Lexical retuning is not the same as audio-visual retuning: the former generalizes better

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Scott Nelson

Michigan State University

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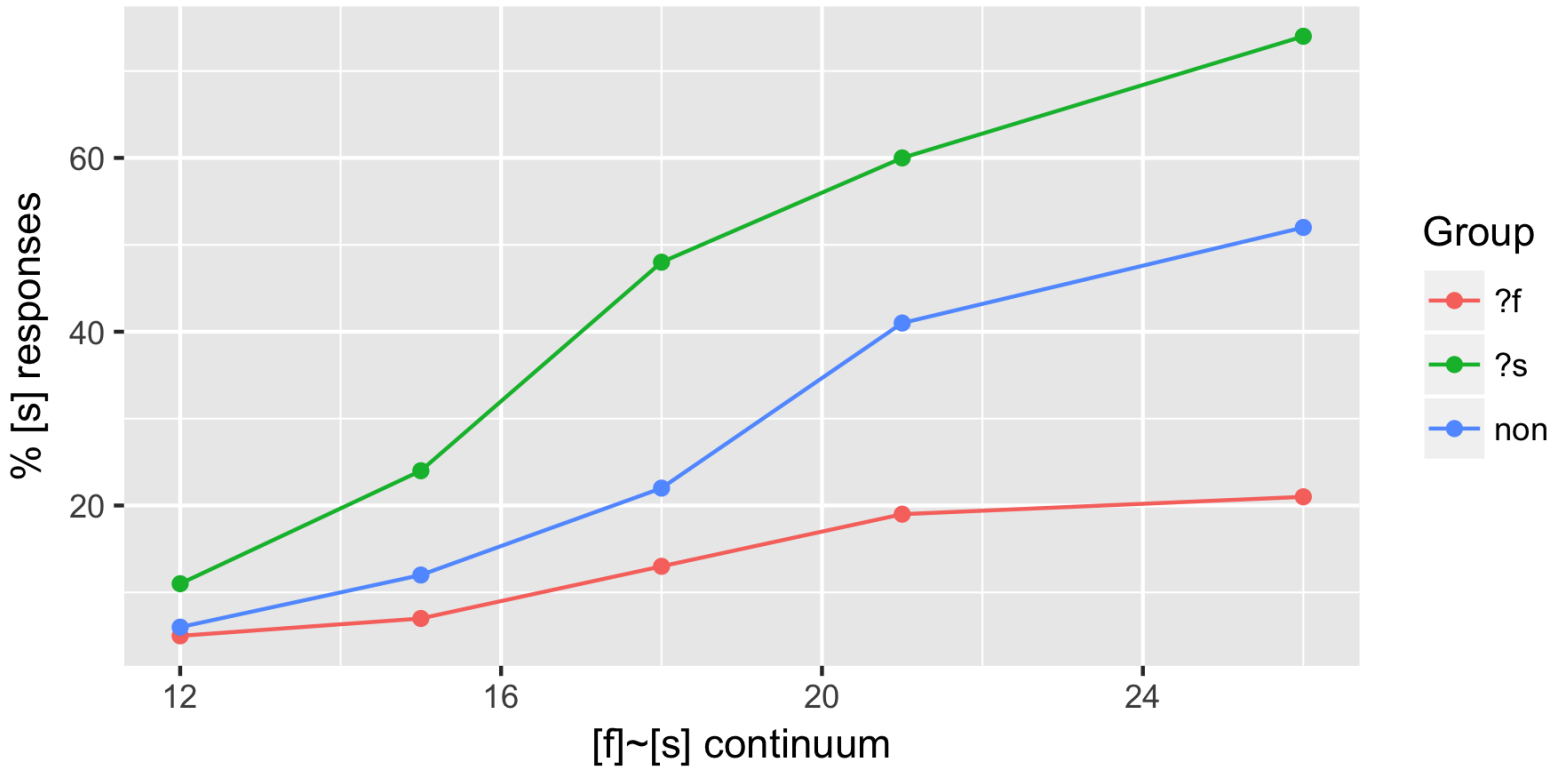
Perceptual Retuning & Re-Calibration

- How does the perceptual system interpret ambiguous input?
- This has been tested using two different methods:
  - Lexical retuning (Norris et al., 2003).
  - Audiovisual re-calibration (Bertelson et al., 2003).
- Van Linden and Vroomen (2007) argue that these elicit the same type of perceptual effect.
- Is this actually the case?
- Before answering this question, I will briefly go over all three of these studies.

