SONORITY-DRIVEN STRESS AND VOWEL REDUCTION IN UYGHUR

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INTRODUCTION

- Sonority has long been recognized as a key factor in phonological patterns
  - Permissible syllable nuclei
  - Sonority Sequencing Principle
  - Syllable contact

- In the 90s, a body of literature began examining sonority distinctions among vowels and variable stress placement
  - Stress is attracted to peripheral vowels, especially low vowels

Clements 1990; Kenstowicz 1994, 1997; Blevins 1995; de Lacy 2002; Parker 2002; Crowhurst & Michael 2005; Goldsmith 2011

SONORITY-DRIVEN STRESS

- An oft-discussed case of sonority-driven stress is Gujarati
  - According to de Lacy (2006),
    - Stress [a] > [ɛ e i u o ɔ] > [ə]
    - Stress penult > antepenult > ultima

- de Lacy encodes sonority directly in the analysis as a set of markedness constraints, e.g. *HDFT/[-low], *HDFT/ə

de Lacy 2002, 2004, 2006

SONORITY-DRIVEN STRESS

- However, a number of recent experimental studies have argued that stress in Gujarati is fixed
- If stress in Gujarati is fixed, this undermines the sonority-driven account, which requires variable stress placement
- Sonority-driven claims have also been countered by work on Chuvash, Mongolian, Eastern Armenian, Munster Irish, and Piuma Paiwan

Dobrovolsky 1999; Karlsson 2014; Haghverdi 2016; Shih 2016, 2018; Blum 2018; Bowers 2019; Shih & de Lacy 2019

SONORITY-DRIVEN STRESS

- In most previous work, sonority-driven stress is yoked to variable stress placement.
- In today's talk I address the role of sonority in a language with fixed stress placement, Uyghur

UYGHUR

- Uyghur has a 9-vowel inventory, /ɑ æ o ø e u ɯ y i/
  - /o ø e/ occur in initial syllables only
- Stress falls on the final syllable
  - Stress is realized as increased duration; no effects on f0 or intensity
- Some report secondary stress, but I remain agnostic to that

2σ	CV.CV	ki.ˈʃi	person
	CVC.CV	ʧiʃ.ˈni	tooth (ACC)
	CV.CVC	ki.ˈʃim	my person
3σ	CV.CV.CV	ki.ʃi.ˈni	person (ACC)
	CVC.CV.CV	ʧiʃ.li.ˈri	his/her teeth
	CV.CVC.CV	ki.ʃim.ˈni	my person (ACC)
	CV.CV.CVC	ki.ʃi.ˈdin	person (ABL)

Nadzhip 1971; Hahn 1998; Yakup & Sereno 2016; Major & Mayer 2018

METHODS

- Data (6,836 syllables) was collected from 9 speakers from Chunja, Kazakhstan
  - Gender: 6 females
  - Age range: 19-63 yrs; mean 44.4 yrs
- Speakers were taught to associate certain visual cues with grammatical categories to produce paradigms
  - Suffix shapes elicited:

    CVC: PL /-lær/, ABL /-din/

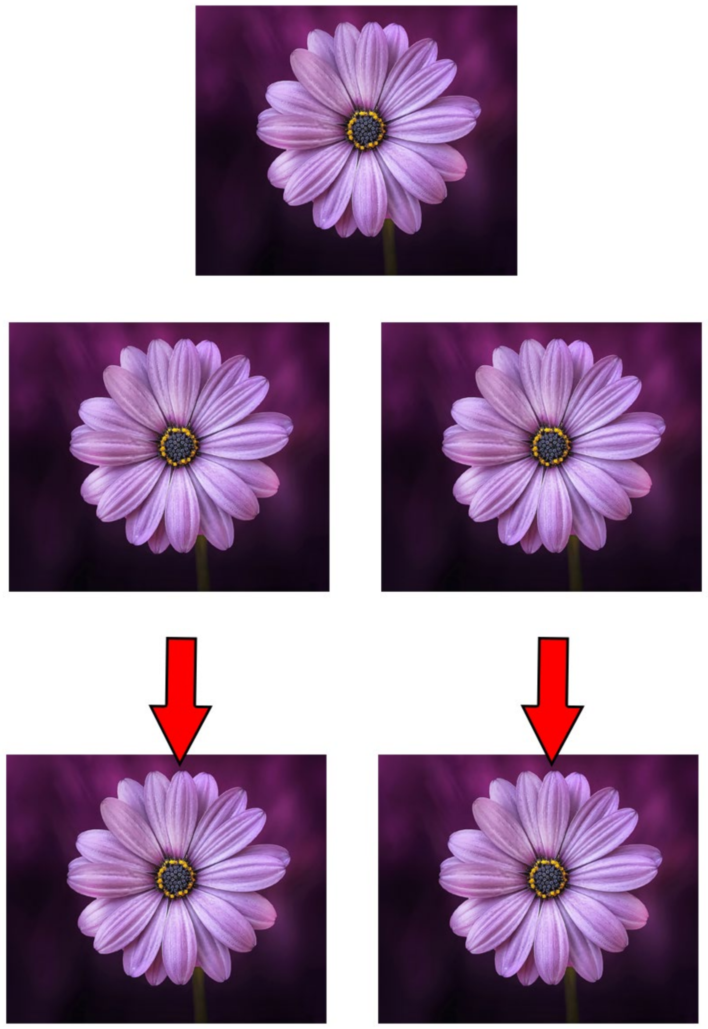
    CV: LOC /-dæ/, ACC /-ni/

    C: POSS.1S /-m/

    V: POSS.3S /-i/

METHODS

- Target words were produced in isolation as responses to pictorial prompts
- Words were up to 5-syllables long
- Vowel and consonant durations were measured
- Data was analyzed using mixed-effects models
  - random intercepts for speaker, vowel height, and word length
  - by-speaker random slopes for vowel height and word length



