Is harmony in Uyghur really gradient?

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Introduction

- Structuralist and early generative phonologists argued for categorical representations for both empirical and conceptual reasons.

- More recently, many have argued against categorical representations based on incomplete neutralization.
  - e.g., prosodic-word final devoicing in German
  - However, some have argued that these results could be spurious or fall out from performance factors.

Halle 1959; Chomsky and Halle 1968; Postal 1968; Charles-Luce 1985; Dinnsen 1985; Port and O'Dell 1985; Fourakis and Iverson 1984; Jassem and Richter 1989; Warner et al. 2004; Du 2023; Du and Durvasula in press

Categorical representations

- *All else being equal*, phonological alternations should produce sounds that are identical to their non-alternating counterparts.

- We examine backness harmony in Uyghur since neutralization of [back] has been argued to be incomplete.

- When we try to control for other factors we don't find evidence of incomplete neutralization.

Morphophonemic alternations are at the very core of what most phonologists think of as phonology . . . If these sorts of cases are shown to involve gradience, this would strike at the core of our understanding of the phonology, since these are the least disputable candidates for 'being phonology.'

-Cohn (2006:36)

In this talk

- We conducted two production studies to assess the status of backness harmony in Uyghur.

- Preview of our findings:
  - We replicated McCollum's (2019) results.
  - However, when we control for morphological and segmental context, and we observe no evidence for the asymmetrical fronting pattern.
  - Instead, the evidence suggests a vanilla post-phonological centralization process.

Uyghur

Turkic, spoken by around 12 million

Vowel inventory

[+back]	ɑ	o	u	(ɯ)	
[-back]	æ	ø	y	i	e

Nadzhip 1971; Engesaeth et al 2013; McCollum 2019; Mayer et al 2022

McCollum (2019)

Methods

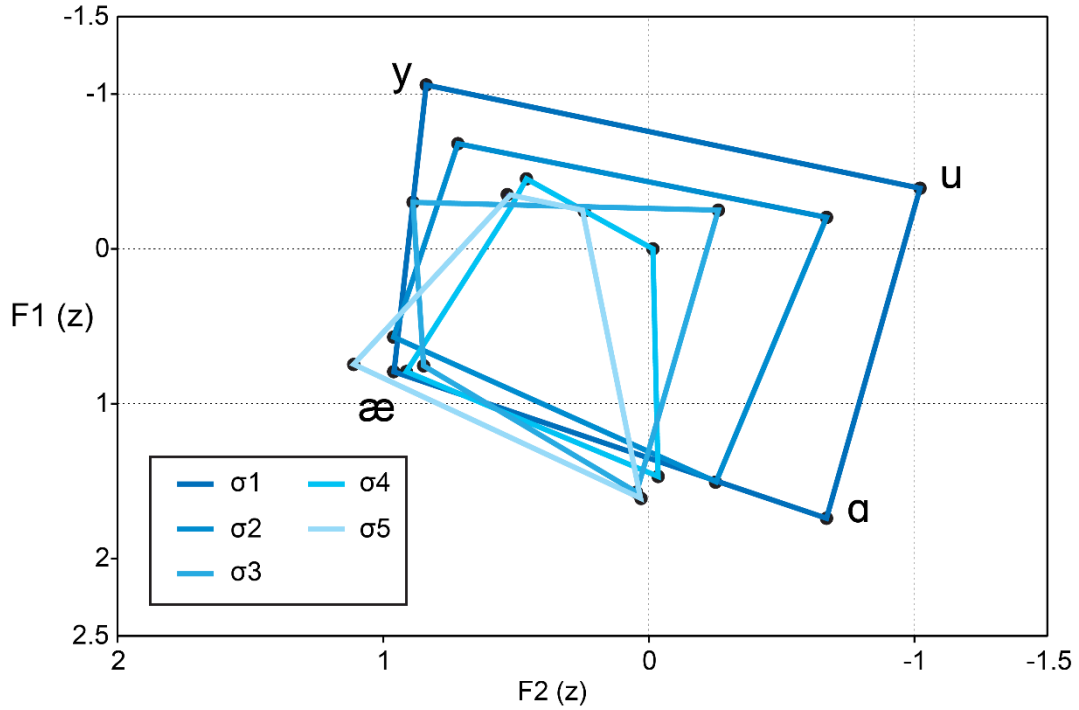
- Picture-naming task
- 9 speakers (5 females; age range 19 – 63 yrs; mean 44.4 yrs)
- Words from 1-5 syllables in length (n=5,927 syllables)

