

# Phonetic (non-)explanation in historical phonology

Duration, harmony, and dissimilation

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## Road map

- Durational trade-offs between neighbouring vowels give rise to vowel reduction
- Diverging phonologization paths of a single phonetic phenomenon
  - Vowel reduction results in synchronic harmony: Nivkh
  - Vowel reduction results in synchronic dissimilation: East Slavic, Irish
- Claim: this weakens the predictive power of a purely phonetic account of phonological change
- Phonological factors do play a significant role in change, potentially even at very early stages.

## 1 Vowel reduction to harmony

### 1.1 Vowel co-occurrence in West Sakhalin Nivkh

#### Nivkh roots

- Native roots are maximally disyllabic.
- Most roots are monosyllabic: the corpus of [Shiraishi & Lok \(2002–2010\)](#) contains about twice as many monosyllabic roots as disyllabic roots (637 vs. 335).
- The Amur dialects of Nivkh, including West Sakhalin Nivkh, have fixed initial stress, e. g. [‘heβa] ‘rope’, [‘kikun] ‘owl’
- The more conservative East Sakhalin dialect has some disyllabic roots with final stress ([Kreinovich 1979](#)); these appear to be restricted to roots with final heavy syllables.

## Nivkh vowels

i	i	u
e		o
	a	

## Vowel co-occurrence restrictions in Nivkh roots

‘Chukotko-Kamchatkan and Tungusic languages have been in close contact for a considerable period in eastern Siberia, so it is plausible that ATR harmony should be an areal feature uniting them. The next question to ask is whether this feature is even more widespread in eastern Siberia’ (Comrie 1997, p. 276; see also Comrie 2015)

‘Historically, Nivkh had vowel harmony between *i i u* and *e a o*’ (Kreinovich 1979, p. 297; translation BB/HS, transcription of the vowels modified).

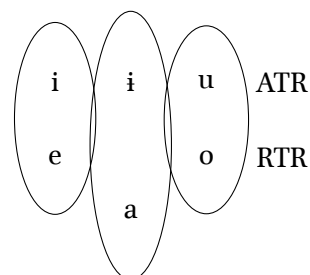
‘The vowel co-occurrence restrictions in Nivkh roots that are observed by Shiraishi & Botma (2013) arguably display “vestiges of stem-internal co-occurrence restrictions based on an [RTR] : [ATR] opposition”’ (Ko, A. Joseph & Whitman 2014, p. 171).

- Shiraishi & Botma (2013) argue instead for a synchronic pattern of co-occurrence restrictions that is based on height, which may have developed from an earlier tongue-root system.

## The synchronic Nivkh vowel system: two options

- a. Shiraishi & Botma (2013)
- |   |   |   |          |
|---|---|---|----------|
| i | i | u | high     |
| e |   | o | non-high |
|   | a |   |          |

- b. The areal feature approach (Ko, A. Joseph & Whitman 2014)



## Distribution of vowels in disyllabic roots in Amur dialects

V1	V2						
	i	ɪ	u	e	a	o	
i	12 (11.1)	14 (3.7)	5 (4.5)	0 (0.8)	1 (8.4)	0 (3.5)	32
ɪ	24 (17.0)	15 (5.7)	9 (6.9)	1 (1.1)	0 (12.8)	0 (5.4)	49
u	21 (14.6)	4 (4.9)	13 (5.9)	0 (1.0)	4 (11.0)	0 (4.6)	42
e	10 (10.4)	0 (3.5)	1 (4.2)	1 (0.7)	17 (7.8)	1 (3.3)	30
a	21 (28.1)	1 (9.5)	8 (11.4)	3 (1.9)	42 (21.1)	6 (8.9)	81
o	13 (19.8)	0 (6.7)	5 (8.0)	2 (1.4)	12 (14.9)	25 (6.3)	57
	101	34	41	7	76	32	291

Table 1: Observed frequencies (expected frequencies: V1 frequency  $\times$  V2 frequency / total)

