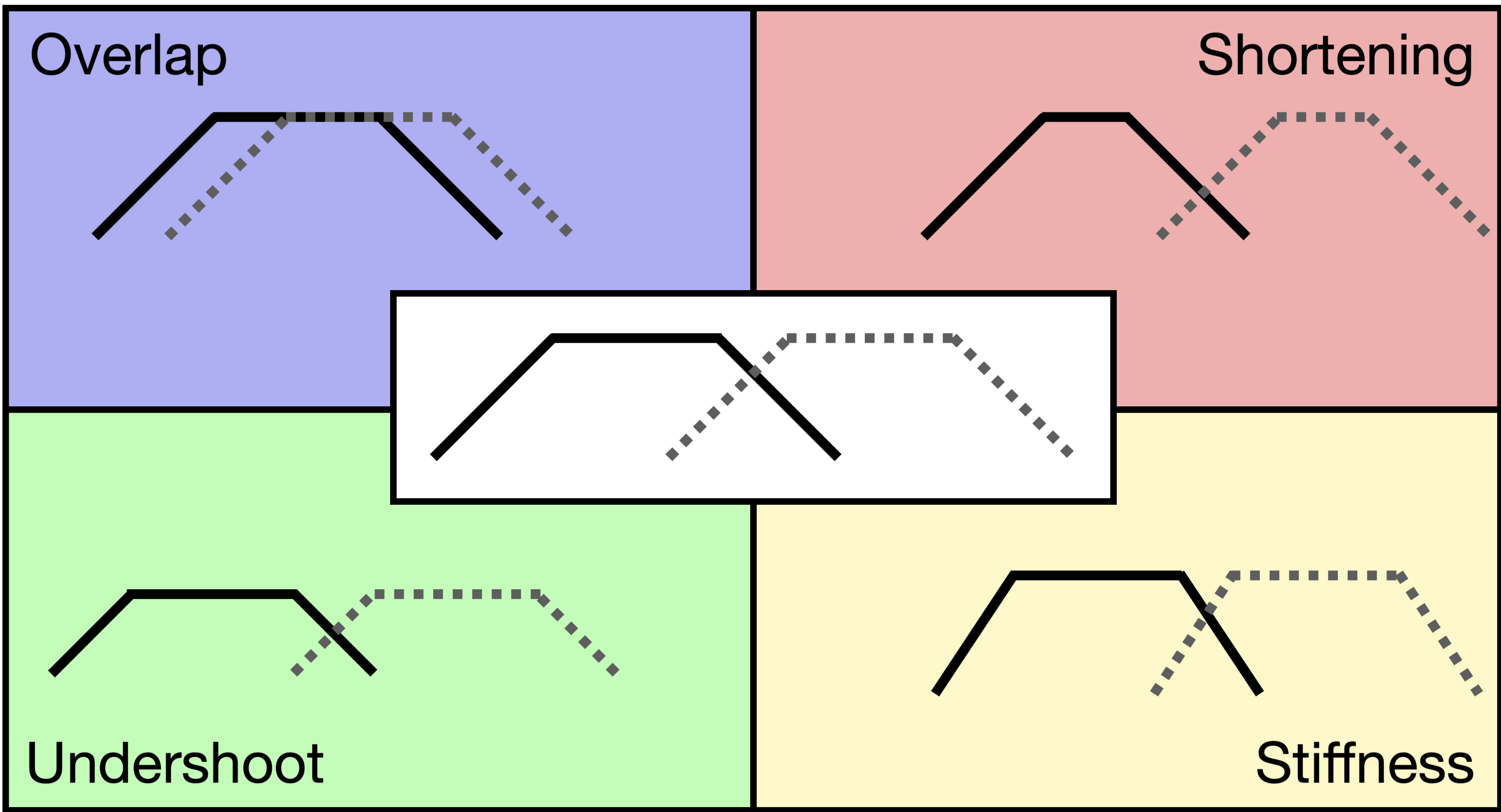


Uncover articulatory correlates of acoustic duration with analysis-by-synthesis: the case of diphthongs