[pɑltɑ-m-dɑ]	‘axe-POSS.1S-LOC’
[sællæ-m-dæ]	‘turban-POSS.1S-LOC’
[yʧky-lyr-i]	‘goat-PL-POSS.3S’
[χurmu-lur-i]	‘persimmon-PL-POSS.3S’

McCollum (2019)

- McCollum (2019) reports that the acoustic distinction between alternating phonemic pairs is reduced in non-initial syllables.
  - F2 of [ɑ u] increases monotonically in non-initial syllables.
  - F2 of their harmonic counterparts [æ y] does not systematically vary by position.
  - Since the pattern is asymmetric, it is not consistent with phonetic centralization.

McCollum (2019)



Analytical options

1. Results are due to phonetic centralization
   - The effect is asymmetrical
2. Harmony is post-lexical or phonetic in nature
   - Triggers structure-preserving consonantal alternation

     /ʁ g/: jɑz-**ʁ**uz-**ʁ**u ‘write-CAUS-GER’

     kæt-**k**yz-**g**y ‘leave-CAUS-GER’
3. Gradient harmony

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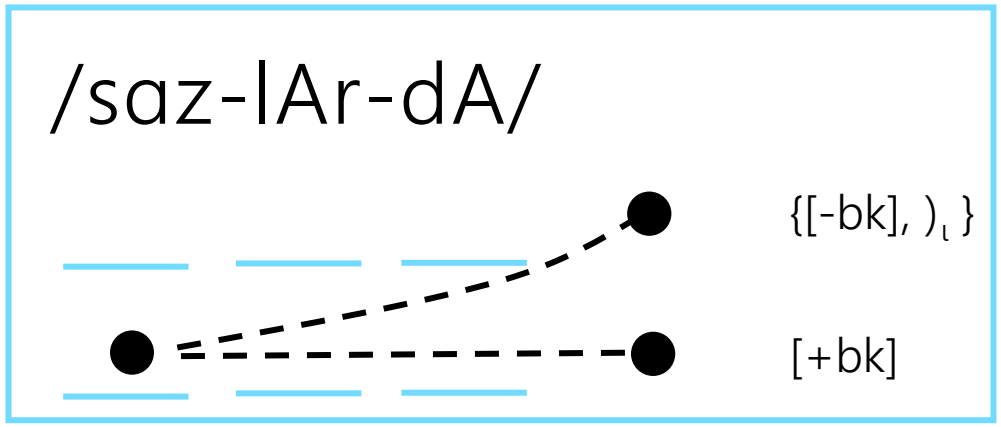
Analytical options

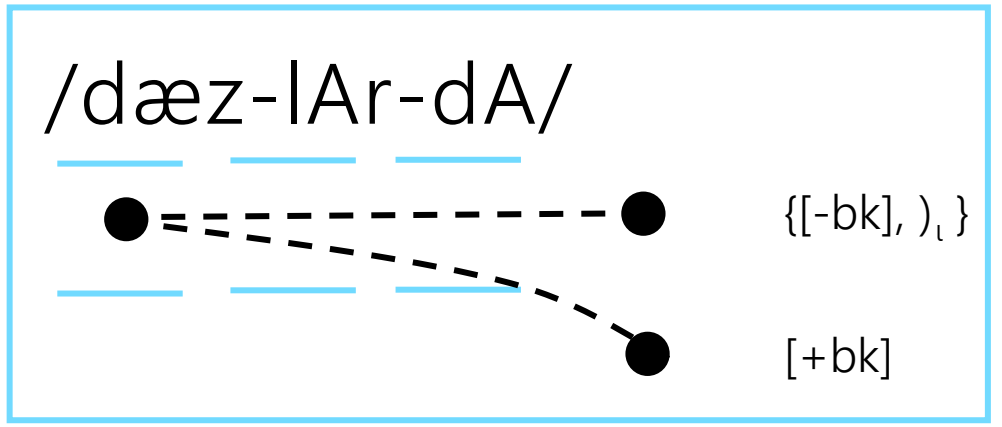
1. ~~Results are due to phonetic centralization~~
2. ~~Harmony is post-lexical or phonetic in nature~~
3. Categorical harmony + phonetic interpolation
4. Categorical harmony + local coarticulatory effects
5. Gradient harmony

Analytical options

Categorical harmony + gradient phonetic interpolation

- Requires a phrase-final [-back] articulatory setting
- Requires something like Keating's window model of interpolation





Keating 1988; Hudu 2010; Allen et al 2013

Experiment 1

Experiment 1 investigates whether F2 of [ɑ æ] depends on position and phrasal context

- If phrasal context is driving the fronting pattern in McCollum (2019), then trajectory of F2 should vary according to backness of the following word.