V1	V2						
	i	ɪ	u	e	a	o	
i	1.09	3.50	1.00	0.00	0.13	0.00	32
ɪ	1.41	2.50	1.29	1.00	0.00	0.00	49
u	1.40	0.80	2.17	0.00	0.36	0.00	42
e	1.00	0.00	0.25	1.00	2.13	0.33	30
a	0.75	0.11	0.73	1.50	2.00	0.67	81
o	0.65	0.00	0.63	2.00	0.80	4.17	57
	101	34	41	7	76	32	291

Table 2: Observed/expected ratios

- Data are extracted from [Pukhta \(2002\)](#)
- Interpretation: 1.00: as expected; 0.00: absent; > 1.00: over-represented; < 1.00: under-represented
- Note: There are good grounds for treating [ɪ] in V2 as intrusive rather than underlying; see [Shiraishi & Botma \(2015\)](#).

## Observations

- Some vowels are much more frequent in V2 than others, e.g. /i/ ( $n = 101$ ). vs. /e/ ( $n = 7$ )
- There is a preference for lining up identical vowels ( $108/291 = 37.1\%$ ), especially for /o...o/.
- An /a/ in V2 is disfavoured if the preceding vowel is high, i.e. /i ɪ u/. (The patterning of /i/ as high may be different from how the vowel patterned historically, viz. as the ATR counterpart of low RTR /a/.)
- Some of the observed vowel sequences, e.g. /e...i/ are compatible with a height approach, but they are problematic for an ATR/RTR approach, where they would be disharmonic.

**Loanword phonology**

Ainu	→ Nivkh	
sisam	→ sezam, sizim, sizim, sizm	‘Japanese’
sintoko	→ sindux, sindux	‘barrel’
Tungusic	→ Nivkh	
luca	→ loci, loca, loc	‘Russian’
iχa	→ eχa	‘cow’

(Pukhta 2002, Shiraishi & Lok 2002–2010, Tangiku, Tanzina & Nitkuk 2008)

**Interpreting the Nivkh pattern**

- The restrictions are *asymmetric*. For example, /a...i/ is permitted while /i...a/ is (almost completely) absent; and /i...a/ is avoided in loanwords.
- Such asymmetries are not normally observed in Tungusic, where ‘RTR harmony within the root cannot be said to be directional, because there is no evidence that a particular root vowel is the trigger or target of RTR harmony’ (Li 1996, p. 135).
- We believe that what sets the Nivkh pattern apart from the vowel harmony in other languages in the region, is that it is *conditioned by stress* and involves *height restrictions rather than RTR*.
- The involvement of stress is atypical for the region: Ainu, Japanese and Tungusic (except Manchu and Solon) have pitch accent and little to no vowel reduction. For Mongolian, Svantesson et al. (2005, p. 96) claim that ‘word stress is not phonologically relevant’.

**1.2 The case for stress-dependent height harmony****Unstressed vowel reduction (UVR) in V<sub>2</sub>**

	East Sakhalin	Amur	
a.	χa'saŋ	χaz[i], χaz[e]	‘scissors’
b.	k <sup>h</sup> il'mir	k <sup>h</sup> ilms	‘navel’

- ‘The shift of accent from the second to the first syllable led to a weakening towards the end of the word in the Amur dialect, such as deletion of consonants or vowels, vowel reduction and shortening of disyllables to a monosyllable’ (Kreinovich 1979, p. 299).

**UVR and vowel height**

- The overwhelming majority of UVR patterns are *based on the elimination of height contrasts from unstressed syllables* (Barnes 2006, p. 19).
- Height contrasts are most sensitive to durational contraction, as producing the high F<sub>1</sub> required for low vowels takes a comparatively long time.

## UVR and quantitative asymmetries

‘UVR appears in languages with a large durational asymmetry between stressed and unstressed syllables, such that *unstressed syllables undergo significant durational contraction relative to a substantially longer stressed syllable*, particularly under increased rate of speech’ (Barnes 2006, p. 29; see also Lehiste 1970).

- This may lead to *articulatory undershoot*, which in turn may lead to neutralization of height contrasts.

