

# Advanced Phonological Theory B – Lecture 6: Explaining vowel harmony

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## 1 Background: basic vowel acoustics

Vowels can be characterised acoustically as follows (cf. Johnson 1997 for details):

- $F_1$  corresponds roughly to (perceived) *vowel height*: high vowels have a low  $F_1$ ; low vowels have a high  $F_1$
- $F_2$  (or  $F_2 - F_1$ ) corresponds roughly to *vowel backness*: back vowels have a low  $F_2$ ; front vowels have a high  $F_2$
- $F_2/F_3$  correspond roughly to *rounding*: rounded vowels have a lower  $F_2/F_3$  than the corresponding unrounded vowels

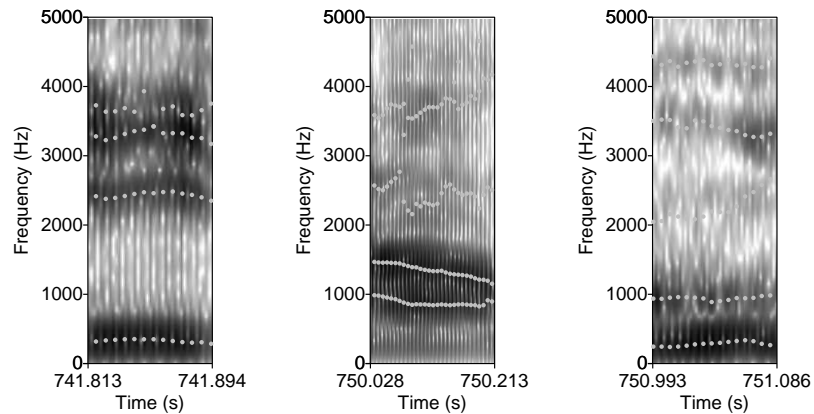


Figure 1: Spectrograms and superimposed formant tracks of slices of /i/, /a/, /u/ as produced by a male speaker of Dutch

## 2 Background: the acoustic vowel triangle

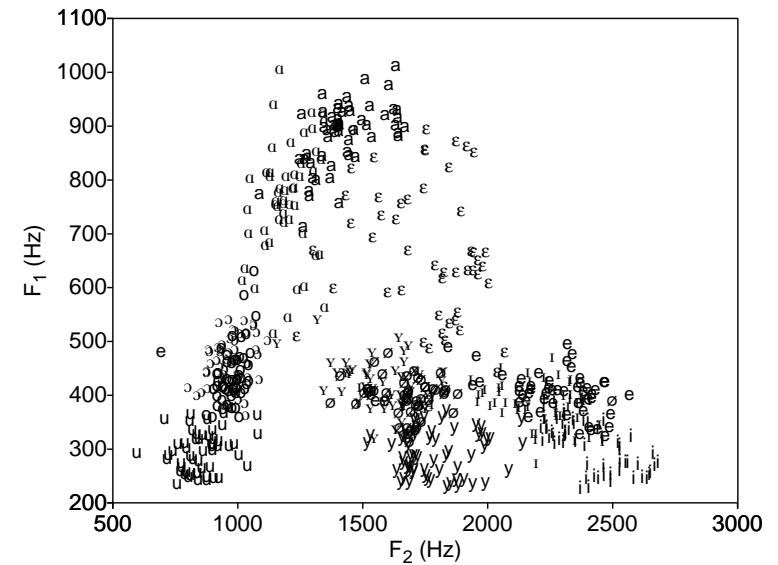


Figure 2:  $F_1 - F_2$  plot of a range of lexical monophthongs as produced by 2 speakers of Dutch

## 3 Rounding harmony

*Rounding harmony* (RH: a.k.a. labial harmony) refers to a type of process whereby non-round vowels acquire the rounding of a preceding or following rounded vowel

Table 1: Rounding harmony trigger – target sequences by height and backness. Derived from (Kaun 1995:chapter 3).

| Trigger         | Target  |         |         |         |
|-----------------|---------|---------|---------|---------|
|                 | [-back] |         | [-back] |         |
|                 | [+high] | [-high] | [+high] | [-high] |
| [-back] [+high] | /yCi/   | /yCe/   | /yCw/   | /yCɣ/   |
| [-back] [-high] | /øCi/   | /øCe/   | /øCw/   | /øCɣ/   |
| [+back] [+high] | /uCi/   | /uCe/   | /uCw/   | /uCɣ/   |
| [+back] [-high] | /oCi/   | /oCe/   | /oCw/   | /oCɣ/   |