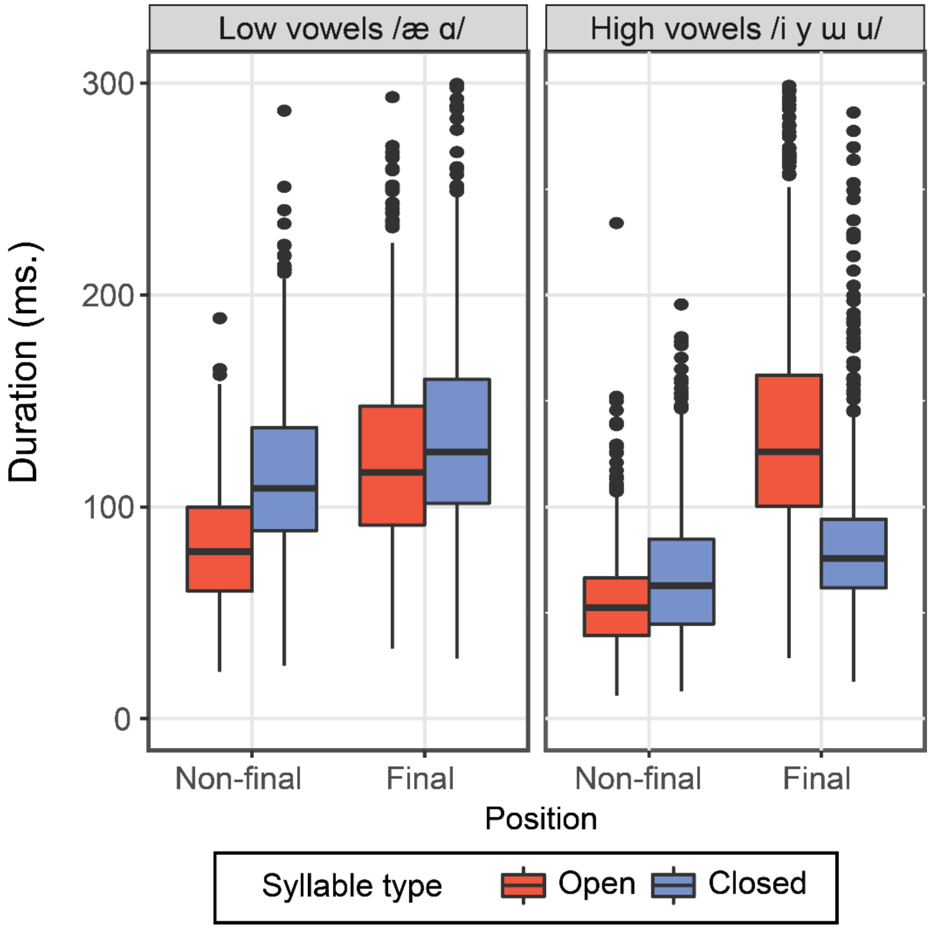
RESULTS

(1) Vowel duration is greater in final syllables

(2) Vowel duration is greater in closed syllables

(3) Low vowels are longer than high vowels

- Except word-final $CV_{[+hi]}$



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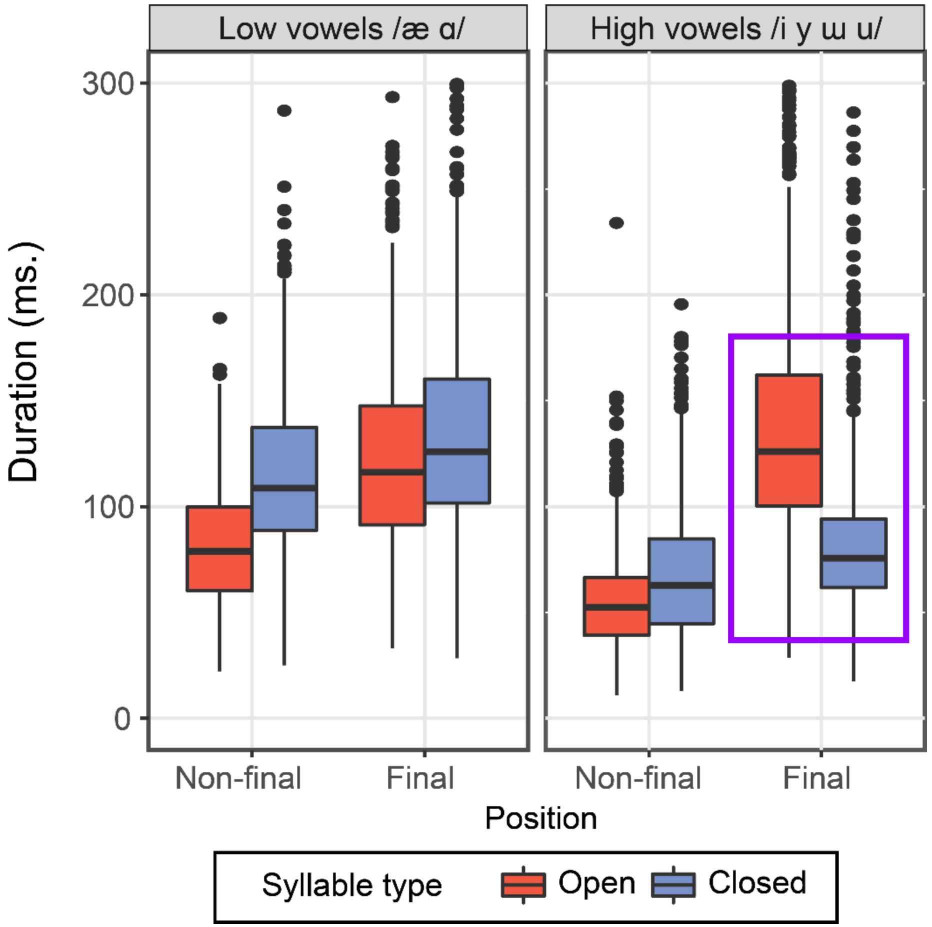


RESULTS

	Low vowel		High vowel	
Closed syllable	sæl.ˈlæm	‘my turban’	bæ.ˈlim	‘my waist’
	ti.ˈkæm	‘my goat’	ki.ˈʃim	‘my person’
	bæl.ˈlær	‘waists’	bæl.ˈdin	‘waist (ABL)’
	itʃ.ˈlær	‘innards’	itʃ.ˈtin	‘inside (ABL)’
Open syllable	sæl.ˈlæ	‘turban’	bæ.ˈliː	‘his/her waist’
	ti.ˈkæ	‘goat’	ki.ˈʃiː	‘person’
	bæl.ˈdæ	‘waist (LOC)’	bæl.ˈniː	‘waist (ACC)’
	itʃ.ˈtæ	‘inside (LOC)’	tʃiʃ.ˈniː	‘tooth (ACC)’

FINAL LENGTHENING?