## Loss of quantity contrasts in V2

- Diphthongs are limited to V1 (e.g. /huiβu-/ ‘remember’ but not \*/βuhui/).
- Diphthongs in loans are accommodated as monophthongs
  - Ainu *kankay* → /qaŋi/ ‘rainbow smelt’
  - Ainu *pencay* → /p<sup>h</sup>entʃi/ ‘type of ship’

## Remaining contrasts in V2

- /i/ and /u/: the relatively unrestricted occurrence of these in V2 may be due to high vowels being intrinsically shorter than non-high vowels, making them less sensitive to ‘durational contraction’.
- /a/: this vowel reduces to [i] (or to some other central, schwa-like vowel) in V2.
- /i/: fieldwork transcriptions suggest that this vowel occurs in V2 when V1 is /i/ or /u/.
- We believe that occurrences of [i] in V2 are either reduced from /a/ or intrusive.

## UVR to stress-dependent harmony: qualitative asymmetries

- Weak positions that already permit fewer contrasts and contain vowels with a diminished duration are ‘more susceptible to co-articulatory effects from neighboring strong vowels’ (Barnes 2006, p. 193).
- Such effects can be seen as the first step towards stress-conditioned harmony.
- ‘While some featural agreement of stressed and unstressed vowels can arise in UVR systems, it tends always to be harmony of the same type: either an unstressed vowel retains its earlier quality when the stressed vowel is of the same quality, or the unstressed vowel takes on the quality of the stressed vowel entirely, showing complete agreement.’ (Barnes 2006, p. 195)

## Stress-dependent vowel harmony in northern Italo-Romance

- Data from Delucchi (2013)

### (1) Claro: total progressive vowel harmony

- a. [‘limi] ← Latin *līma* ‘file’
- b. [‘tere] ← Latin *tērra* ‘earth’

- (2) Monteviasco: vowel harmony destroyed utterance-internally
- a. [sølø] ‘sole’
  - b. [sølø di ʃkarp] ‘the sole of the shoes’
- (3) Spriana: Centralization to [i] irrespective of preceding vowel
- a. [ˈlimi] ‘file’
  - b. [ˈtəri] ‘earth’

### Durational ratio of unstressed vs. stressed vowels

Spriana 54%    Monteviasco 62%    Claro 86%  
 Strong VR                      ←————→                      Stable vowel harmony

### Preliminary investigation of Nivkh UVR

- *Subjects*: Three from Amur, two from West Sakhalin
- *Materials*: Target CaCa words (/nana/ ‘recently’, /napa/ ‘still’, /χaza/ ‘scissors’ /βaqa/ ‘box’, /ara/ ‘almost’) embedded in the second position of a frame sentence (e.g. /ɲikin napa iɲɾumdʒ/ ‘My brother is still eating’).
- The presence of /a/ in V2 in the orthography suggests that the vowel is present underlyingly.
- *Method*: Translation/elicitation task. Durational measurements of the target vowels were taken from linked spectrographic and waveform displays using Praat (Boersma & Weenink 2014). Duration was judged on reliable periodicity and significant energy in the higher formants.

Language	UV/SV ratio	Task	Source
Amur 1 (1946-, F)	73% (17 tokens)	elicitation	Fieldwork (Sep 2014)
Amur 2 (1935-, F)	54% (41 tokens)	elicitation	Fieldwork (Sep 2015)
Amur 3 (1939-, F)	70% (34 tokens)	elicitation	Fieldwork (Sep 2015)
W. Sak. 1 (1942-, M)	67% (13 tokens)	elicitation	Fieldwork (Sep 2014)
W. Sak. 2 (1946-, F)	90% (39 tokens)	elicitation	Fieldwork (Sep 2014)
English	62%	extemporaneous speech	<a href="#">Delattre (1966)</a>
Spanish	76%	extemporaneous speech	<a href="#">Delattre (1966)</a>
Russian	84% (1st pretonic) 31% (2nd pretonic)	sentence reading	<a href="#">Barnes (2006)</a>

Table 3: Duration ratio between unstressed vowel (UV) and stressed vowel (SV)

### 1.3 Phonological analysis

#### Formalizing stress-dependent height harmony

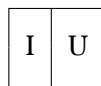
- We envisage an Element Theory approach ([Harris & Lindsey 1995](#), [Smith 2000](#)) in which the ‘low’ element  $|A|$  is permitted, or ‘licensed’, in  $V_2$  only if it is simultaneously present in  $V_1$ .