Table 2: Typology of rounding harmony developed by Kaun (1995) (labels adapted).

| Type  | [+high] trigger |        |              |        |                |        |              |        | [-high] trigger |        |              |        |                |        |              |        |   |
|-------|-----------------|--------|--------------|--------|----------------|--------|--------------|--------|-----------------|--------|--------------|--------|----------------|--------|--------------|--------|---|
|       | [+high] target  |        |              |        | [-high] target |        |              |        | [+high] target  |        |              |        | [-high] target |        |              |        |   |
|       | [-b] trigger    |        | [+b] trigger |        | [-b] trigger   |        | [+b] trigger |        | [-b] trigger    |        | [+b] trigger |        | [-b] trigger   |        | [+b] trigger |        |   |
|       | [-b] t          | [+b] t | [-b] t       | [+b] t | [-b] t         | [+b] t | [-b] t       | [+b] t | [-b] t          | [+b] t | [-b] t       | [+b] t | [-b] t         | [+b] t | [-b] t       | [+b] t |   |
| /yCi/ | /yCu/           | /uCi/  | /uCu/        | /yCe/  | /yCɣ/          | /uCe/  | /uCɣ/        | /øCi/  | /øCu/           | /oCi/  | /oCu/        | /øCe/  | /øCɣ/          | /oCe/  | /oCɣ/        |        |   |
| I     | ✓               | ✓      | ✓            | ✓      | ✓              | ✓      | ✓            | ✓      | ✓               | ✓      | ✓            | ✓      | ✓              | ✓      | ✓            | ✓      |   |
| II    | ✓               | ✓      | ✓            | ✓      |                |        |              |        | ✓               | ✓      | ✓            | ✓      |                |        |              |        |   |
| III   |                 |        |              |        |                |        |              |        |                 |        |              |        |                | ✓      | ✓            | ✓      | ✓ |
| IV    | ✓               | ✓      | ✓            | ✓      |                |        |              |        |                 |        |              |        |                |        |              |        |   |
| V     | ✓               | ✓      | ✓            | ✓      |                |        |              |        | ✓               | ✓      | ✓            | ✓      | ✓              | ✓      | ✓            | ✓      | ✓ |
| VI    | ✓               | ✓      | ✓            | ✓      |                |        |              |        |                 |        |              |        |                | ✓      | ✓            | ✓      | ✓ |
| VII   | ✓               |        |              | ✓      | ✓              |        |              |        | ✓               |        |              | ✓      | ✓              |        |              |        |   |
| VIII  | ✓               |        |              | ✓      | ✓              |        |              |        | ✓               |        |              | ✓      |                |        |              |        |   |
| IX    | ✓               |        |              | ✓      | ✓              |        |              |        | ✓               |        |              | ✓      | ✓              |        |              |        | ✓ |

## 4 A typology of rounding harmony

Kaun (1995) defines 9 distinct types of RH (see Kaun 2004 for extensions):

**Type I** RH unrestricted by height or backness

- Examples: Kirghiz (dialect) as described by Comrie (1981).

**Type II** RH target must be [+high]

- Examples: Turkish, Tuvan. Also Nawuri, Sierra Miwok, Southern Paiute

**Type III** RH trigger and target must both be [-high]

- Examples: Eastern Mongolian dialects, various Tungusic.

**Type IV** RH trigger and target must both be [+high]

- Examples: Kachin Khakass, Hixkaryana, Tsou

**Type V** RH trigger and target must agree in height, or trigger must be [+high]

- Examples: Yakut

**Type VI** RH trigger and target must agree in height

- Examples: Yokuts

**Type VII** RH unrestricted among [-back] vowels; among [+back] vowels, target must be [+high]

- Examples: Kazakh, Chulym Tatar, Karakalpak

**Type VIII** RH unrestricted among [-back] vowels; among [+back] vowels, trigger and target must both be [+high]

- Examples: Kyzyl

**Type IX** RH unrestricted among [-back] vowels; among [+back] vowels, trigger and target must agree in height, or target must be [+high]

- Examples: Kirghiz (dialect) described in Herbert & Poppe (1963); Altai

## 5 Generalisations about RH

This typology indicates that RH tends to apply in the following configurations (cf. Kaun 1995:72):