- Since words were produced in isolation it is possible that these effects are due to final lengthening and not stress.
  - Some previous stress claims have been shown to derive from other factors
    - e.g. Indonesian, Chuvash, Mongolian

- We need to evaluate the predictions of a final lengthening account

Dobrovolsky 1999; Gordon 2000; Goedemans & van Zanten 2007; Karlsson 2014

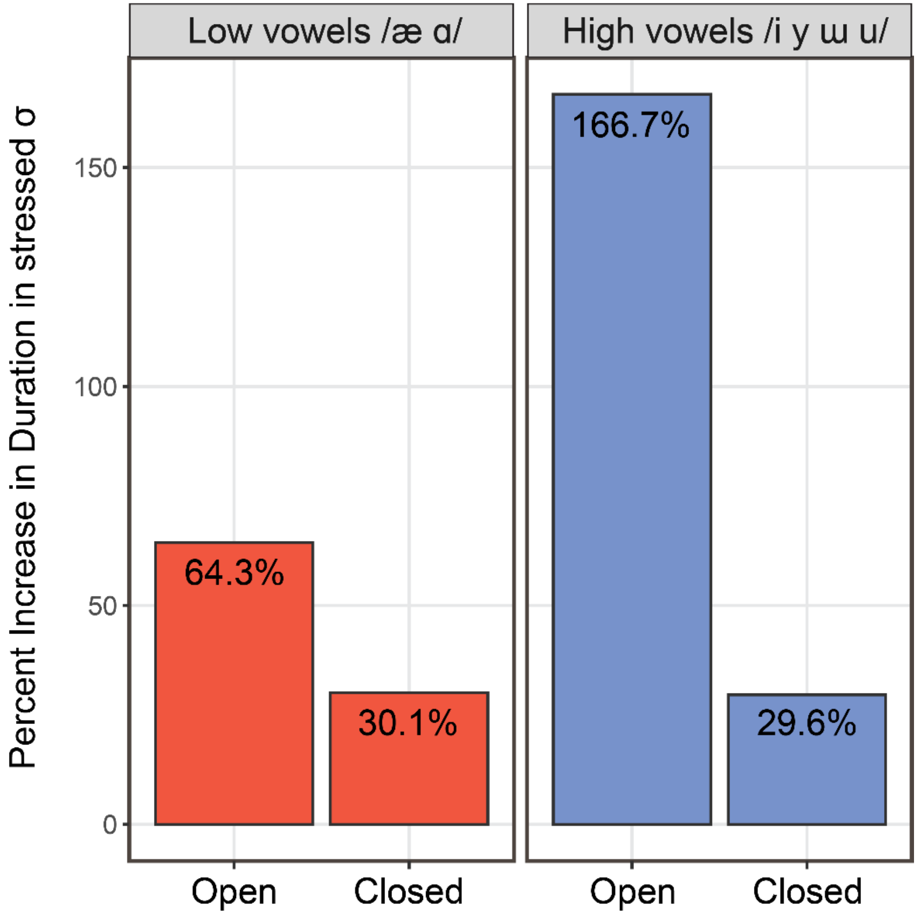
FINAL LENGTHENING?

- Previous work has found that final lengthening affects all vowels equally
  - e.g. Klatt (1976): 35% increase in intrinsic vowel duration

- This predicts that the percent increase in duration of low vowels should equal that of high vowels.

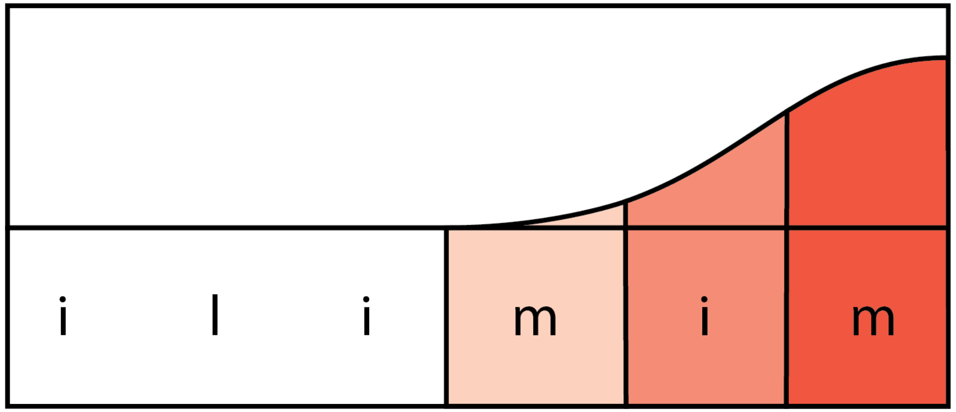
FINAL LENGTHENING?

- However, lengthening is asymmetric
  - Word-final high vowels are lengthened far more than low vowels



FINAL LENGTHENING?

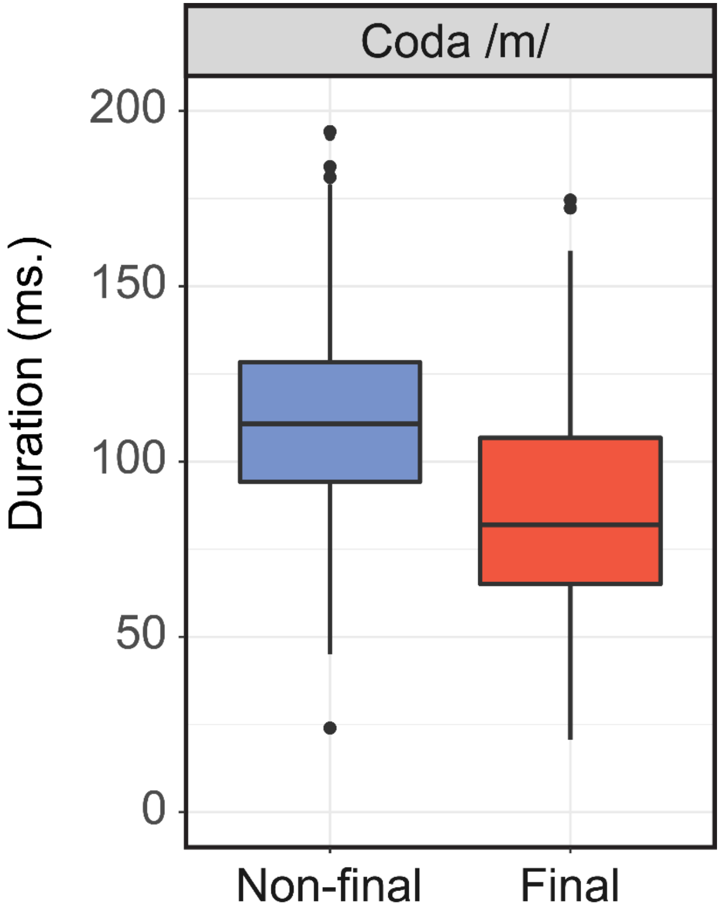
- Final lengthening is modulated by proximity to a prosodic boundary
  - Closer to boundary = more lengthening
  - This predicts that word-final consonants should be longer than other coda consonants.



