

Thus: (25) > (26)

7 Conclusion

Modelling of the two vowel harmony patterns in Phuthi employing Nevins’ approach leads to a rule/operation ordering paradox.

⇒ As it stands, Phuthi poses a challenge for Nevins’ attempt to derive different phenomena of different modules of the grammar from the same core principles of the Minimalist Program.

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