1. [αhigh] – [+high] (high targets are preferred)
2. [-high] – [-high] (a non-high trigger is preferred when the target is non-high); taking on board the previous configuration this can be generalised to [αhigh] – [αhigh] (trigger and target agree in height) and [-high] – [αhigh] (non-high triggers are preferred)
3. [αback] – [αback] (triggers and target agreeing in backness are preferred), with a slight bias towards [-back] – [-back]

## 6 Type 1: Kirghiz

Data from Kaun (1995)/Comrie (1981):

- (1) Kirghiz vowel inventory:

|      | Front     | Central/Back |
|------|-----------|--------------|
| High | i i: y y: | ɨ ɨ: u u:    |
| Mid  | e e: ø ø: | o o:         |
| Low  |           | a a:         |

- (2) Behaviour of the ordinal suffix /-(l)nčl/ after *unrounded* root vowels (where /l/ stands for a high vowel unspecified for backness and rounding):

|           |          |               |             |
|-----------|----------|---------------|-------------|
| [bir]     | 'one'    | [bir-inčɨ]    | 'first'     |
| [beš]     | 'five'   | [beš-inčɨ]    | 'fifth'     |
| [altɨ]    | 'six'    | [altɨ-nčɨ]    | 'sixth'     |
| [žzjırma] | 'twenty' | [žzjırma-nčɨ] | 'twentieth' |

- (3) Behaviour of the ordinal suffix /-(l)nčl/ after *rounded* root vowels:

|         |         |              |          |
|---------|---------|--------------|----------|
| [yč]    | 'three' | [yč-ynčy]    | 'third'  |
| [tørt]  | 'four'  | [tørt-ynčy]  | 'fourth' |
| [toguz] | 'nine'  | [toguz-unčɨ] | 'ninth'  |
| [on]    | 'ten'   | [on-unčɨ]    | 'tenth'  |

- (4) Behaviour of the ablative suffix /TAn/ after *unrounded* root vowels (where /T/ stands for an alveolar plosive that is either voiced or voiceless and /A/ for a non-high vowel unspecified for backness and rounding):

|        |         |            |              |
|--------|---------|------------|--------------|
| [iš]   | 'work'  | [iš-ten]   | 'work-ABL.'  |
| [et]   | 'meat'  | [et-ten]   | 'meat-ABL.'  |
| [zɨ]   | 'year'  | [zɨl-dan]  | 'year-ABL.'  |
| [alma] | 'apple' | [alma-dan] | 'apple-ABL.' |

- (5) Behaviour of the ablative suffix /TAn/ after *rounded* root vowels:

|         |          |             |               |
|---------|----------|-------------|---------------|
| [yj]    | 'house'  | [yj-døn]    | 'house-ABL.'  |
| [kø]    | 'lake'   | [kø-døn]    | 'lake-ABL.'   |
| [tuz]   | 'salt'   | [tuz-don]   | 'salt-ABL.'   |
| [tokoj] | 'forest' | [tokoj-don] | 'forest-ABL.' |

## 7 Type 2: Tuvan

Data from Kaun (1995)/Krueger (1977):

- (6) Tuvan vowel inventory:

|      | Front     | Central/Back |
|------|-----------|--------------|
| High | i i: y y: | ɨ ɨ: u u:    |
| Mid  | ɛ ɛ: œ œ: | ɔ ɔ:         |
| Low  |           | a a:         |

- (7) Behaviour of the ordinal suffix /Kl/ after *unrounded* stem vowels (where /K/ stands for a velar plosive that is either voiceless or voiced, and /l/ for a high vowel unspecified for backness or rounding):

|            |             |
|------------|-------------|
| [bir-gi]   | 'first'     |
| [sɛs-ki]   | 'eighth'    |
| [aldɨ-gɨ]  | 'sixth'     |
| [tɔzan-gɨ] | 'ninetieth' |

- (8) Behaviour of the ordinal suffix /Kl/ after *rounded* stem vowels:

|           |              |
|-----------|--------------|
| [yʃ-ky]   | 'third'      |
| [dœrt-ky] | 'fourth'     |
| [muŋ-gu]  | 'thousandth' |
| [ɔn-gu]   | 'tenth'      |

- (9) Behaviour of the locative suffix /TA/ after *unrounded* stem vowels where /T/ stands for an alveolar plosive that is either voiceless or voiced, and /A/ for a non-high vowel unspecified for backness or rounding:

|           |                 |
|-----------|-----------------|
| [ɛʒik-tɛ] | 'door-LOC.'     |
| [inɛk-tɛ] | 'cow-LOC.'      |
| [kɨr-da]  | 'ridge-LOC.'    |
| [dag-da]  | 'mountain-LOC.' |

