Uncover articulatory correlates of acoustic duration with analysis-by-synthesis: the case of diphthongs

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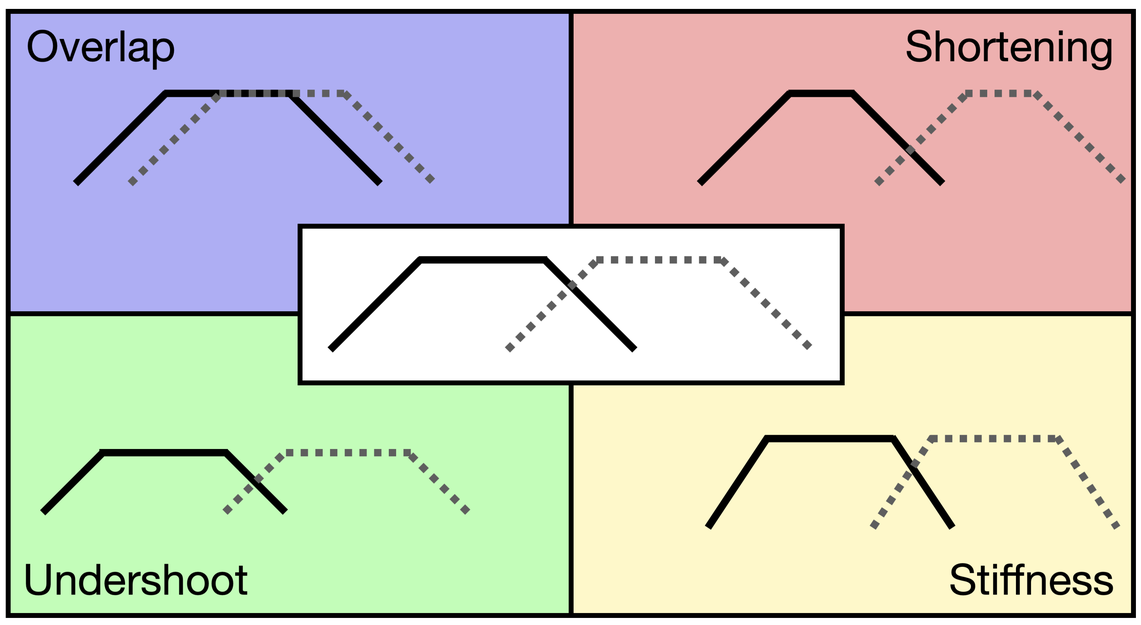
SLaM

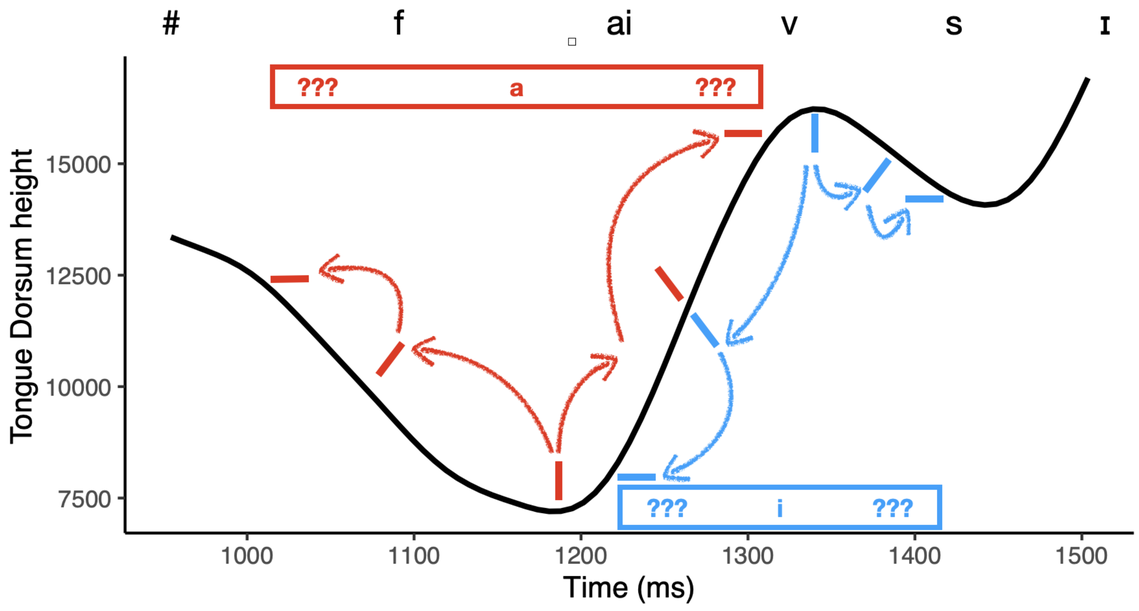
Question

- What are the articulatory mechanisms involved in reduction?
  - increased gestural overlap
  - shortening of gestures
  - undershoot of target
  - increased stiffness (mass-spring model)
- How does reduction take place in a diphthong?

