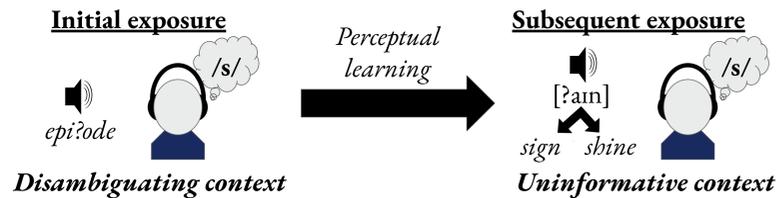


# The influence of sentence context on lexically guided perceptual learning

Sahil Luthra, Rachel J. Steiner, James S. Magnuson, & Emily B. Myers

## Introduction

Listeners can leverage different forms of context, such as **lexical knowledge**, to guide interpretation of ambiguous speech.<sup>1</sup> Such context can also guide perception in the future (**perceptual learning**).<sup>2</sup>



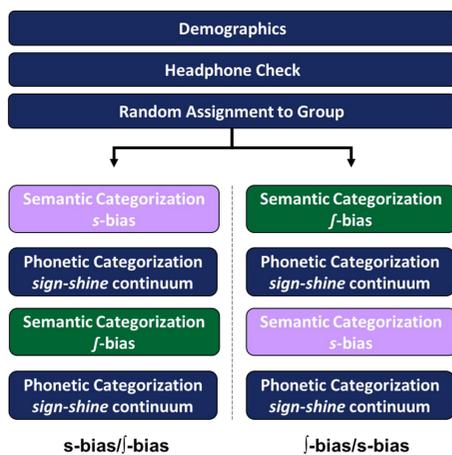
Of interest is whether **the strength of a listener's prior expectations** for a particular word can modulate the extent of perceptual learning. We manipulated how strongly a particular word was expected using **preceding sentence context**.

Does the extent to which a sentence context predicts an upcoming word influence the magnitude of lexically guided perceptual learning?

## Hypotheses

- A **predictive sentence context** boosts the prior probability of a particular **phoneme**, so perceptual learning might be *enhanced* after a predictive context.
- Alternatively, a **predictive context** may encourage listeners to pay less attention to the bottom-up signal, potentially *diminishing* learning effects.

## Methods



### Semantic categorization task (Is the target a concrete noun?)

- Participants were exposed to an ambiguous sound (s/f blend).
- In one block, lexical contexts biased interpretation the ambiguous sound toward /s/; in another block, context biased toward /f/. Block order was counterbalanced.

### Phonetic categorization task (Is the stimulus "sign" or "shine"?)

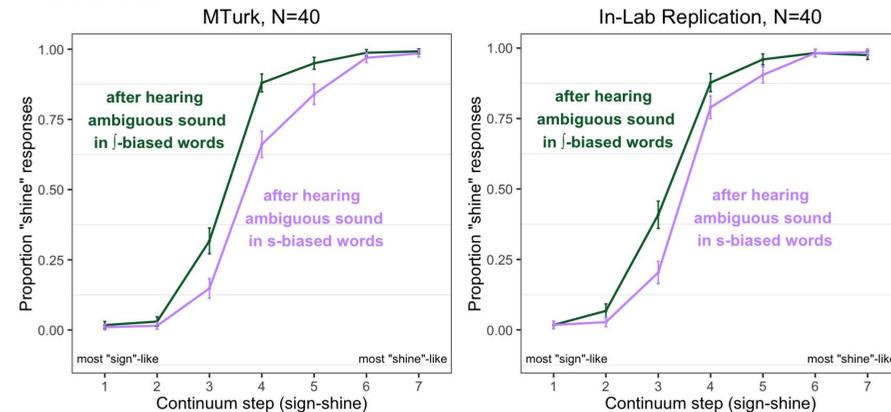
- Learning was assessed using a 7-step continuum from *sign* to *shine*.

## References

<sup>1</sup>Ganong, W. F. (1980). Phonetic categorization in auditory word perception. *Journal of Experimental Psychology: Human Perception and Performance*, 6(1), 110–125.  
<sup>2</sup>Norris, D., McQueen, J. M., & Cutler, A. (2003). Perceptual learning in speech. *Cognitive Psychology*, 47(2), 204–238.  
<sup>3</sup>Kraljic, T., Samuel, A. G., & Brennan, S. E. (2008). First impressions and last resorts: How listeners adjust to speaker variability. *Psychological Science*, 19(4), 332–338.  
<sup>4</sup>Drouin, J. R., & Theodore, R. M. (2018). Lexically guided perceptual learning is robust to task-based changes in listening strategy. *The Journal of the Acoustical Society of America*, 144(2), 1089–1099.

## Experiment 1: No sentence contexts

Because previous lexically guided perceptual learning studies have not used a semantic categorization task during exposure, we first verified that perceptual learning occurred with this task.