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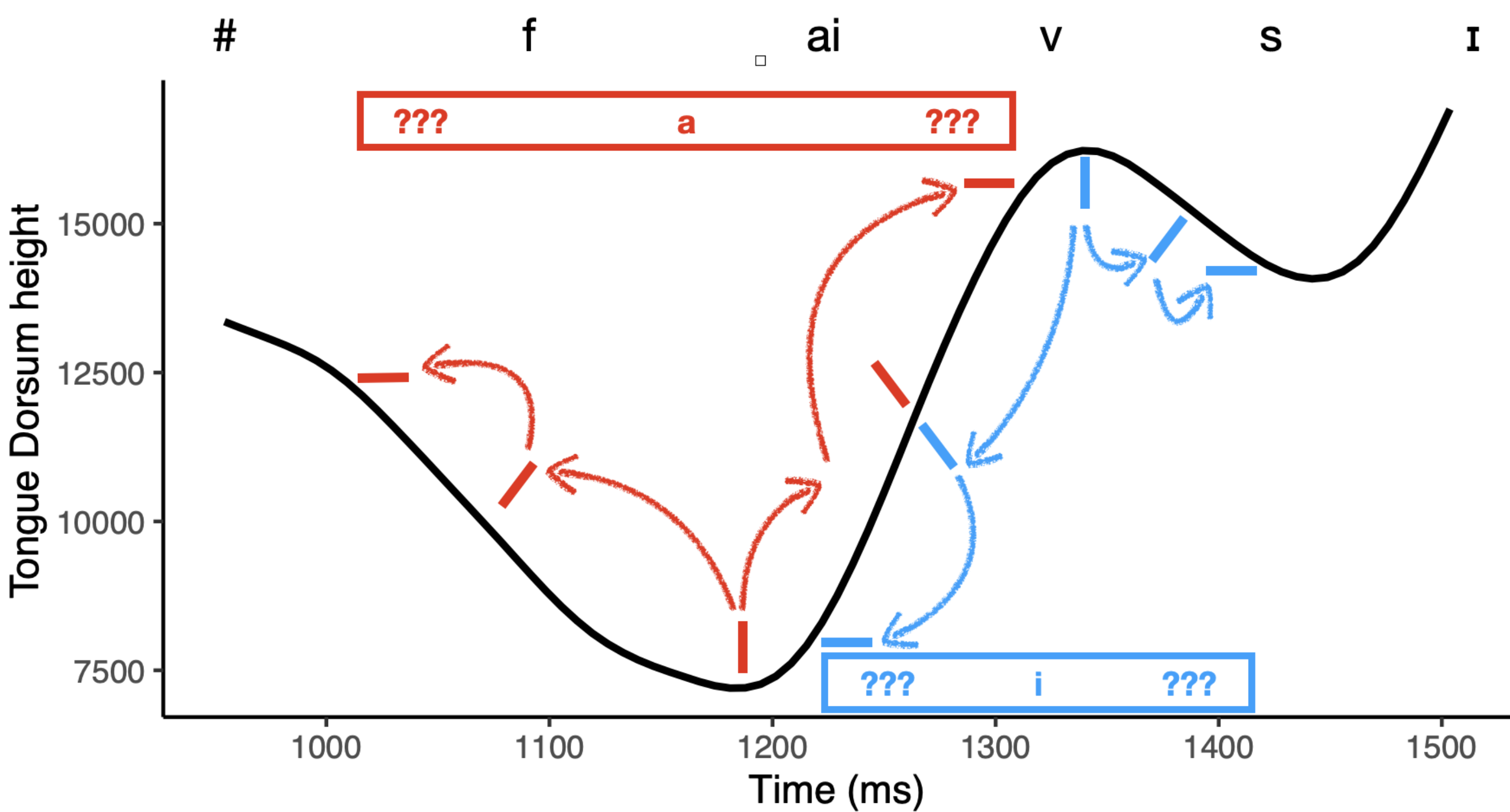
Question

- ▶ 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?