Experiment 1

- 16 speakers (8 females) in Chunja, KZ
- Age range 19 – 63 yrs; mean 47.1 yrs

- Target words produced in two phrasal contexts

bu _____ $CV_{[+bk]}\cdots$ / $CV_{[-bk]}\cdots$

- Words from 2-3 syllables long (n= 4,438 σ)
  - 16 disyllabic; 24 trisyllabic
  - 20 distractor items

Fieldwork = work in the (cucumber) field

Experiment 1

PL	LOC	PL+LOC	Gloss
saz-lar	saz-da	saz-lar-da	‘instrument’
dæz-lær	dæz-dæ	dæz-lær-dæ	‘crack’
dan-lar	dan-da	dan-lar-da	‘kernel’
tæn-lær	tæn-dæ	tæn-lær-dæ	‘body’

بۇ تەنلەردە تارتۇق بار.

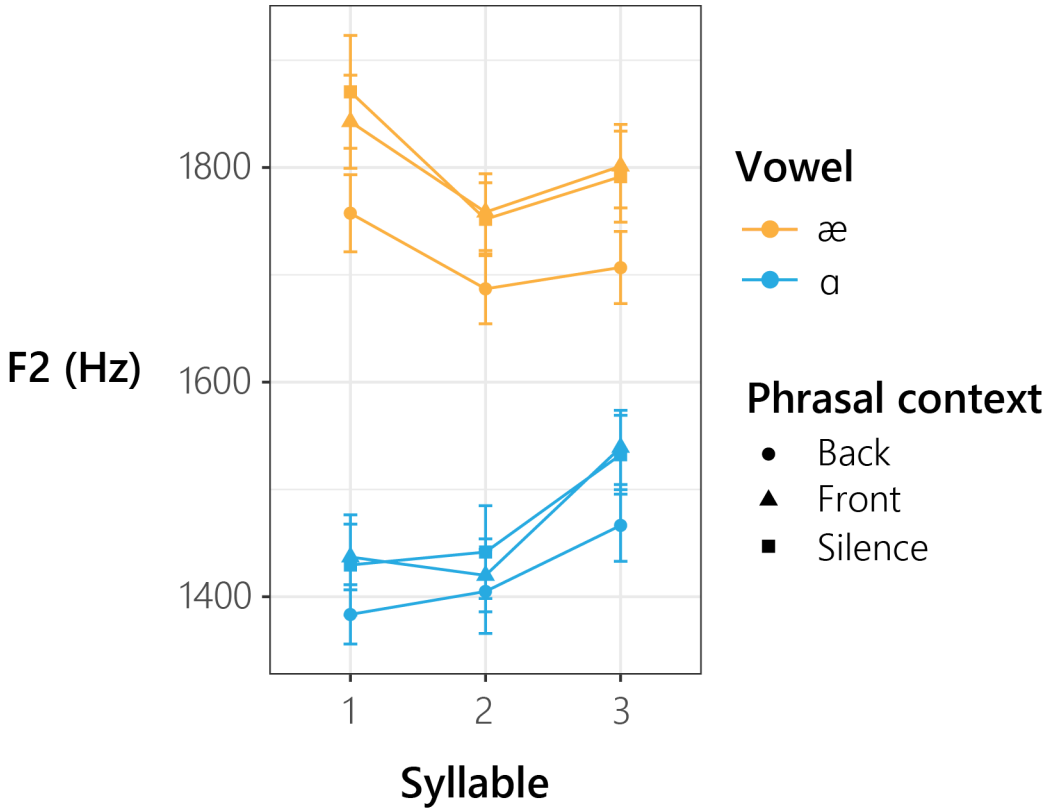
Бу тәнләрдә тартуқ бар.

Bu tenlerde tartuq bar.