Berkovits 1993a,b, 1994; Byrd & Saltzman 2003, 2006

FINAL LENGTHENING?

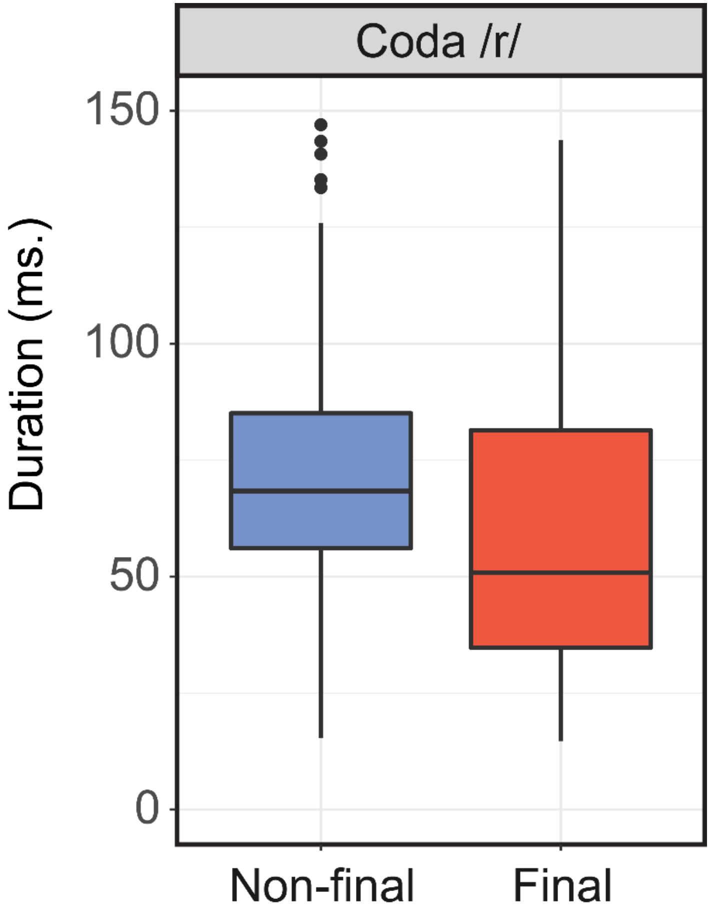
- In fact, coda /m/ is shorter in word-final position
  - Mean durations
    - Non-final: 114 ms.
    - Final: 86 ms.
- In a model with random intercepts for word length and speaker:
  - $\chi^2(1)=67.74$, $p < .001$



FINAL LENGTHENING?

- Coda /r/ is shorter in word-final position
  - Mean durations
    - Non-final: 71 ms.
    - Final: 64 ms.

- In a model with random intercepts for word length and speaker:
  - $\chi^2(1)=6.60$, $p = .01$



FINAL LENGTHENING?

Predictions			Final lengthening	Results
Effects on vowels	Increased final-syllable vowel duration		✓	✓
	Equal effect on all vowels		✓	✗
Effects on consonants	Final coda is longer than non-final coda	/m/	✓	✗
		/r/	✓	✗

SONORITY-DRIVEN STRESS

- If these effects are not derivable from final lengthening, then why are high vowels asymmetrically augmented in open final syllables?

SONORITY-DRIVEN STRESS

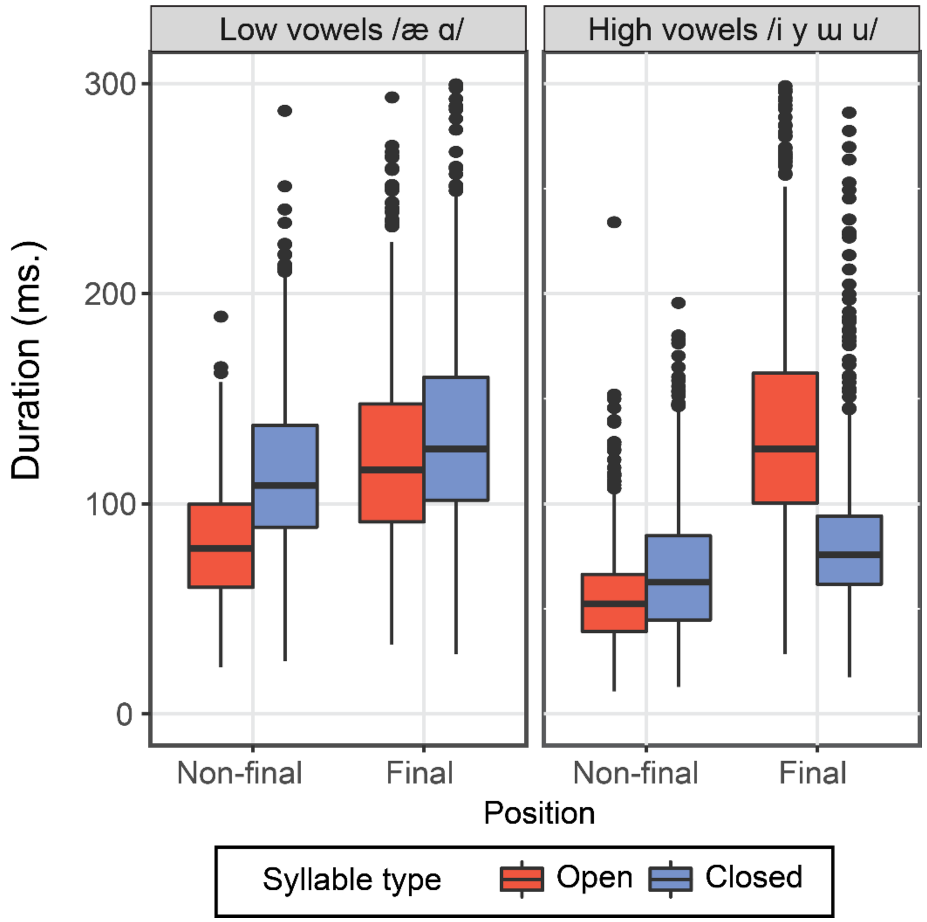
- My analysis makes three claims:
  (1) Asymmetric augmentation of high vowels is due to sonority, which is encoded as a moraic weight distinction
    - High vowels are monomoraic
    - Non-high vowels are bimoraic