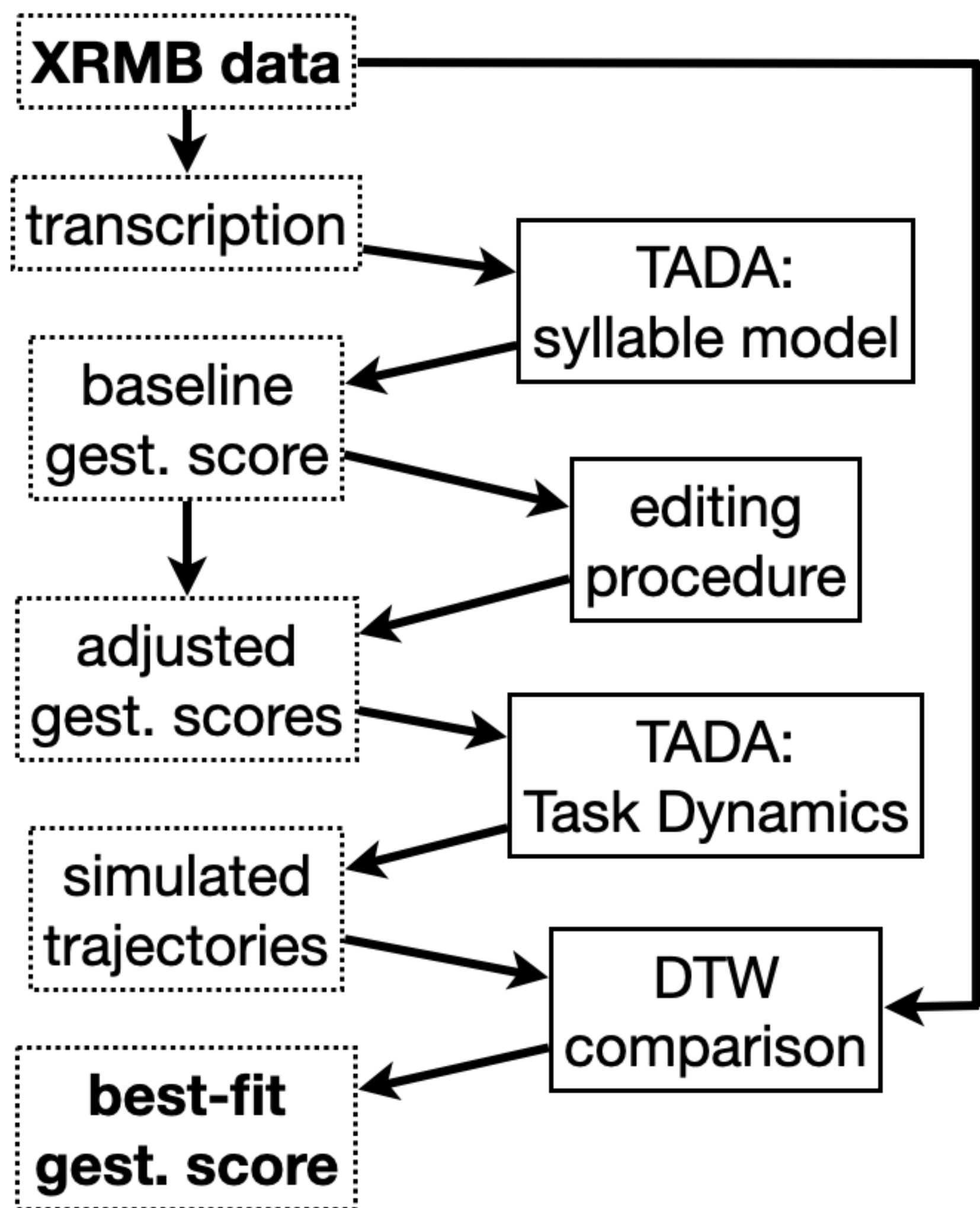


Problem: identifying gestures

- ▶ 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	overlap		shortening		overlap		shortening	
	384	352			383	392		
location	undershoot		stiffness		undershoot		stiffness	
	211	352			27	5		
degree	overlap		shortening		overlap		shortening	
	391	372			369	388		
location	undershoot		stiffness		undershoot		stiffness	
	263	249			19	57		

Co-occurrence and duration

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

var 1	var 2	corr	var	corr w/dur
i-deg-over	i-loc-short	0.93	a-loc-short	-0.69
i-deg-short	i-deg-over	0.88	i-deg-over	-0.64
i-deg-over	a-loc-short	0.83	i-loc-short	-0.61
i-loc-short	a-loc-short	0.82	i-deg-short	-0.58
i-deg-short	i-loc-short	0.81	i-loc-over	-0.47
Variables most strongly correlated with each other			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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- ▶ Thanks to Jason Shaw, Tino Sering, members of DFG CRC1675 and practice audiences at Heinrich-Heine-Universität Düsseldorf.