

Can Prosodic Units Support Phonotactic Learning? A Computational Evaluation against Infant Behavior



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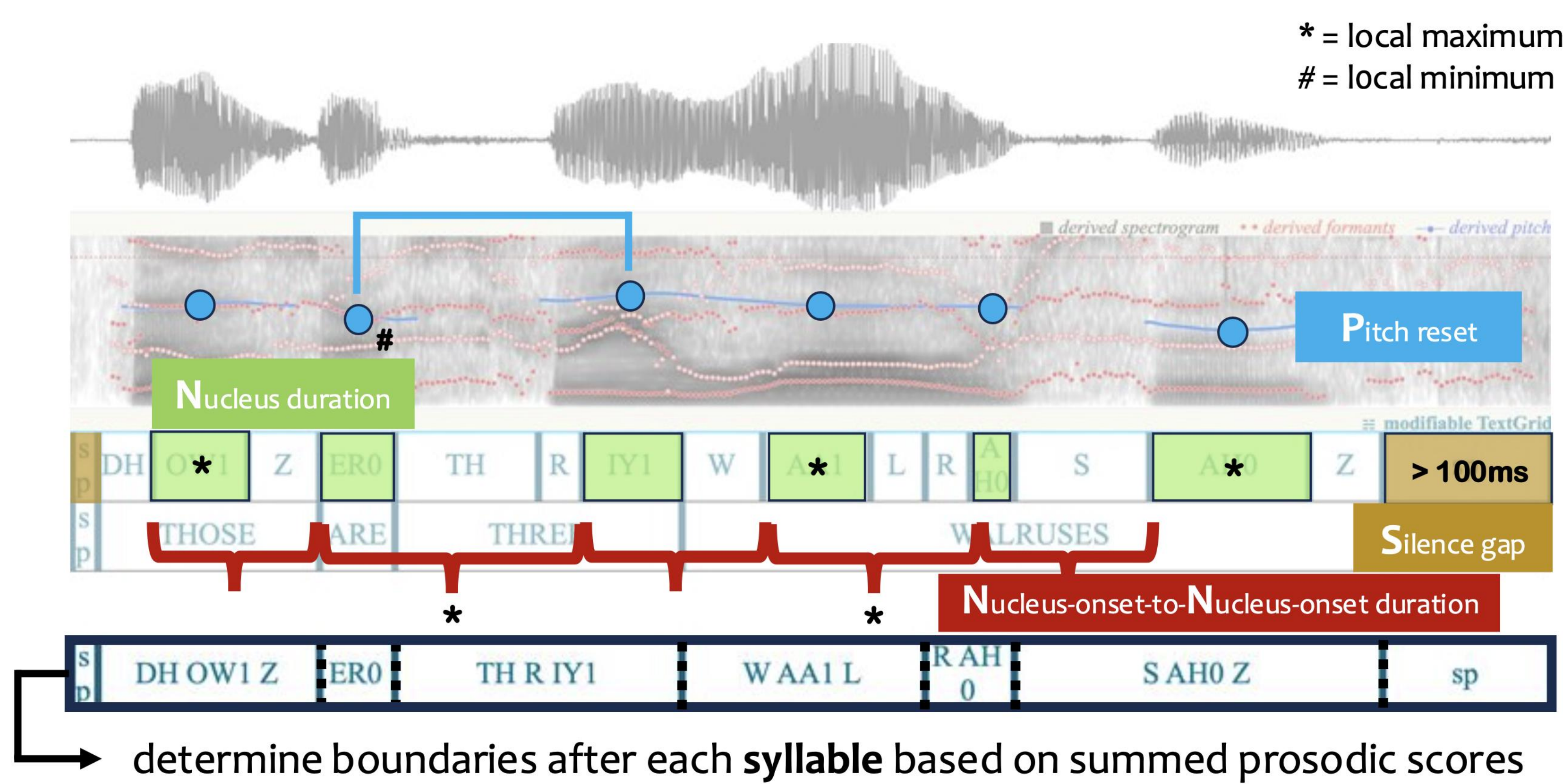
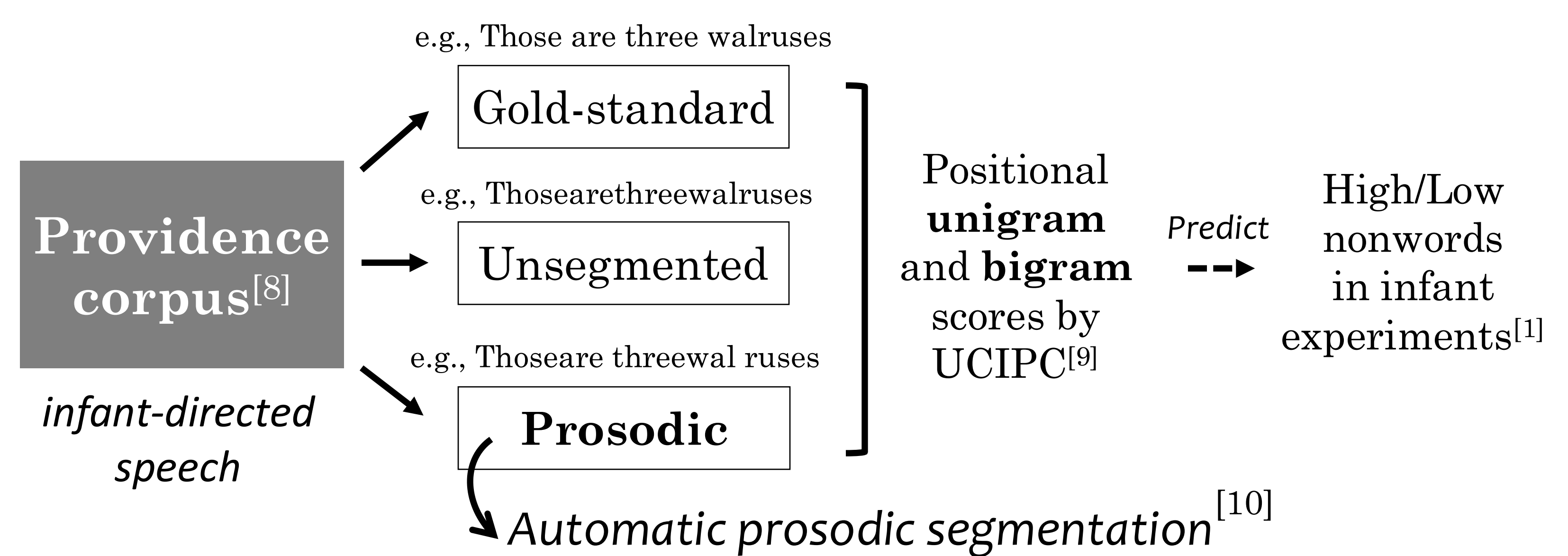
Background