  (2) Uyghur requires stressed syllables to be heavy

  (3) Codas are moraic

SONORITY-DRIVEN STRESS

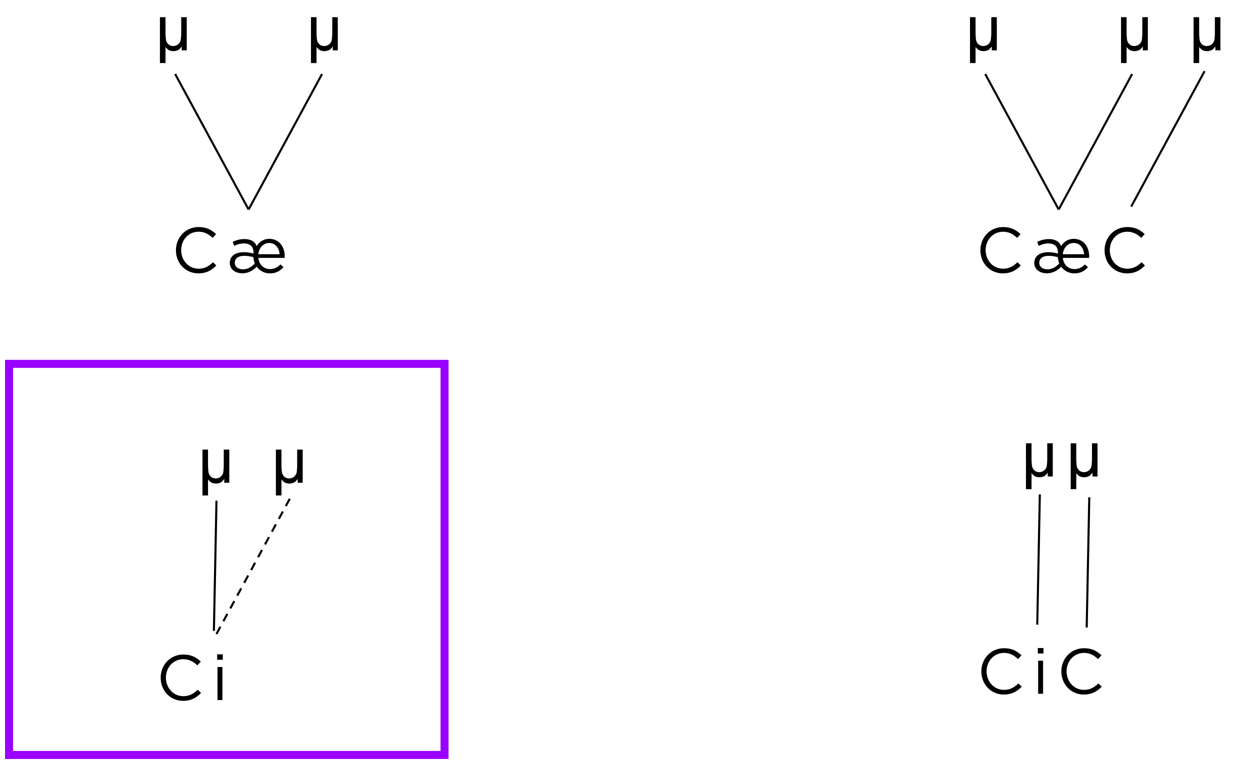
- Evidence for the mora
  1. Compensatory lengthening when /r/ is deleted in plural suffix
  2. Vowels in closed syllables do not shorten
  3. Secondary stress is reportedly modulated by weight



Maddieson 1985; Hayes 1989; Hahn 1991, 1998; Broselow et al. 1997; Engesath et al. 2010

SONORITY-DRIVEN STRESS

- Representationally:



SONORITY-DRIVEN STRESS

- Sonority is encoded as a moraic weight distinction
  - High vowels are monomoraic: $*i_{\mu\mu}$ >> $*i_{\mu}$
  - Non-high vowels are bimoraic: $*æ_{\mu}$ >> $*æ_{\mu\mu}$

- The language requires stressed syllables to be heavy:

  STRESS-TO-WEIGHT (S2W) >> DEP-μ, *HEAVY

- Codas are moraic: WEIGHT-BY-POSITION (WBP) >> *μ/Coda

SONORITY-DRIVEN STRESS

- Assuming a ranking that generates final stress with no secondary stresses (ALLFEET-R >> PARSE-σ, IAMB >> TROCHEE)

	/kiʃi/	S2W	*HEAVY	DEP-μ	ID-[HI]
	ki$_{\mu}$.ˈʃi$_{\mu}$	*!			
	ki$_{\mu}$.ˈʃæ$_{\mu\mu}$		*	*	*!
☞	ki$_{\mu}$.ˈʃiː$_{\mu\mu}$		*	*	

	/kiʃi-m/	S2W	*HEAVY	DEP-μ	ID-[HI]
☞	ki$_{\mu}$.ˈʃi$_{\mu}$m$_{\mu}$		*		
	ki$_{\mu}$.ˈʃæ$_{\mu\mu}$m$_{\mu}$		*	*!	*
	ki$_{\mu}$.ˈʃiː$_{\mu\mu}$m$_{\mu}$		*	*!	

VOWEL REDUCTION

- The proposed analysis can also account for vowel reduction (raising)
  - In <u>medial</u> <u>open</u> syllables, low vowels raise to high

/sællæ/	sæl.læ	‘turban’
/sællæ-m/	sæl.læm	‘my turban’
/sællæ-m-dæ/	sæl.læm.dæ	‘my turban (LOC)’
/sællæ-dæ/	sæl.li.dæ	‘turban (LOC)’
/sællæ-lær/	sæl.li.lær	‘turbans’
/sællæ-lær-i/	sæl.li.li.ri	‘his/her turbans’

VOWEL REDUCTION

- Reduction is analyzed as deletion of a mora
- The raising context supports the moraicity of codas
  - Vowels are not reduced in medial closed syllables
  - /sællæmdæ/ → [sæl.læm.dæ] 'my turban (LOC)' *[sæl.lim.dæ]
- Note: vowels in initial syllables are generally immune to raising
  - /ætæ-lær/ → [æ.ti.lær] 'tomorrows' *[i.ti.lær]

SONORITY-DRIVEN STRESS

- Assuming a ranking that generates final stress with no secondary stresses (ALLFEET-R >> PARSE-σ, IAMB >> TROCHEE)