#### Partitioning the vowel space

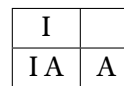
a.

 $|A|$  = low

b.

 $|I|$  = front,  $|U|$  = back

c.

 $|IA|$  = front, low

#### Vowel place

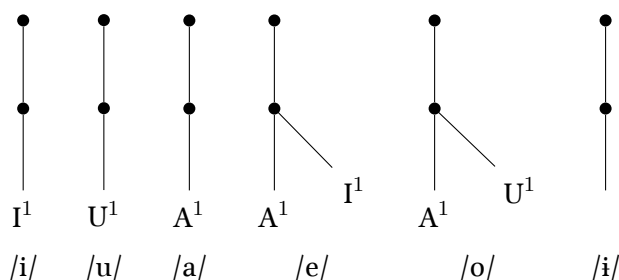
a. Primary place

 $A^1$  : low $I^1$  : front $U^1$  : back

b. Secondary place

 $A^2$  : RTR $I^2$  : ATR $U^2$  : round

#### Nivkh vowels



- The natural class of high vowels (*/i, i, u/*) is identified by the absence of  $|A|$ .
- The empty structure of */i/* is supported by synchronic vowel reduction (reduction of */a/* to [i] involves suppression of  $|A|$ ), and perhaps also by the development from an RTR to a height-based system (see [Shiraishi & Botma 2015](#)).

#### Vowel co-occurrence restrictions

a.  $tʃ^h$  o lŋ i ‘reindeer’

I  
A  
U

b.  $tʃ$  a q o ‘knife’

A >>>> A  
U

c.  $*p^h$  u zl e

I  
A  
U

d.  $*p$  i k a

I  
A

- V2 cannot license [A] unless V1 acts as ‘licensor’
- /a/ is permitted in V2 if V1 also structurally contains [A]

## 2 Vowel reduction to dissimilation

### 2.1 Dissimilative vowel reduction in East Slavic

#### Vowel reduction in East Slavic

- UVR in East Slavic
  - No reduction: Northern Russian (*okan’je*), Ukrainian
  - Reduction to [a] or [ə] (*akan’je*): Central Russian (including Standard Russian), Southern Russian, Belarusian
- Focus here: outcome in first pretonic syllable
- Cf. ‘bisyllabic domain’ (Bethin 1998), iambic foot (Crosswhite 2000)
- ‘Extreme reduction’ outside the first pretonic syllable: different pattern but may be phonologically irrelevant (Iosad 2012)
- Focus on patterns after non-palatalized consonants

#### Dissimilative UVR

- Basic pattern of UVR
  - Stressed syllables: 5–7 stressed vowels: /i (i) u (e) (o) ε ɔ a/
  - Unstressed syllables: 3 vowels: /i u a-ə/
  - Our focus: non-high member of unstressed inventory
- In varieties such as Standard Russian, first pretonic syllables always have [a]
- In varieties with ‘dissimilative’ UVR, the outcome depends on the stressed vowel

#### Obojan’ pattern

- Also (probably misleadingly) known as ‘archaic’

Pretonic	Stressed	
a	i	u
	e	o
ə	ε	ɔ
	a	

- Cf. [sta’lu] ‘desk-DAT.SG’, [sta’lje] ‘desk-LOC.SG’ ([e] ← \*e) vs. [stə’la] ‘desk-GEN.SG’, [stə’lʲɛfnʲɪk] ‘tablecloth’ ([e] ← \*ε)



## Zhizdra pattern

Pretonic	Stressed	
	i	u
a	e	o
	ɛ	ɔ
ə	a	

- Cf. [və'da] 'water-NOM.SG' vs. [va'du] 'water-ACC.SG', [va'doj] 'water-INST.SG'

## Origins of the pattern

- Banned pairs: \*/a...a/ (opposite of Nivkh), \*/ə...i/
- Strictly one [a] in the bisyllabic domain
- Dissimilation not in height per se but in *inherent length*
- Prefigured already by [Broch \(1916\)](#), see also [Crosswhite \(2000\)](#), [Kniazev \(2000\)](#)
- Vowels preferentially neutralize to [a] ([de Lacy 2006](#), [Hermans 2008](#)) but shorten if the stressed vowel is too long already