- 5-month-olds distinguish high- (e.g., *kip*) vs. low-probability (e.g., *lvag*) nonwords^[1]
 → yet unclear phonotactic learning mechanism
- Pre-lexical hypothesis^[2,3,4]: infants can learn phonotactics from unsegmented speech
 → *partially supported* by previous modeling results^[5]
- Infants detect large prosodic breaks
 → aids speech segmentation^[6,7].

Research question: Can prosodic units further support phonotactic learning beyond unsegmented speech?

Method

- Computational modeling trained on corpora derived from different segmentation, benchmarked against infant data^[1]



determine boundaries after each syllable based on summed prosodic scores

Rescale within utterances * = local maximum

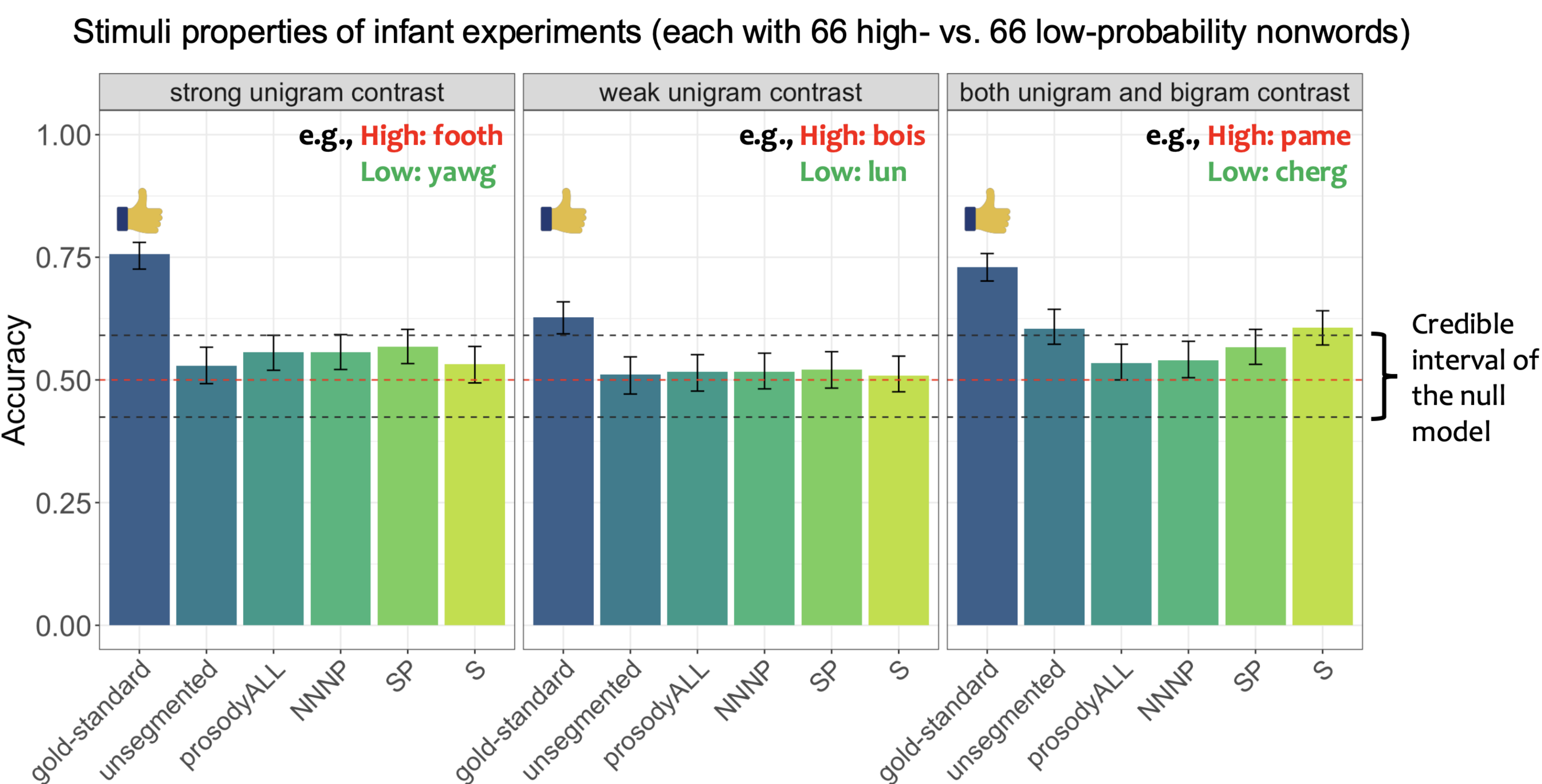
Syllable (orthography)	Syllable (arpabet)	nucleus	S	N	NN	P	sum	Prosodic boundary
Those	DH OW1 Z	OW1	0	0.88	0	0	0.88	0
are	ER0	ER0	0	0	1	1	2 *	1
three	TH R IY1	IY1	0	0	0	0	0	0
wal	W AA1 L	AA1	0	1	0.79	0	1.79 *	1
ru	RA H0	AH0	0	0	0	0	0	0
ses	SA H0 Z	AH0	1	0	0	0	1	999

*1 = prosodic boundary, 0 = no boundary, 999 = utterance-final boundary

- Four different prosodic cue combinations:
 - [a] ALL; [b] **NNNP** (best recall/F1 against gold standard);
 - [c] **SP** (motivated by [7]); [d] **S** (best precision).
- Each corpus divided into five splits, with each split randomly sampling 80% of the unique utterance types to simulate variation in the speech input.