	/sællæ-lær-i/	S2W	*HEAVY	DEP-μ	ID-[HI]
	sæ$_{\mu\mu}$l$_{\mu}$.læ$_{\mu\mu}$.læ$_{\mu\mu}$.ˈri$_{\mu}$	*!	***		
	sæ$_{\mu\mu}$l$_{\mu}$.li$_{\mu}$.li$_{\mu}$.ˈri$_{\mu}$	*!	*		**
	sæ$_{\mu\mu}$l$_{\mu}$.læ$_{\mu\mu}$.læ$_{\mu\mu}$.ˈriː$_{\mu\mu}$		***!*	*	
	sæ$_{\mu\mu}$l$_{\mu}$.læ$_{\mu\mu}$.li$_{\mu}$.ˈriː$_{\mu\mu}$		***!	*	*
☞	sæ$_{\mu\mu}$l$_{\mu}$.li$_{\mu}$.li$_{\mu}$.ˈriː$_{\mu\mu}$		**	*	**

TRIMORAIC SYLLABLES

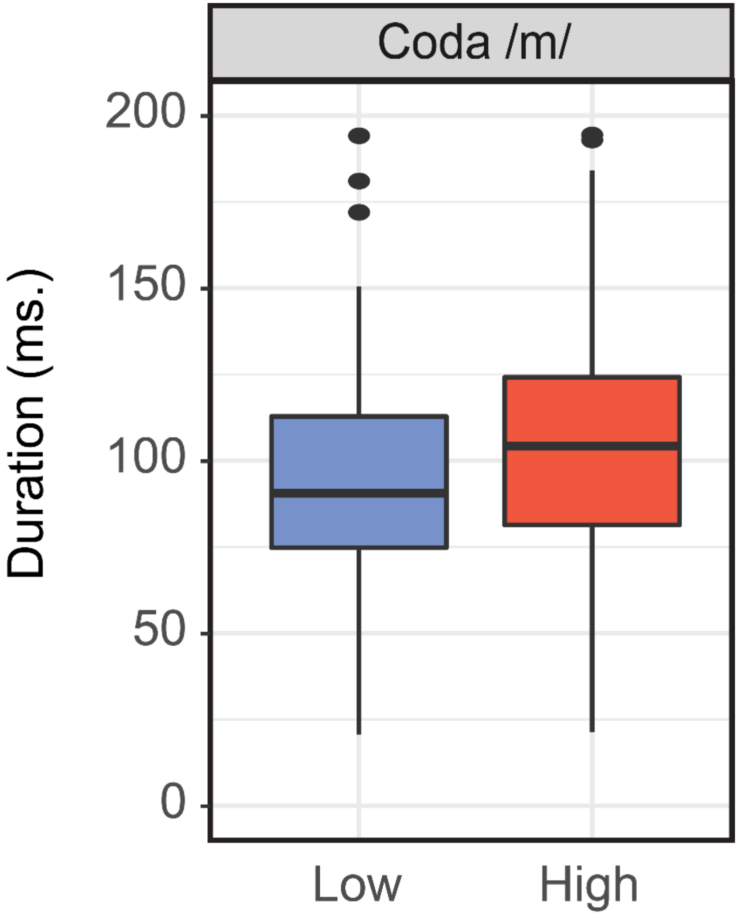
- I've claimed that codas are moraic and non-high vowels are bimoraic, which makes $CV_{[-hi]}C$ syllables trimoraic
- Do coda consonants only contextually contribute a mora?
  - Broselow et al. (1997) demonstrates that coda consonant durations differ in languages with contextually moraic consonants
  - If codas are only moraic after high vowels, this predicts that codas are longer in that context

Hayes 1995; Moren 2000

TRIMORAIC SYLLABLES

- Coda /m/ is 8 ms. longer after high vowels
  - $\chi^2(1)=7.72$, $p < .01$

- This is likely not perceivable
- This difference is much smaller than the differences in Broselow et al (1997), which were ~18-34 ms.



Huggins 1972; Klatt & Cooper 1975

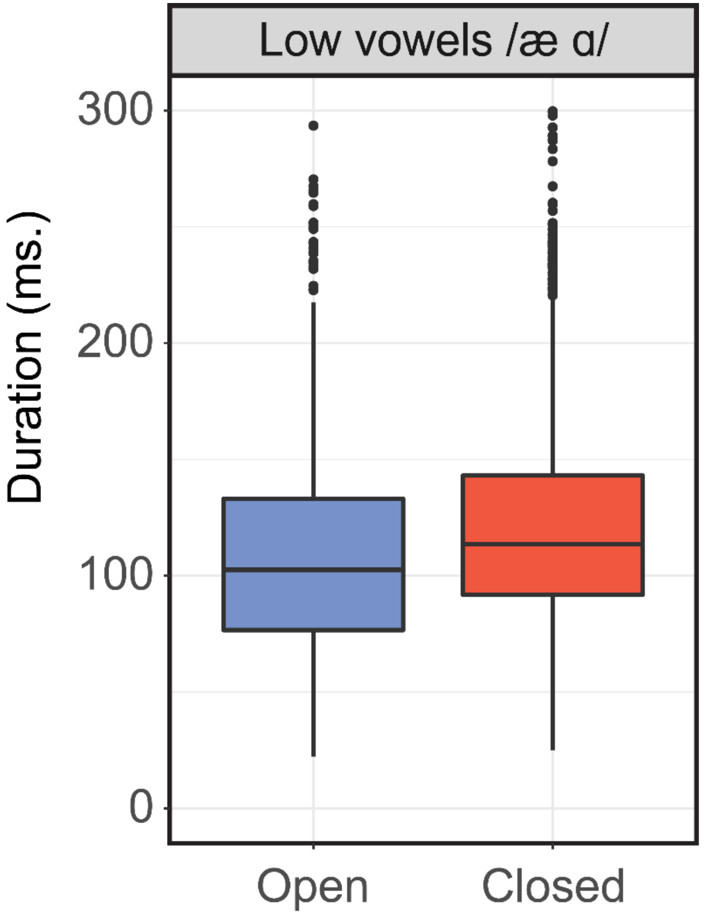
TRIMORAIC SYLLABLES

- Broselow et al. (1997) also demonstrates that vowel length may vary according to mora sharing
  - CVV > CVVC; CV > CVC in Malayalam
  - Durations do not differ in languages where the coda is moraic (e.g. Hindi, Levantine Arabic V vs. VC rhymes)