## Proto-dissimilative UVR

- Logically we expect a third type of dissimilative reduction
- High vs. non-high contrast as in Nivkh

Pretonic	Stressed	
a	i	u
	e	o
ə	ɛ	ɔ
	a	

- This exists after palatalized consonants ('Don *jakan'je*') but described as rare in our context
- [Kniazev & Šaul'skij \(2007\)](#) compare a putative Don dialect with a Zhizdra system
  - Zhizdra: categorical difference between [a] (before nonlow) and [ə] (before low) in F1 and duration relative to stressed vowel duration
  - 'Don': continuous trade-off between the durations of the two vowels

## Duration trade-offs and phonologization

- The origin of the pattern is a phonologization of *relative short duration*
- Short duration leads to elimination of height contrasts ([Barnes 2006](#))
- The outcome of neutralization is driven by a kind of isochrony within the disyllabic domain
- Outcome: superficial *dissimilation* pattern

## 2.2 Dissimilation and reduction in Irish

### Forward stress in the Gaelic languages

- See, inter alia, [O'Rahilly \(1936\)](#), [Ó Sé \(1984, 1989, 2008\)](#), [Green \(1996, 1997\)](#)
- Historically in the Gaelic languages stress is word-initial: Old Irish, Ulster Irish, Scottish Gaelic
- Shift of stress to second syllable in some circumstances ('forward stress'): Munster Irish, Manx
- Historical forward stress with reversion to initial syllable later: Connacht Irish

### Stress shift and UVR

- See in particular [Ó Sé \(1989\)](#)
- Stress shifts to a second-syllable long vowel: OIr *scatán* 'herring'
  - Ulster ['skadan]
  - Munster [skə'da:n]
  - Connacht ['skudə:n]
- Vowel reduction by raising!
- Raising most often to [i u] (backness is predictable from consonantal context so ignored here)

### Synchronic UVR: Munster

- Stress shift is synchronically active in Munster

#### (4) Corca Dhuibhne Irish ([Ó Sé 2000](#))

- |    |           |                 |                  |
|----|-----------|-----------------|------------------|
| a. | [ˈduːhɪʃ] | <i>dúthaigh</i> | 'country-NOM.SG' |
| b. | [duː'hi:] | <i>dúthaí</i>   | 'country-NOM.PL' |

- Vowel reduction active as a synchronic restriction:
  - Nonhigh vowel in peninitial stressed syllable  $\Rightarrow$  initial syllable has [ə]/[ɪ] (|A| only preceded by non-|A|)
  - High vowel in peninitial stressed syllable  $\Rightarrow$  initial syllable can have [a], but does not have to (non-|A| vowels do not trigger dissimilation)
  - [ba'stu:n] *bastún* 'uncouth person', [ko'ri:] *corraí* 'stirring', [gʲu'ri:ə] *giorria* 'hare' vs. [gə'ba:n] *gobán* 'bluffer', [də'se:n] *dosaen* 'dozen'
- Vowel reduction as a synchronic rule
- Precedes stress retraction: word-level process (cf. [Ó Sé 1989](#), *pace* [Bennett forthcoming](#))

- #### (5)
- |    |                  |                    |   |
|----|------------------|--------------------|---|
| a. | [ˈknap]          | <i>cnap</i>        | 'lump' (underlying /a/)   |
| b. | [knə'pa:n]       | <i>cnapán</i>      | 'lump-DIM' (reduction to [u] ( $\rightarrow$ [ə]?))                 |
| c. | [ˌknupa:n 'monə] | <i>cnapán mona</i> | 'a lump of peat' (retraction prevents shortening/further reduction) |

## Diachronic UVR: Connacht

- No alternations in Connacht but clear evidence for raising before second-syllable [a(:) o:]
- All nonhigh vowels raise (Cois Fhairrge Irish; [De Bhaldraithe 1975](#))
  - OIr *occoras* ‘hunger’ → [ˈukrəs]
  - OIr *bratán* ‘fish sp.’ → [ˈbruda:n]
- No durational data available
- Yet clear enough that UVR gives rise to dissimilation

## 3 Explanation in historical phonology

### 3.1 Summary of findings

#### Vowel reduction and (dis)similation

- Shortening promotes vowel reduction ([Barnes 2006](#))
- Vowel reduction creates ambiguity, promotes sound change through reanalysis ([Ohala 1981](#), [Blevins 2004](#), [Stevens & Harrington 2013](#))
- *What* sound change though?
- What are the restrictions on the outcome of this process?

