**Undershoot** in Kyrgyz **short vowels** increases with the **articulatory distance** to adjacent consonants.

# Undershoot in Kyrgyz Short Vowels is Articulatorily Conditioned

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## Background

### Undershoot

Occurs when articulators fall short of reaching their target position in a gesture.

- Extremely common
- Conditioned by extra-ling. factors (speech rate)
- Result of decreasing articulatory effort
- Related to coarticulation
- Timing vs. adjacent segments debated

### Undershoot in vowel length

- In languages with V̆/V: constrast, V̆ more central
- V: articulations thought of as targets for V̆
- At times minor differences phonologised

### Vowel length in Kyrgyz

- Largely unstudied
- Documented C influence on V and vice versa
- Potentially high amounts of undershoot

## Methodology

### Corpus

- Speakers of Turkish, Kazakh, Kyrgyz
- Indiana University Speech Production Lab
- Philips EPIQ 7 Ultrasound System
- $C_1VC_2$ stems (mostly); range of $C_1$ and $C_2$
- in various morphological forms, from 1σ to 3σ
- 2 carrier sentences, 1 each per stimulus
  Үйгө барып, _____ деп айттым.
  [yjɣœ βarɯp _____ deβ ɑjttʰɯm]
  "I went/reached home and said _____."
  Үйгө кирип, _____ деп айттым.
  [yjɣœ ɣiɾip _____ deβ ɑjttʰɯm]
  "I entered the house and said _____."
- sentences randomised, 6 per slide, ~150 slides
- session up to 2 hours, optional breaks

### Speaker

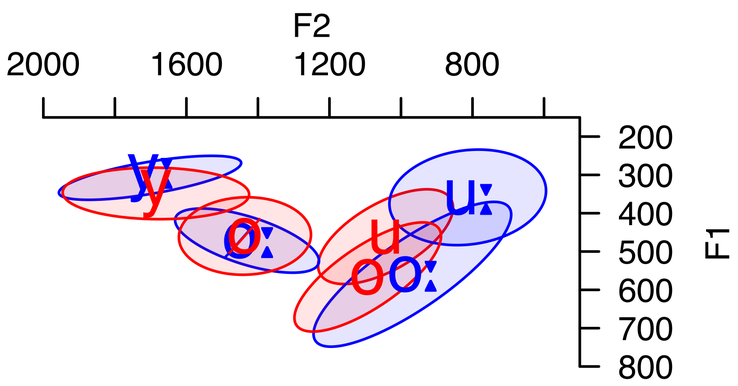
P04: 42/F; from Kyrgyzstan, Jalalabat oblast, Suzaq district, Joon Küngöy village; also knows Russian, Turkish, English, some Arabic

### Data processing

- Examined Vs / #K__Dσ(σ)  K: k,q  D: d,l,n,r,s
  - Avoids documented palatal C influence on V
  - Avoids stress effects
  - Avoids other limitations of corpus
- US frames acquired every 19.6ms (51Hz)
- Processed in UltraTrace (Murphy et al. 2020)
- US & audio recordings aligned, adjusted by hand
- US frames traced by hand
- US frame closest to vowel midpoint selected

## Findings

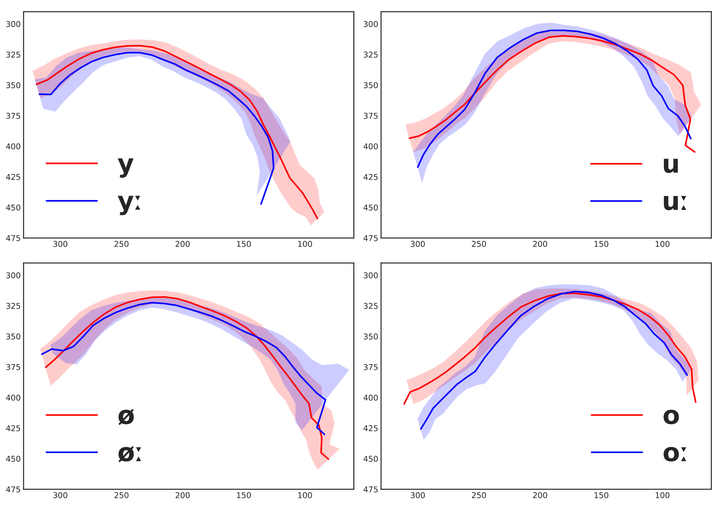
### Acoustic




1. Spectral differences between V̆ and V:
2. Mainly back V̆ more central than V:

### Articulatory

← tongue tip left




3. back V̆s — raised tongue tip
4. front V̆s — raised tongue dorsum
5. back V̆s — backed tongue root