- If codas are only moraic after high vowels, this predicts that low vowels are shorter in closed syllables

TRIMORAIC SYLLABLES

- Low vowels are actually longer by 20 ms. in closed syllables
  - $\chi^2(1)=3.73$, $p = .05$



Huggins 1972; Klatt & Cooper 1975

SUMMARY

Claim	Accounts for
Uyghur weight is mora-based	Compensatory lengthening, no closed-syllable shortening, potential secondary stress placement
Vowel sonority is encoded by moraic differences	Asymmetric augmentation of high vowels in stressed open syllables
Stressed syllables must be heavy	
Heavy syllables are marked	Triggers raising of low vowels in medial open syllables
Codas are always moraic	Partially defines context for raising (medial closed syllables are immune), durations of Vs and coda Cs

DISCUSSION

- My analysis supports sonority-sensitivity in manner quite distinct from Kenstowicz (1994) and de Lacy (2002)
- Asymmetric augmentation in Uyghur supports sonority as an indirect, representational difference in moraic content
  - This is consistent with Shih (2018) and Shih & de Lacy (2019)
- In addition, sonority provides a unifying perspective for reduction and augmentation in the language

THANK YOU!

IMPRESSIONISTIC DESCRIPTIONS OF STRESS

- Nadzhip (1971): primary stress on ultima in native words; doesn't report secondary stress
- Hahn (1991): stress penult if heavy and the ultima is light, otherwise, stress ultima. Secondary stress falls on heavy syllables. Stress is realized as raised pitch and greater intensity.
- Hahn (1998): primary stress on ultima; secondary stress on long vowels
- Engesath et al. (2010): primary stress falls on the leftmost heavy syllable; otherwise, stress the ultima. Stress is realized as a pitch accent.

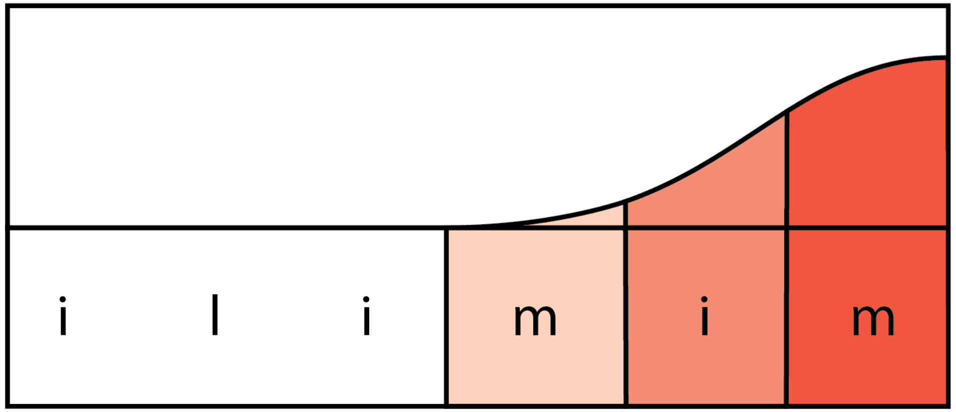
INITIAL SYLLABLES

- Initial-syllable vowels are typically immune to raising
  - /ætæ-lær/ → [æ.ti.lær] 'tomorrows' *[i.ti.lær]

- However, the initial-syllable vowel may raise if the syllable is open and the second-syllable vowel is high
  - /bæl-i/ → [be.li]~[bi.li] 'his/her waist'
  - /bæl-ni/ → [bæl.ni] *[be.li] 'his/her waist'
  - /ætæ/ → [æ.tæ] *[i.tæ] 'tomorrow'

FINAL LENGTHENING?

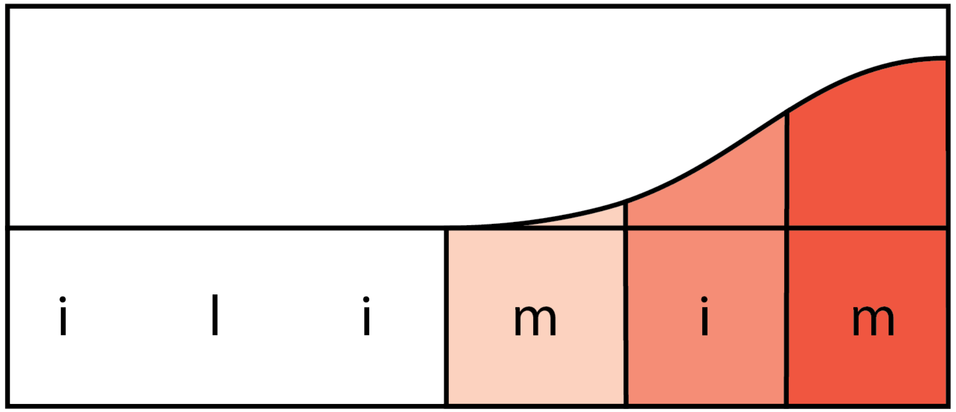
- Final lengthening is modulated by proximity to a prosodic boundary



FINAL LENGTHENING?