Experiment 1 results

General remarks

- [ɑ] exhibits higher F2 in non-initial syllables, especially when word-final
- [æ] also exhibits higher F2 when word-final
- Phrasal context does not appear to affect by-position changes in F2 for [æ ɑ]



Experiment 1 summary

- Results do not conform to the predictions of the categorical harmony + phonetic interpolation account
  - F2 trajectories are generally parallel across phrasal contexts
  - Word-final vowels, both [æ ɑ] exhibit higher F2

Analytical options

1. ~~Results in McCollum (2019) are due to phonetic centralization~~
2. ~~Harmony is simple post-lexical or phonetic in nature~~
3. ~~Categorical harmony + phonetic interpolation~~
4. Categorical harmony + local coarticulatory effects
5. Gradient harmony

Experiment 2

Experiment 2 investigates whether F2 of [ɑ æ] depends on position and morphemic/segmental context.

- If harmony is gradient, then the asymmetrical fronting pattern should persist even after controlling for morpheme.

- If harmony is derivable from local coarticulatory effects, then asymmetrical fronting should vanish after controlling for morpheme/segmental context.

Experiment 2

- 17 speakers (10 females) in Chunja, KZ
- Age range 19 – 63 yrs; mean 33.6 yrs

Experiment 2

- Target words produced in isolation
  - All [æ]: tær-dæ tæʃ-kæn-dæ sæpær-læ-ʃ-kæn-dæ
  - All [ɑ]: tɑr-dɑ tɑʃ-qɑn-dɑ nɑʧɑr-lɑ-ʃ-qɑn-dɑ

- Words from 2-5 syllables in length (n= 9,367 σ)
  - 76 target words (2 repetitions)

    14 σσ words 20 σσσσ words

    23 σσσ words 19 σσσσσ words

Experiment 2

- Target morphemes

UR	SRs	Gloss	Position (σ)
/lA-ʃ/	[læʃ]~[laʃ]	VBZ-RECIP	2, 3
/KAn/	[kæn]~[qɑn]	NMLZR	2, 3, 4
/lAr/	[lær]~[lɑr]	PL	2, 3, 4
/DA/	[dæ]~[dɑ], [tæ]~[tɑ]	LOC	2, 3, 4, 5

Experiment 2

- We compared F2 of each morpheme at vowel midpoint in each syllable

- We ran mixed-effects linear regressions for each vowel
  - Simpler models: $F2_{Vowel}$ ~ Position + (Position | Subject) + (Position | Item)
  - Context models: $F2_{Vowel}$ ~ Position + (Position | Subject) + (Position | Item) **(Position | Morpheme)**