- (10) Behaviour of the locative suffix /TA/ after *rounded* stem vowels:

|           |                      |
|-----------|----------------------|
| [xyn-dɛ]  | 'sun-LOC., day-LOC.' |
| [xœl-dɛ]  | 'lake-LOC.'          |
| [xɔvu-da] | 'steppe-LOC.'        |
| [dɔʃ-ta]  | 'ice-LOC.'           |

## 8 Type 3: Khalkha Mongolian

Data from Kaun (1995)/Svantesson (1985):

- (11) Khalkha vowel inventory:

|          | Front    | Central/Back |
|----------|----------|--------------|
| High     | [+ATR] i | u            |
|          | [-ATR]   | ɯ            |
| Non-high | [+ATR] e | o            |
|          | [-ATR]   | a ɔ          |

- (12) High suffixal vowels show ATR harmony only:

|              |                    |
|--------------|--------------------|
| [gʊrv-u:l]   | 'three-COLLECTIVE' |
| [arv-u:l]    | 'ten-COLLECTIVE'   |
| [ɔr-u:l]     | 'enter-CAUS.'      |
| [dɔrv-u:l]   | 'four-COLLECTIVE'  |
| [jos-u:l]    | 'nine-COLLECTIVE'  |
| [medegd-u:l] | 'know-CAUS.'       |

- (13) Non-high suffixal vowels harmonize rounding with preceding non-high stem vowels:

- a. [-ATR,-high,-round] or [-ATR, +high, +round]:

|              |                     |
|--------------|---------------------|
| [ača-ga:r]   | 'burden-INSTR.'     |
| [tulai-ga:r] | 'hare-INSTR.'       |
| [jav-la:]    | 'go-NARRATIVE-PAST' |

- b. [+ATR,-high,-round] or [+ATR, +high, +round]:

|              |                       |
|--------------|-----------------------|
| [de:l-e:r]   | 'coat-INSTR.'         |
| [guze:-ge:r] | 'rumen-INSTR.'        |
| [uz-le:]     | 'see-NARRATIVE-PAST'  |
| [bilu:d-le:] | 'whet-NARRATIVE-PAST' |

- c. [-ATR, -high,+round]:

|              |                        |
|--------------|------------------------|
| [nɔxɔi-gɔ:r] | 'dog-INSTR.'           |
| [ɔr-lɔ:]     | 'enter-NARRATIVE-PAST' |

- d. [+ATR, -high,+round]:

|              |                       |
|--------------|-----------------------|
| [doro:-go:r] | 'stirrup-INSTR.'      |
| [og-lo:]     | 'give-NARRATIVE-PAST' |

## 9 Type 4: Kachin Khakass

Data from Kaun (1995)/Korn (1969):

- (14) [+high, +round] root vowel, [+high] suffixal vowel:

[kuš-tuŋ] 'of the bird'  
[kyn-ny] 'day-ACC.'

- (15) [-high, +round] root vowel, [+high] suffixal vowel:

[ok-tiŋ] 'of the arrow'  
[čø-r-zi] 'having gone'

- (16) [+high, +round] root vowel, [-high] suffixal vowel:

[kuzuk-ta] 'in the nut'  
[kyn-gæ] 'to the day'

- (17) [-high, +round] root vowel, [-high] suffixal vowel:

[pol-za] 'if he is'  
[čø-r-gæn] 'who went'

## 10 Type 5: Yakut

Data from Kaun (1995)/Krueger (1962):

- (18) Yakut vowel inventory:

|                    | Front     | Central/Back |
|--------------------|-----------|--------------|
| High               | i i: y y: | ɨ ɨ: u u:    |
| Mid                | e e: ø    | o o:         |
| Low                |           | a a:         |
| Falling diphthongs | ie yø     | ɨa uo        |

- (19) [-round] root vowels followed by [+high] suffix vowels:

[aya-ni] 'father-ACC.'  
[iska:p-ti:n] 'cabinet-SOC.'  
[kinige-ni] 'book-PL.'  
[et-im] 'meat-POSS.'

- (20) [+high, +round] root vowels followed by [+high] suffix vowels:

[oyo-nu] 'child-ACC.'  
[oyo-lu:n] 'child-SOC.'  
[murun-u] 'nose-ACC.'  
[tobug-u] 'knee-ACC.'