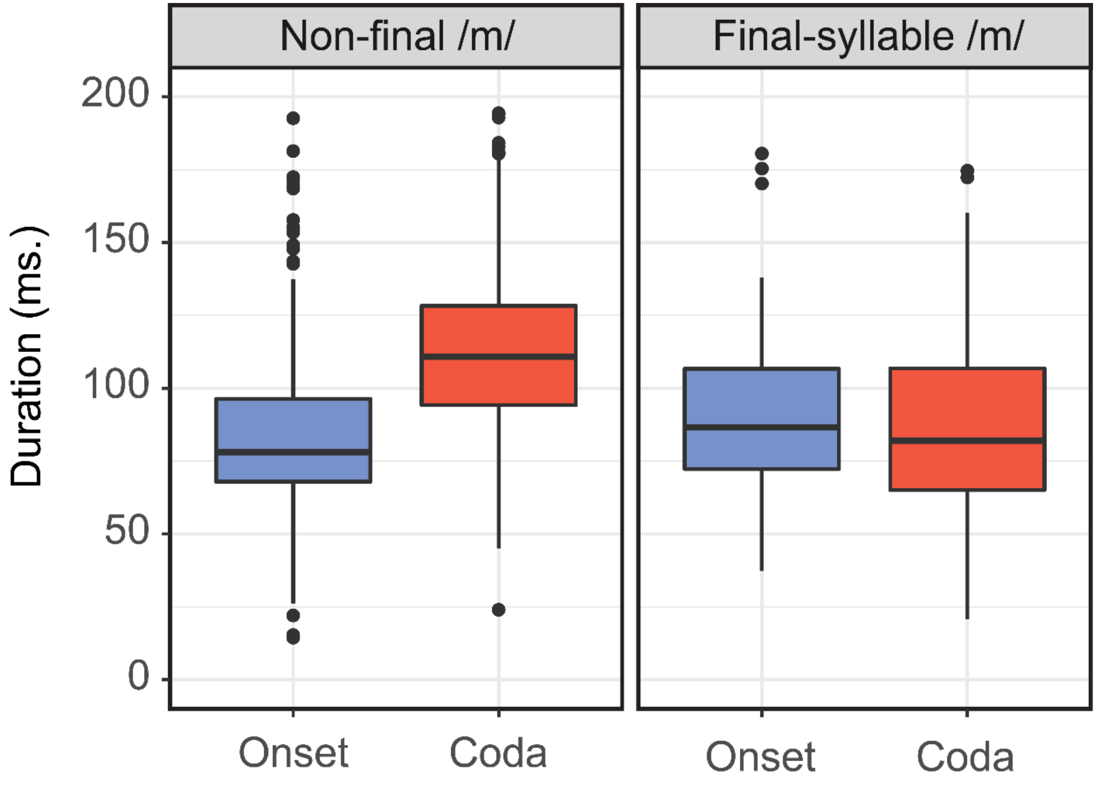
- Final lengthening is modulated by proximity to a prosodic boundary
    - This also predicts that the relative duration of codas should be greater in final syllables

$$\frac{\mu Coda_{Final}}{\mu Onset_{Final}} > \frac{\mu Coda_{NonFinal}}{\mu Onset_{NonFinal}}$$



FINAL LENGTHENING?

- The coda-onset duration ratio for /m/ decreases in final syllables



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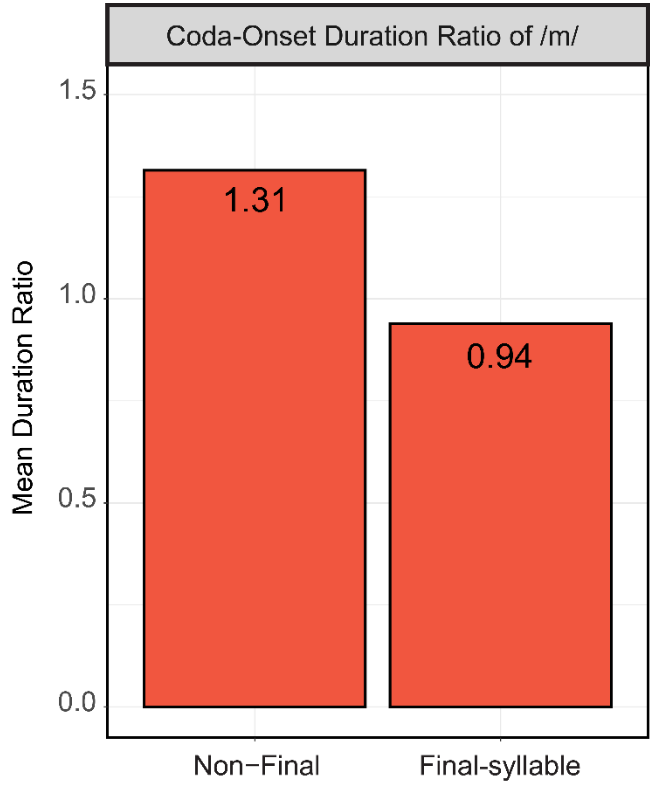
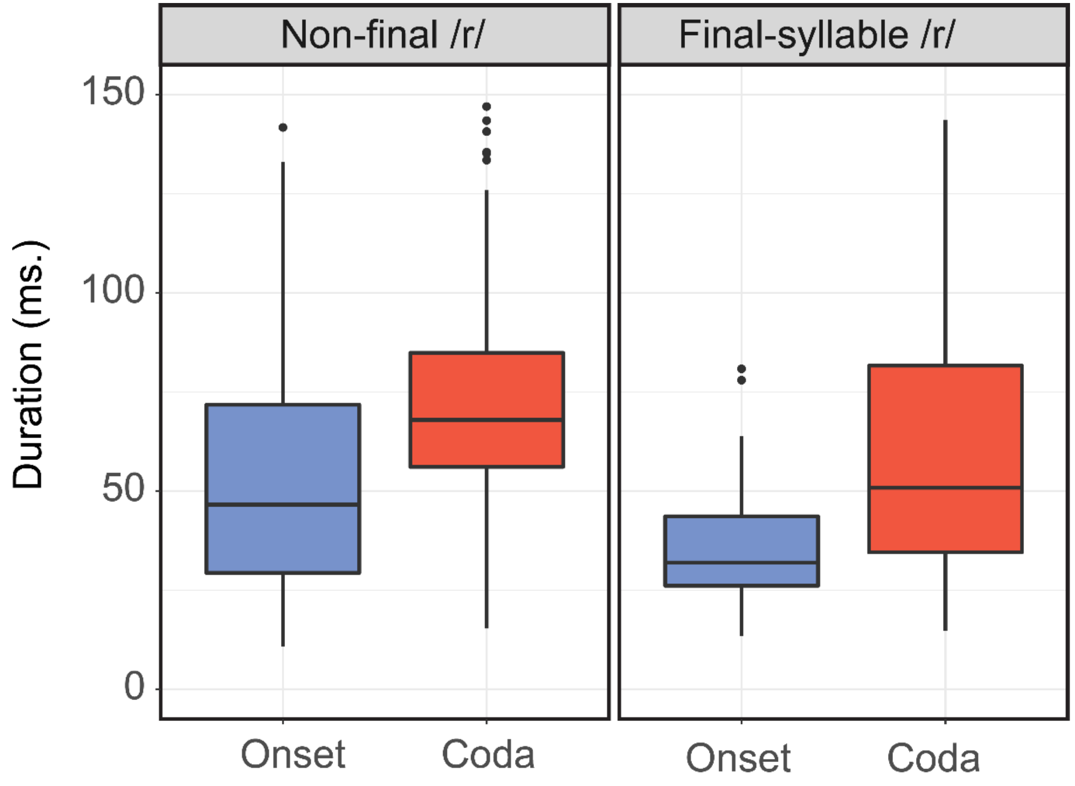


FINAL LENGTHENING?

- In contrast, the coda-onset duration ratio for /r/ increases in final syllables



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