## Analysis

Effect of **preceding dorsal** on undershoot:

- All Vs: tongue body closer to Cs' POA
- Front Vs: velum (4); back Vs: uvula (5)

Effect of **following coronal** on undershoot:

- Back Vs: tongue tip closer to aleveolar ridge (3)
- Front Vs: tongue is already very close

Effect of undershoot on **high vs non-high** (back) Vs:

- Tongue tip: more undershoot in non-high V
- Tongue dorsum & root: more undershoot in high Vs

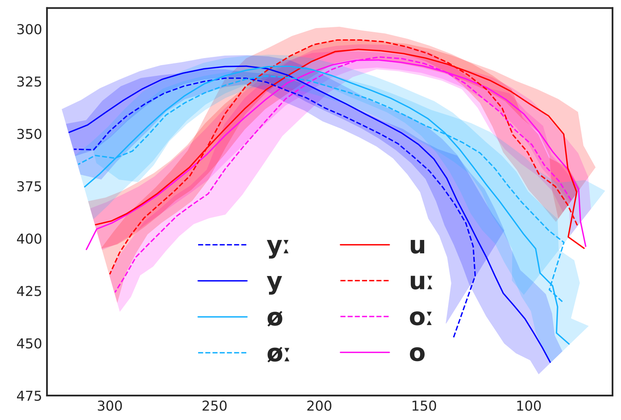
Effect of undershoot on **formants** (2):

- Front Vs: no effect, dorsal raising small
- Back Vs: connection between formant and articulation differences not yet modeled

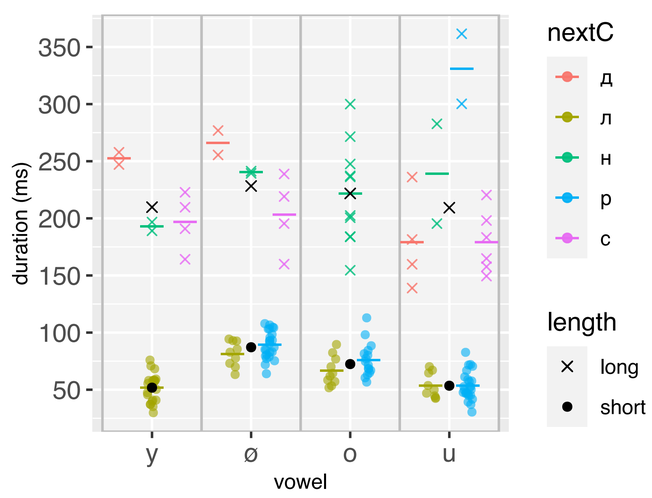
**Generally: most undershoot where largest articulatory effort would be required**

### Supplemental data

All vowels together




### Durations




### Words examined

| | | | | | |
|---|---|---|---|---|---|
| колдогу | кородду | көрүмөбү? | кулумабы? | курунда | күлүмөбү? |
| колдубу? | корот | көрүндө | кулуна | курүптүр | күлүндө |
| колумабы? | корсунбу? | көрүнө | кулунда | куудагы | күлүнө |
| колуна | коруптур | көрүптүр | курабы? | куудубу? | күлүптүр |
| колунда | көлдүбү? | көрөбү? | курарды | куунубу? | күлөбү? |
| коондогу | көлдөгү | көрөрдү | курат | куурду | күлөрдү |
| коондубу? | көлүмөбү? | көрөт | курганга | куусуна | күлөт |
| коонумабы? | көлүндө | көөдөгү | курганын | куусунбу? | күүдөгү |
| коонуна | көлүнө | көөнүбү? | курдагы | куусунда | күүнүбү? |
| коонунда | көргөнгө | көөсүндө | курдубу? | күлгөнгө | күүсүндө |
| коргонго | көргөнүн | көөсүнө | курсунбу? | күлгөнүн | күүсүнө |
| коргонун | көрдүбү? | күлдагы | курумабы? | күлдүбү? | |
| кордубу? | көрдөгү | күлдубу? | куруна | күлдөгү | |
| коробу? | көрсүнбү? | | | күлсүнбү? | |

**158 V tokens**: 24 y  8 yː  34 u  14 uː
34 ø  8 øː  26 o  10 oː

## Future work

- Examine articulation of adjacent Cs
- Expected acoustic effects = observed? Model!
- Examine other Kyrgyz speakers in corpus
- V̆ versus V: in other articulatory contexts?
- Do these findings hold up cross-linguistically?
- Can undershoot effects be lang.-dependent?

## References

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