- (21) [-round] root vowels followed by [-high] suffix vowels:

[aya-lar] 'horse-PL.'  
[balik-lar] 'fish-PL.'  
[et-ter] 'meat-PL.'  
[kini-ler] 'he-PL. (= they)'

- (22) When the suffixal vowel is [-high], the final vowel of the root must be [-high] too to trigger harmony:

- a. [-high, +round] root vowels followed by [-high] suffix vowels:

[ohox-tor] 'stoves-PL.'  
[torbos-tor] 'heifer-PL.'

- b. [+high, +round] root vowels followed by [-high] suffix vowels:

[tunnuk-ter] 'window-PL.'  
[tobuk-ka] 'knee-DAT.'

## 11 Type 7: Kazakh

Data from Kaun (1995)/Korn (1969):

(23) [-back] root vowel, [+high] suffixal vowel:

[køl-dy] 'lake-ACC.'  
[yj-dy] 'house-ACC.'

(24) [+back] root vowel, [+high] suffixal vowel:

[koj-du] 'sheep-ACC.'  
[kul-du] 'servant-ACC.'

(25) [-back] root vowel, [-high] suffixal vowel:

[køl-dø] 'lake-LOC.'  
[yj-dø] 'house-LOC'

(26) [+back] root vowel, [-high] suffixal vowel:

[son-dan] 'rubble-ABL.'  
[kul-da] 'servant-LOC.'

## 12 Modelling (asymmetries in) vowel harmony

- Autosegmental and Feature-Geometrical accounts (e.g., Clements & Sezer 1982; Odden 1991; revised in Padgett 2001)
- Accounts based on vowel-to-vowel coarticulation ( $\Rightarrow$  misperception): Busá & Ohala (1999)
- Perception-driven accounts: Suomi (1983); Kaun (1995, 2004); Boersma (1998)

## 13 Vowel-to-vowel coarticulation

*Coarticulation* refers to (the observable results of) articulatory strategies that manage the transitions between sounds produced in sequence. The results in question include phenomena such as the partial nasalisation of vowels adjacent to nasal stops found in English and other languages (Cohn, 1993). *Vowel-to-vowel* coarticulation refers to the spread of phonetic features (e.g. lip rounding) between vowels across intervening consonants (Fowler, 1981). Models such as *Articulatory Phonology* (Browman & Goldstein, 1986, 1992) offer formal frameworks to capture the (hypothesized) articulatory strategies underpinning coarticulation effects.

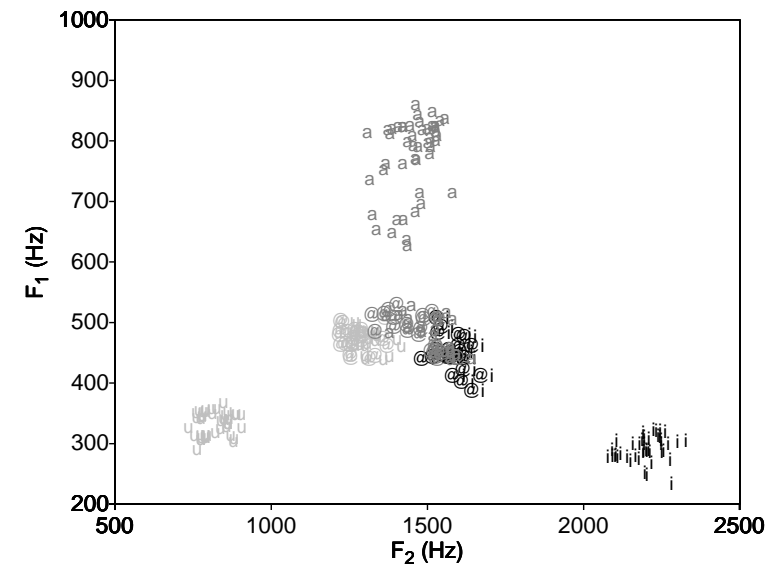


Figure 3: Vowel-to-vowel coarticulation in [VbəbV] nonsense sequences by a single male speaker.

## 14 Problems with a purely coarticulation-based account

- Production data unclear as to the scope of V-to-V coarticulation in (more) naturalistic speech (cf. Benguerel & Cowan 1974 vs. Bell-Berti & Harris 1979)
- Experiments reported by Busá & Ohala (1999) fail to detect listener sensitivity to V-to-V coarticulation
- Unattested patterns of consonantal interference in VH (?)

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