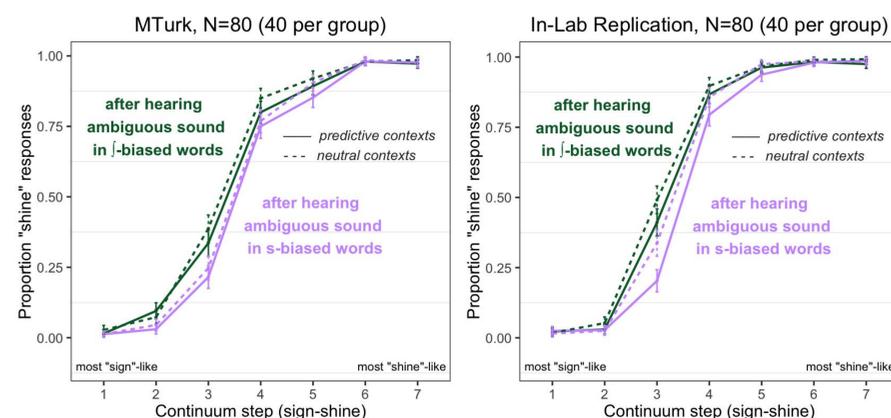
With online and in-lab samples, we found robust perceptual learning when ambiguous sounds were encountered during a semantic categorization task.

## Experiment 2: Auditory sentence contexts

During exposure, one group heard **predictive** sentence contexts (mean Cloze of final word: 0.74). Another group heard **neutral** contexts (Cloze: 0). Sentence contexts did not include /s/ or /f/.

*I love "The Walking Dead" and eagerly await every new... epi?ode*

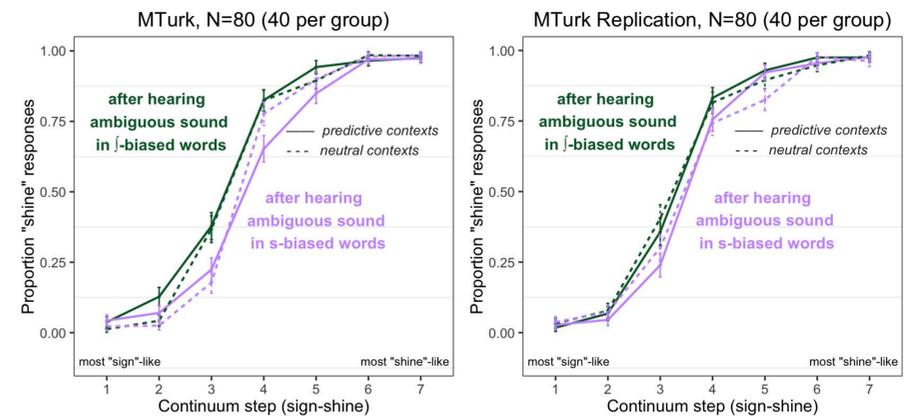
*My ballpoint pen ran out of ink when I was halfway through writing the word... epi?ode*



Robust learning also occurred following auditory sentence contexts, but the magnitude of learning was not modulated by how predictive the context was.

## Experiment 3: Written sentence contexts

Sentence contexts did not include /s/ or /f/ but did include other fricatives (e.g., /z/). **Auditory exposure to unaltered fricatives in Exp. 2 may have diminished learning overall**<sup>3</sup>, potentially obscuring group differences. In Exp. 3, we thus used written contexts (presented via self-paced reading) that preceded each auditory target.



In an initial sample, we found larger learning effects for participants who read predictive contexts (solid lines) than those who read neutral contexts (dashed lines). However, this effect **did not replicate** in an identical replication study.

Learning also occurred after written sentences, but the extent of learning was **not consistently modulated** by how predictive the sentence was.

## Discussion

- Across all experiments, we achieved **robust perceptual learning** after using a semantic categorization task at exposure, consistent with work indicating that perceptual learning can be elicited by myriad exposure tasks.<sup>4</sup>
- However, the extent of perceptual learning was **not reliably modulated by the predictive power of preceding sentence context**. Note that in the current study, listeners could use lexical information alone to resolve the identity of an ambiguous phoneme (e.g., *epi?ode*).
- Previous work has shown that a biasing sentence context can guide perceptual learning, but in that study, listeners needed to use sentence information to resolve phoneme identity, since ambiguous phonemes were encountered in contexts where lexical information could not disambiguate phoneme identity (e.g., [s/f]in).<sup>5</sup>

If lexical knowledge is sufficient to resolve the identity of an ambiguous phoneme, listeners may not rely strongly on sentence-level context to guide learning.

- One other potential limitation is that in the present study, listeners never heard nonwords, and all speech was presented without background noise. Such conditions may have led to relatively strong levels of learning overall<sup>6,7,8</sup>, potentially obscuring group differences in the size of the learning effect.

## Acknowledgements

This work was supported by an NSF Graduate Research Fellowship to SL as well as by NIH R01 DC013064 (E.B.M., PI), NSF IGERT grant DGE-1144399 (J.S.M., PI), NSF Research Traineeship grant (NRT) IGE1747486 (J.S.M., PI), and NSF 1754284 (J.S.M., PI).

<sup>5</sup>Jesse, A., & Laakso, S. (2015). Sentence context can guide the retuning of phonetic categories to speakers. *Poster Presented at the 56th Annual Meeting of the Psychonomic Society*.  
<sup>6</sup>Davis, M. H., Ford, M. A., Kherif, F., & Johnsruide, I. S. (2011). Does semantic context benefit speech understanding through "top-down" processes? Evidence from time-resolved sparse fMRI. *Journal of Cognitive Neuroscience*, 23(12), 3914–3932.  
<sup>7</sup>Scharenborg, O., & Janse, E. (2013). Comparing lexically guided perceptual learning in younger and older listeners. *Attention, Perception, & Psychophysics*, 75(3), 525–536.  
<sup>8</sup>Zhang, X., & Samuel, A. G. (2014). Perceptual learning of speech under optimal and adverse conditions. *Journal of Experimental Psychology: Human Perception and Performance*, 40(1), 200–217.