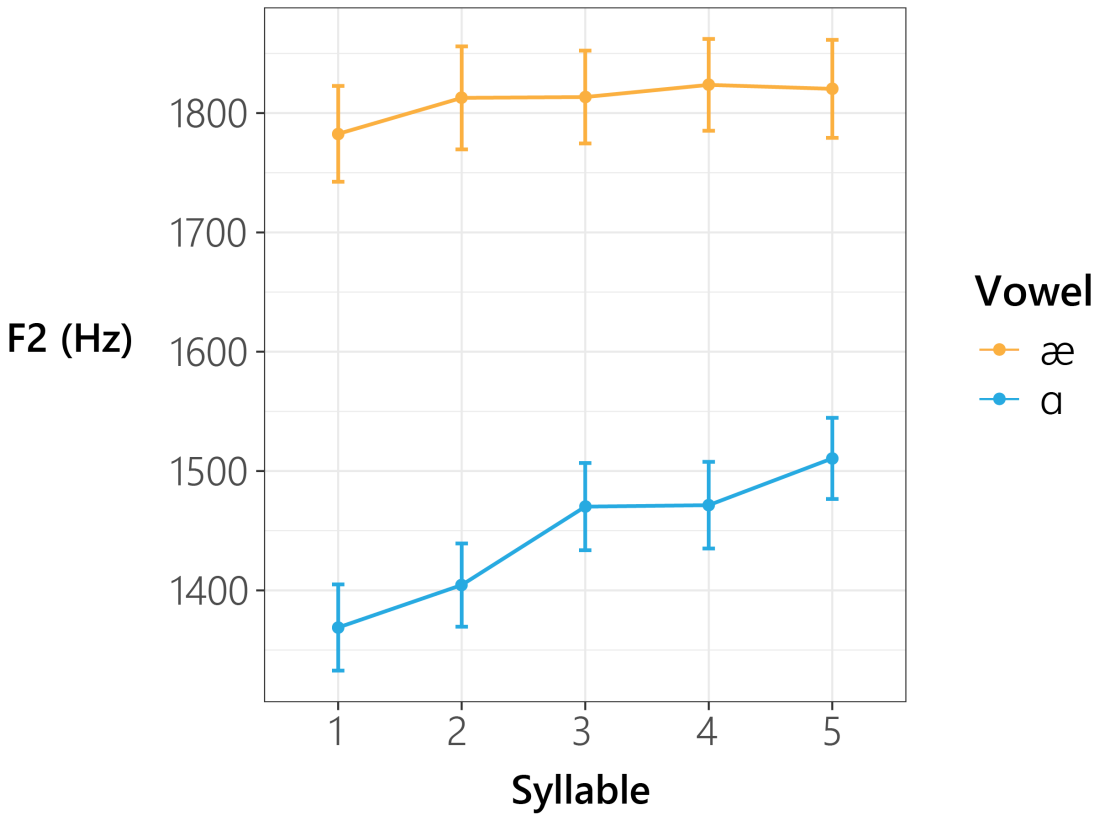
Experiment 2 results

$F2_{[æ]}$ ~ Position + (Position | Subject)
+ (Position | Item)

- **β = 1.00, p=.92**

$F2_{[ɑ]}$ ~ Position + (Position | Subject)
+ (Position | Item)

- **β= 47 Hz, p<.0001**



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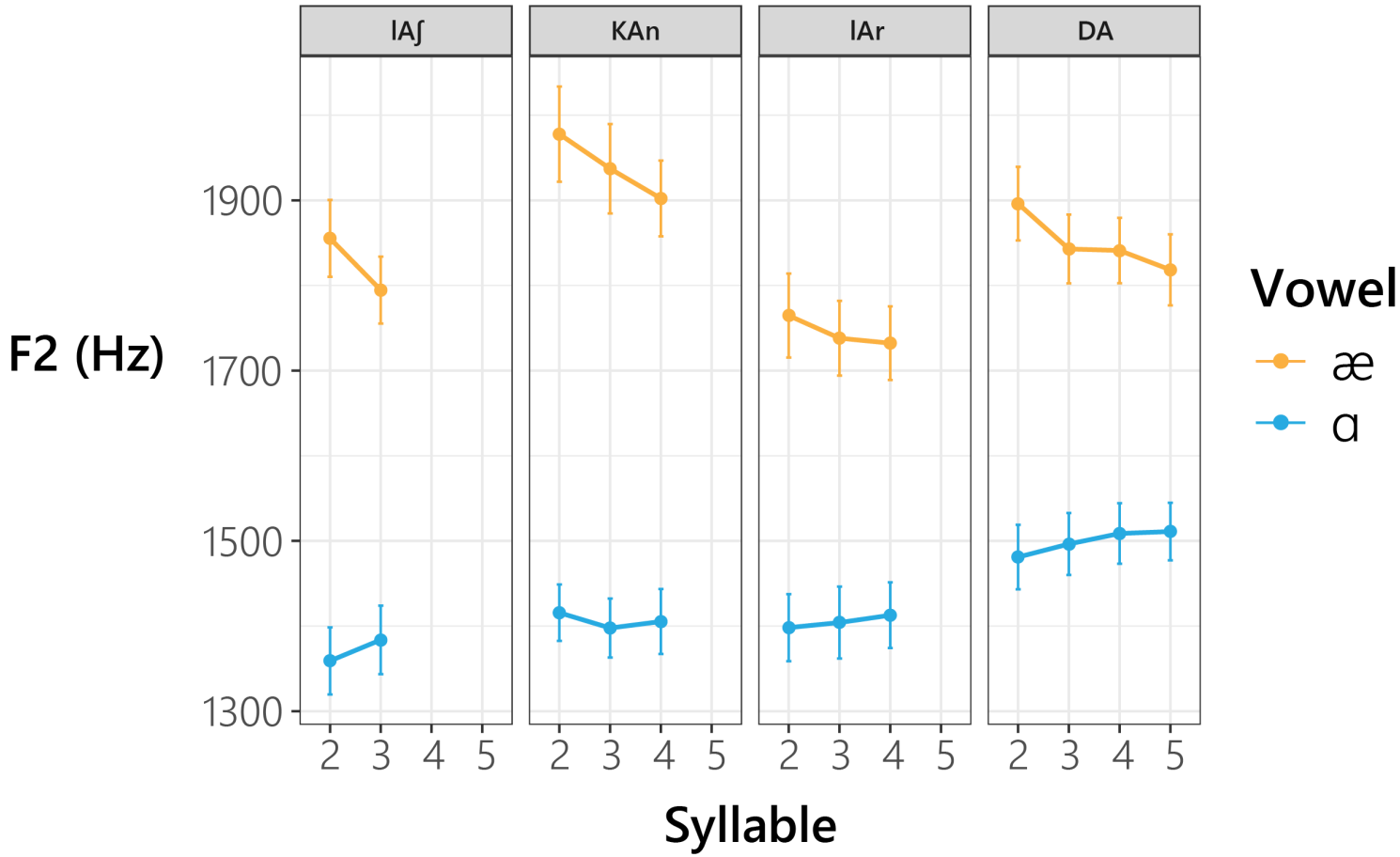


