Using Temporal Stability to Probe the Syllabification of Medial Geminates: Evidence from Moroccan Arabic

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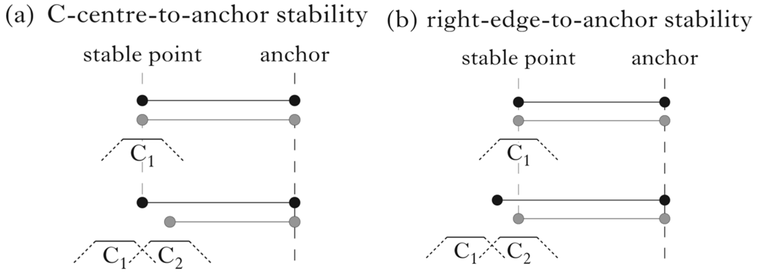
Introduction

- **Takeaway:** the syllabification of geminates can be probed using temporal stability methodology.
- Similar to CC sequences, medial geminates have a heterosyllabic representation in Moroccan Arabic.
- **Background:** two patterns of temporal stability:



- Previous studies using temporal stability largely focused on initial clusters (e.g., Shaw et al., 2009), and to a lesser extent medial clusters (e.g., Gafos et al., 2020).
- Geminates are commonly argued to be heterosyllabic (e.g., Davis, 2011), but phonetic evidence is limited.

Methods

- **Participants:** 10 native speakers of Moroccan Arabic.
- **Stimuli:** 10 word pairs: 5 reps → 300 tokens/speaker. Improved on Gafos et al., (2020) with more participants (10 vs. 4) and carefully selected real-word stimuli.

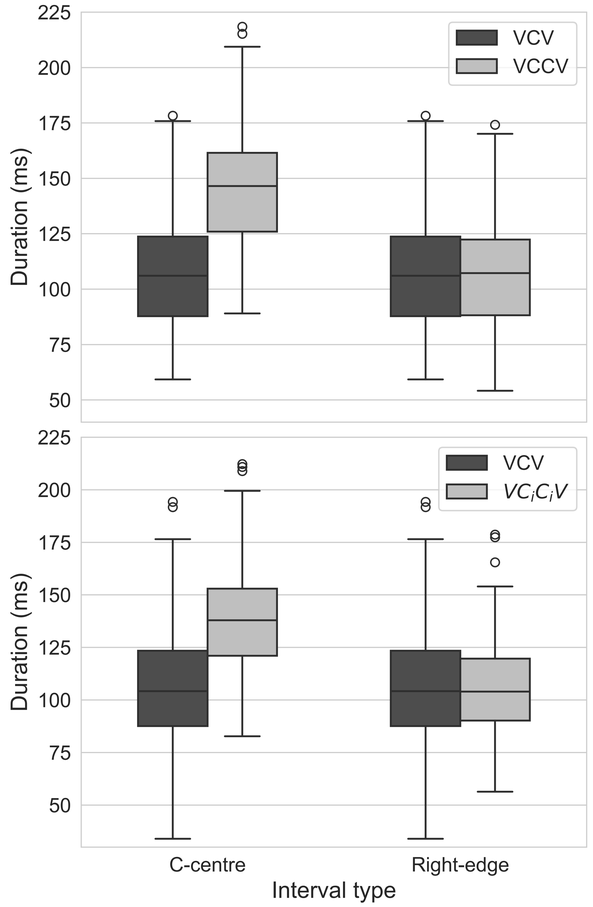
VCV	VC_iC_iV	VCV	VCCV
sˤarˤa	*dˤarˤrˤa*	*baqa*	*sabqa*
ʕuma	*ʕamma*	*sala*	*makla*
kala	*lalla*	*nuba*	*rakba*
sˤatˤa	*ħatˤtˤa*	*mama*	*raʒma*
riʃa	*kaʃʃa*	*ʕana*	*baʕna*

- **Annotation:** Automatic alignment with WebMAUS, manually corrected in Praat.
- Geminates were split into two equal halves to isolate the right consonantal gesture.

- **Measurements:** C-centre-to-anchor and Right-edge-to-anchor durations were extracted.
- **Relative Standard Deviation** (RSD = $\frac{\text{SD}}{\text{Mean}} \times 100$): controls for duration differences; lower RSD = more stable timing.

Results: overall raw durations

- C-centre interval lengthens with added consonants or gemination, while right-edge interval remains stable across both conditions.



- Raw duration is not diagnostic of syllabification, interpretation relies on RSD.

Results: RSDs

- Right-edge interval has lower RSD than C-centre in all word pairs of both geminates and CC-sequences.
- Indicates higher temporal stability at the right edge.

Geminates	CC	RE
sˤarˤa ~ dˤarˤrˤa	23.9	16.7
ʕuma ~ ʕamma	16.5	12.1
kala ~ lalla	21.7	15.0
sˤatˤa ~ ħatˤtˤa	15.6	11.3
riʃa ~ kaʃʃa	11.9	11.8
Average	17.9	13.4

CC-sequences	CC	RE
baqa ~ sabqa	15.1	13.3
sala ~ makla	19.1	13.1
nuba ~ rakba	18.2	10.3
mama ~ raʒma	22.6	11.5
ʕana ~ baʕna	22.9	15.3
	19.6	12.7

- Right-edge interval was significantly more stable than the C-centre interval:
  - *Geminates:* right-edge RSD < c-centre RSD, $\beta = -4.52$, $SE = 1.61$, $t = -2.80$, $p = .006$
  - *CC-sequences:* right-edge RSD < c-centre RSD, $\beta = -6.94$, $SE = 1.78$, $t = -3.90$, $p < .001$
- No significant difference in right-edge RSD between geminates and CC-sequences: $\beta = 0.68$, $SE = 1.53$, $t = 0.45$, $p = .65$

Conclusions

- Temporal stability is a useful diagnostic for probing the syllabification of geminates.
- Like non-geminate CC sequences, medial geminates in Moroccan Arabic show right-edge-to-anchor stability, supporting a heterosyllabic analysis.
- Future work can test whether these patterns generalize to other geminate types and positions.

References

Davis, S. (2011). *Geminates*. In *The Blackwell Companion to Phonology*.

Gafos, A. I., Roeser, J., Sotiropoulou, S., Hoole, P., and Zeroual, C. (2020). *Structure in mind, structure in vocal tract*.

Shaw, J., Gafos, A. I., Hoole, P., & Zeroual, C. (2009). *Syllabification in Moroccan Arabic*.