#### Reduction to harmony

- Nivkh: reduction + licensing-driven preservation of [A] in weak position ⇒ synchronic harmony system
- Italo-Romance: reduction ⇒ loss of contrast ⇒ hypercorrection if enough duration available ⇒ harmony
- Other cases:
  - Central North Germanic disyllables (e. g. [Hesselman 1948–1953](#))
    - \* Heavy first syllable: reduction (centralization) of V<sub>2</sub>, followed by apocope
    - \* Light first syllable: no apocope, ‘vowel balance’ (partial or total harmony)
    - \* Here: relatively *long* duration gives harmony

#### Reduction to dissimilation

- East Slavic: reduction constrained by need to have at least one [A] in bisyllabic domain ⇒ superficial dissimilative pattern
- Irish: reduction driven by dispreference for two [A] segments in bisyllabic domain ⇒ true dissimilative pattern
- Other cases
  - South-western Welsh ([Awbery 1986](#), [Wmffre 2003](#), [Iosad 2015](#)): high vs. non-high triggers, [ɛ: ɔ:] vs. [e: o:] undergoers, undergoers shorter than triggers but not UVR
  - Kera ([Pearce 2007](#)): probably continuous inherent duration trade-off

### 3.2 Phonetic (non-)explanation

#### An evolutionary approach?

- Our findings show that relative short duration can be phonologized as both assimilation and dissimilation
- What determines the course of phonologization?
- Why are there multiple phonologization paths?
- Evolutionary Phonology ([Ohala 1981](#), [Blevins 2004](#), *inter alia*): phonologization is stochastic and driven by ambiguity  $\Rightarrow$  this is expected
- Question: how *predictive* is the ‘evolutionary’ approach to phonological change?
- Diametrically opposed phonological outcomes for single phonetic precursor
- Both equally plausibly rationalized *post hoc*

#### Precursor comparability?

- Objection: different paths are expected if the *cætera* are not *paria*
- In our examples, tone may be involved in some cases but not in others
  - Central North Germanic ([Riad 2006](#), [Bye 2008](#))
  - East Slavic ([Bethin 2006](#), [Molczanow 2015](#))
  - Welsh (?)
  - Irish (???; [Blankenhorn 1981](#))
  - But probably not in Nivkh or Italo-Romance
- We could be sure the precursors are comparable if we had better data, but we don't
- In fact we almost never do!

#### The value of formal explanation

- The ‘evolutionary’ framework attempts to largely obviate synchronic factors by appeal to diachronic paths
- We suggest: formal factors are important in constraining the shape of the resulting phonological patterns
- ☞ In our cases:
  - Domains for processes (feet?)
  - Featural representations: importance of |A|, segmental complexity
  - Processes compatible with the synchronic phonology: licensing, reduction
- Are diachronic considerations so important that formal ones are irrelevant?
- They could be if they gave us a restrictive theory
- In historical phonology, we almost never have the quality of data to build sufficiently restrictive theories of potential phonologization paths
- Our modest conclusion: formal explanations in historical phonology do have value
- We expect early involvement of phonological grammar under ‘Big Bang’ theories in any case (e. g. [Janda & B. D. Joseph 2003](#), [Janda 2003](#), [Baker, Archangeli & Mielke 2011](#), [Fruehwald forthcoming](#))

## Summary

- Relative short duration of vowels facilitates (phonetic) vowel reduction
- Vowel reduction can further give rise to both assimilatory and dissimilatory patterns
- Evolutionary approaches to phonological change underdetermine the course of phonologization
- A complete theory of phonological change may still need to refer to characteristics of formal synchronic grammars

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