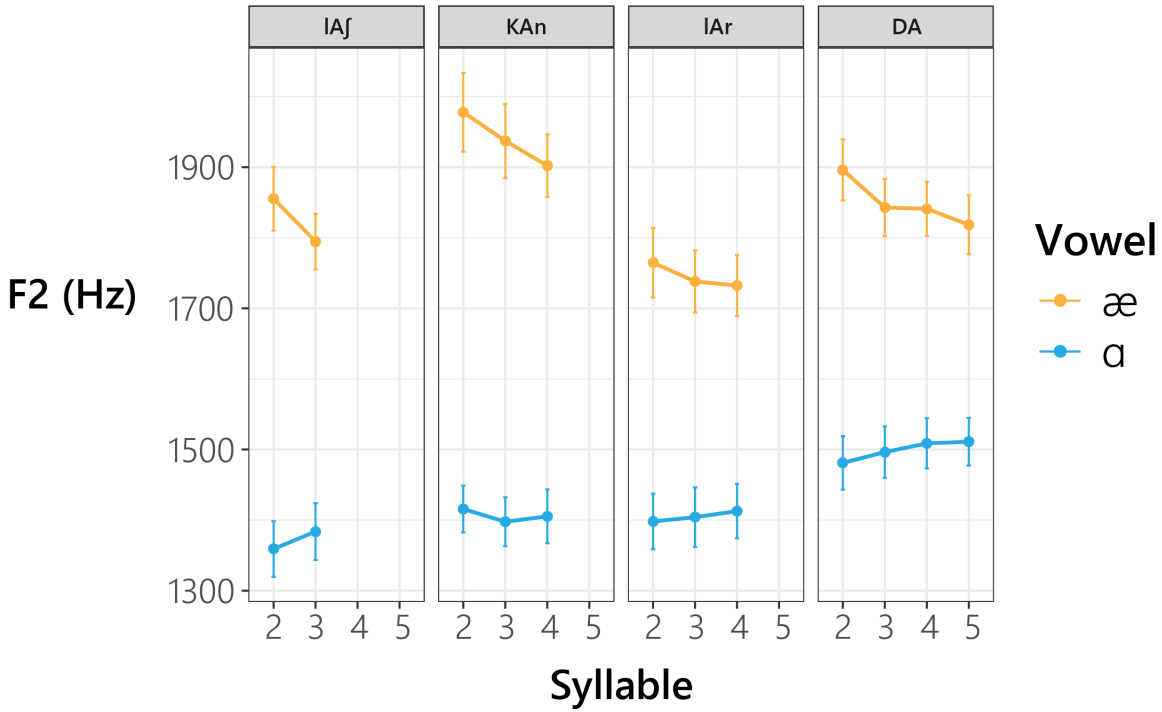
Experiment 2 results

$F2_{[æ]}$~Position + (Position | Subject)
+ (Position | Morpheme)
+ (Position | Item)

- **β= -24 Hz, p=.01**

$F2_{[ɑ]}$~Position + (Position | Subject)
+ (Position | Morpheme)
+ (Position | Item)

- **β= 12 Hz, p=.002**



Experiment 2 analysis

We performed model comparisons, using AIC to assess model fit.

- ΔAIC > 8-10 indicates highly significant difference in model fit
- ΔAIC > ~20 indicates the poorer fitting model receives no support

The models incorporating morpheme/segmental context into the random effect structure fit the data significantly better than the simpler models

$\Delta AIC_{[æ]} = -125$

$\Delta AIC_{[ɑ]} = -130$

Burnham and Anderson 2004; Burnham et al. 2011

Experiment 2 analysis

In sum, when context is controlled for, non-initial [æ ɑ] exhibit symmetrical centralization in Uyghur.