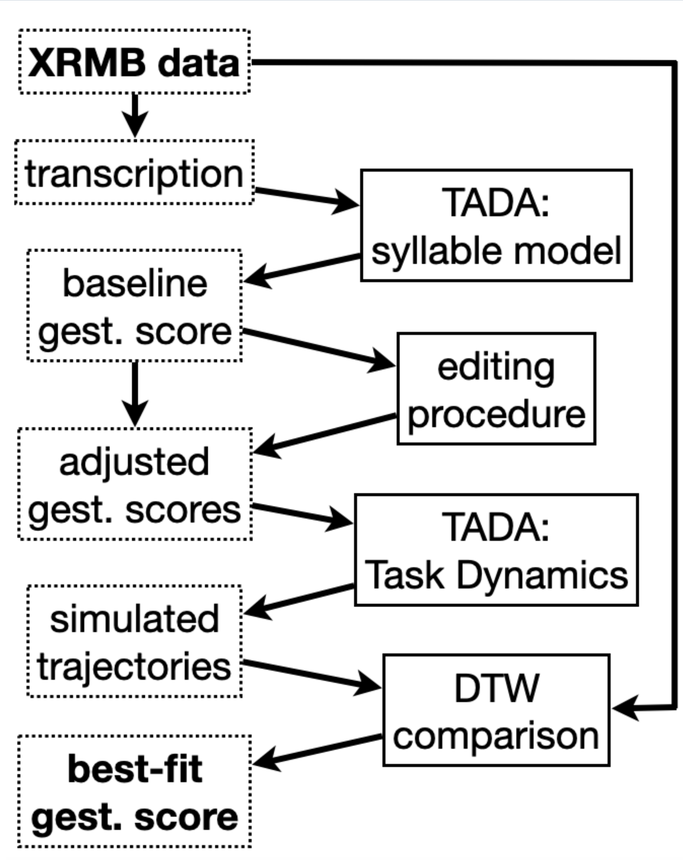


Problem: identifying gestures

- Acoustics? "Many-to-one" mapping
- Articulatory thresholds? Arbitrary, not good for shared articulators



Proposed solution: Analysis-by-synthesis



- 465 tokens of *five* by 48 speakers in Wisconsin XRMB Database
- Simulations were made with two values for each parameter
- Use parameters for best-fit simulation as annotation

Best-fit simulations

- Of the 465 best-fit simulations, most had shortening and overlap of both [a] and [i]; fewest had stiffness and undershoot

		onglide: a		offglide: i	
degree		384 overlap	352 shortening	383 overlap	392 shortening
		211 undershoot	352 stiffness	27 undershoot	5 stiffness
location		391 overlap	372 shortening	369 overlap	388 shortening
		263 undershoot	249 stiffness	19 undershoot	57 stiffness

Co-occurrence and duration

- Best-fit simulations showed extensive correlation among paramters
- Strongest correlations among shortening and overlap for [i] gestures
- Acoustic duration most correlated with shortening and overlap

var 1	var 2	corr
i-deg-over	i-loc-short	0.93
i-deg-short	i-deg-over	0.88
i-deg-over	a-loc-short	0.83
i-loc-short	a-loc-short	0.82
i-deg-short	i-loc-short	0.81

Variables most strongly correlated with each other

var	corr w/dur
a-loc-short	-0.69
i-deg-over	-0.64
i-loc-short	-0.61
i-deg-short	-0.58
i-loc-over	-0.47

Strongest correlations with duration

Discussion

- Most common reductions: overlap, shortening
- Correlations among overlap & shortening & acoustic duration
- Interpretations
  - Overlap and shortening can vary across tokens
  - Stiffness & undershoot ([a] only) affect shape more than acoustic duration
  - Location & degree gestures (if separate) vary together
- Proof-of-concept: studying simulations allows us to investigate overlapping gestures with a shared articulator
- Next steps:
  - Computationally-efficient alternatives
  - More "steps", try multiple best-fit simulations
  - Alternatives to DTW?
  - Use articulatory variation to inform theories of representation

References

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