Results

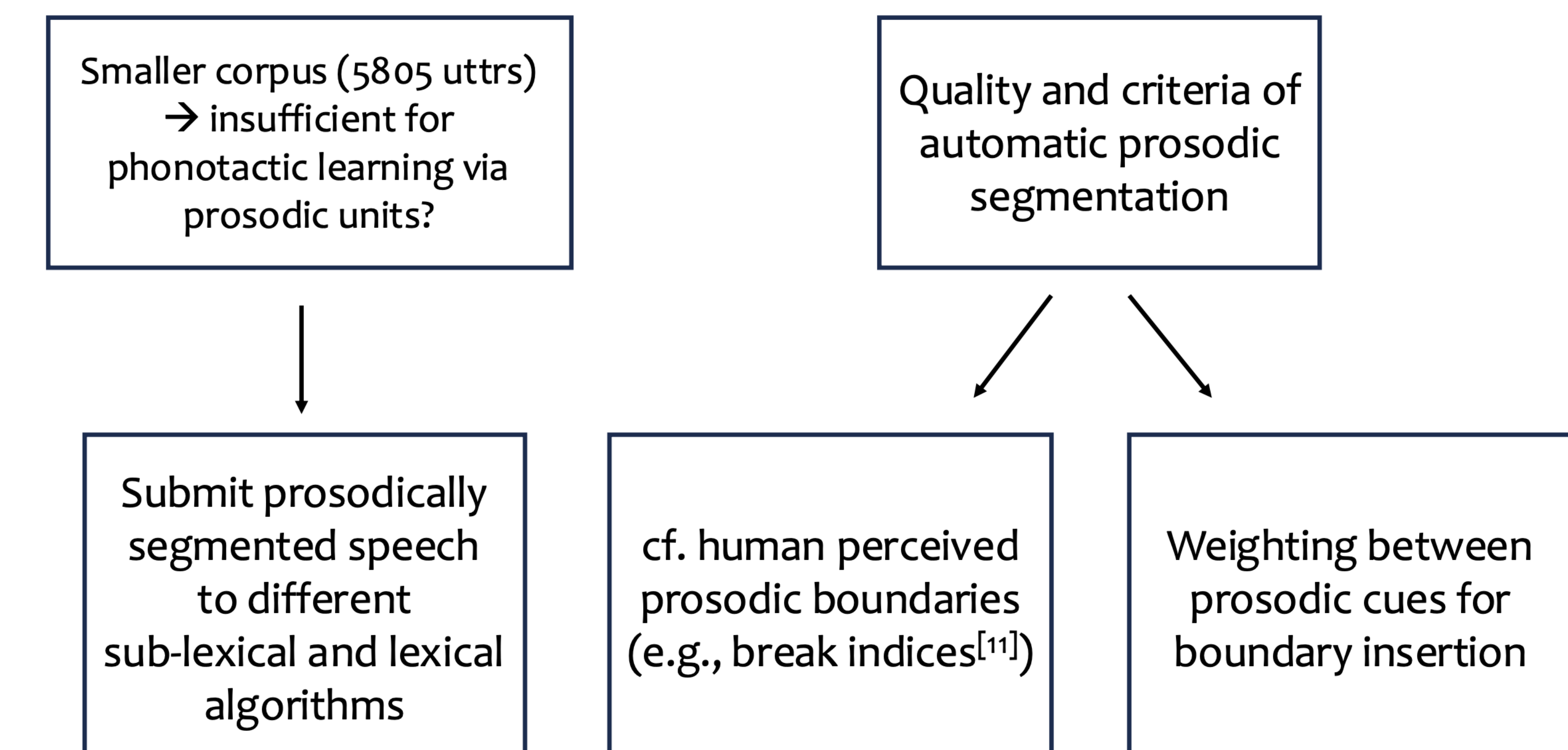
- Bayesian logistic regression model (List ~ PosUnigramP * PosBigramP + (1 | RandSplit)) with k-fold validation comparing prediction accuracy against the null model (List ~ 1).



- Outperform the null model: Gold-standard segmented corpus
- No better than the null model: Unsegmented corpus & **all prosodically segmented corpora (ALL, NNNP, SP, S)**

Discussion

- Preliminary evidence shows that prosodic units created by automatic prosodic segmentation may not facilitate phonotactic learning in 5-month-olds.
- Caveats and potential next steps:



Acknowledgements

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References

[1] Sundara, M., & Breiss, C. (submitted). *Cognition*. [2] Adriaans, F., & Kager, R. (2010). [3] Brent, M. R., & Cartwright, T. A. (1996). *Cognition*. [4] Daland, R., & Pierrehumbert, J. B. (2011). *Cognitive Science*. [5] Sundara, M., Breiss, C., Dickson, N., & Mayer, C. (submitted). *Developmental Science*. [6] Johnson, E. K., & Seidl, A. (2008). *Infancy*. [7] Seidl, A. (2007). *Journal of Memory and Language*. [8] Demuth, K., Culbertson, J., & Alter, J. (2006). *Language and Speech*. [9] Mayer, C., Kondur, A., & Sundara, M. (2025). *Behavior Research Methods*. [10] Ludusan, B., Cristia, A., Mazuka, R., & Dupoux, E. (2022). *Cognition*. [11] Beckman, M., & Hirschberg, J. (1994). Ohio State University. [Online].