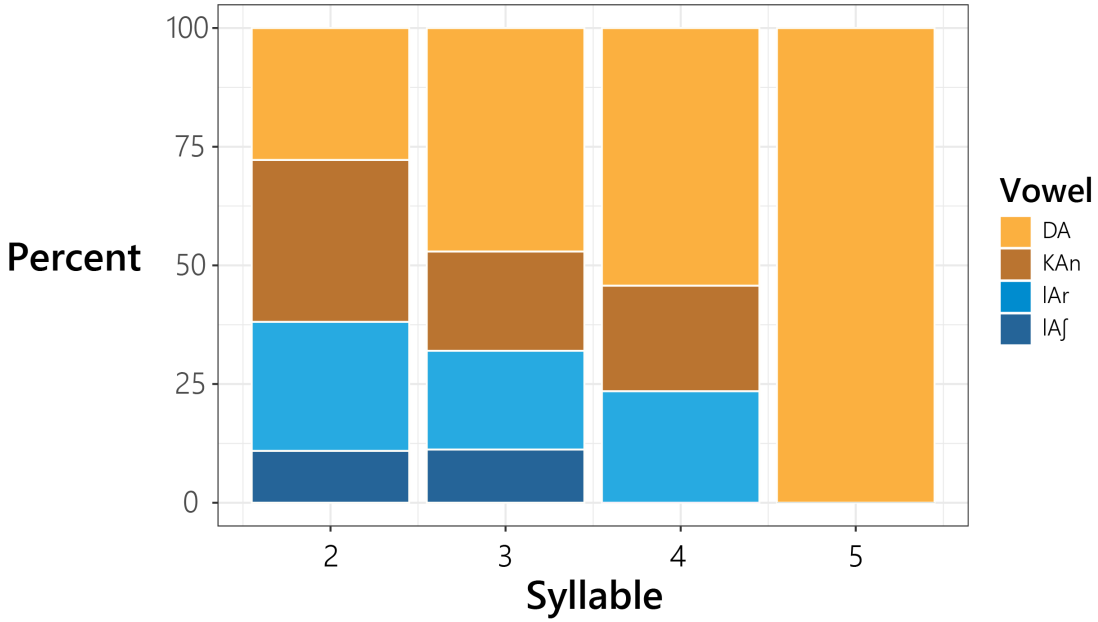
What produces the epiphenomenal fronting of [ɑ]?

- The locative suffix /DA/ is the culprit.

Experiment 2 analysis

- The frequency of /DA/ increases by syllable.

- /DA/ exhibits highest F2 in [+bk] contexts
  - Vowel is word-final
  - Phonetic fronting of word-final vowels
    - Expected [ɪ ə] from /i/ is produced as [i]
    - Evidence from contours in Experiment 1



Analytical options

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Discussion

- Implications for the analysis of Uyghur
  - The present findings suggest that harmony is best understood as categorical with symmetrical phonetic centralization.
  - McCollum's (2019) findings provided the best support for the claim that [+back] rather than [-back] is active in Uyghur.
  - Work by Connor Mayer and colleagues marshals evidence from transparency that supports the activity of [-back].

McCollum 2020; Mayer 2021; Mayer et al. 2019, 2020, 2022

Discussion

- Were McCollum's (2019) results due to a task effect?
  - No. We replicated those general findings using two different elicitation methods.

- Methodologically, our findings underscore the necessity of careful data collection and analysis.
  - McCollum (2019) elicited suffixes with predominantly [coronal] place, using a fixed effect for consonant place to attempt to account for these effects.

Discussion

Implications for phonological theory:

- Uyghur does not provide evidence for phonological gradience
- If incomplete neutralization more generally is derivable from non-phonological forces (e.g., task effects, performance),
  - Categorical contrasts can be maintained
    - No [0.81 back]-esque representations
  - Interacting processes are still manageable
    - No [.58 dorsal] → [0.65 back] / ___ [0.17 syllabic, 0.81 back]-esque processes

Du and Durvasula to appear

Thank you to the Uyghur community in Chunja for sharing their time, language, and lives with us.

Thank you for staying awake.

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Experiment 1 results

- Contours in Syllables 1 and 2 look more like centralization

- In Syllable 3, we see
  - Fronting of both vowels
  - Phonetic interpolation