Lexical Retuning (Norris et al., 2003)

- [f] $\sim$ [s] continuum.
- LDT followed by phonetic categorization.
  - LDT contains non-minimal pair words containing /f/ or /s/ replaced by [?$_{fs}$].
  - Listeners exploit their lexical knowledge (Ganong, 1980) for identification.
- Listeners identification function shifted depending on which segment contained [?$_{fs}$].

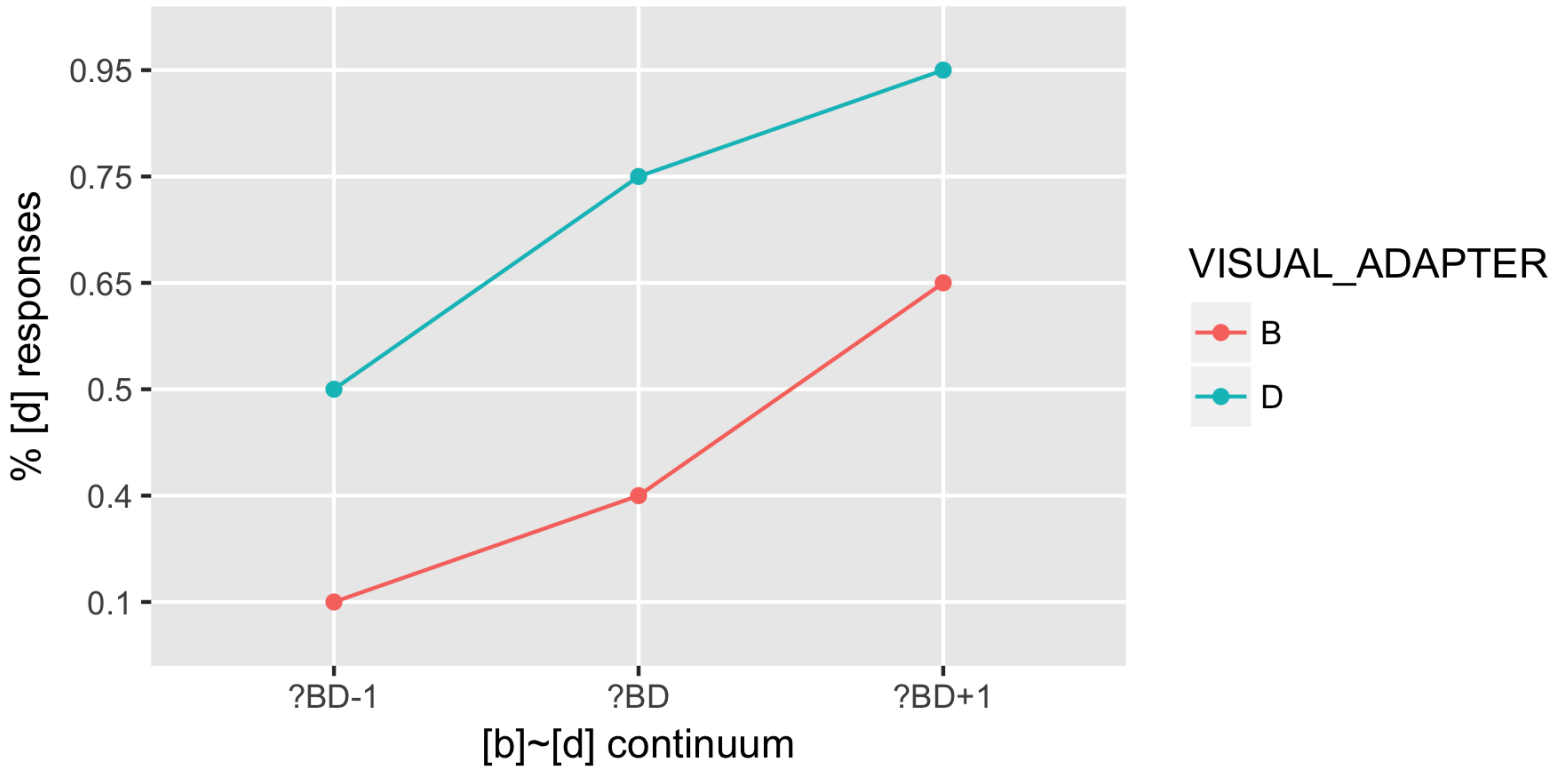
Lexical Retuning (Norris et al., 2003)



Audio-Visual Recalibration (Bertelson et al., 2003)

- [b] $\sim$ [d] continuum.
- Audio-visual presentation of stimuli followed by phonetic categorization.
  - Audio presentation was an /ɑCɑ/ string with the consonant segments replaced by [?$_{bd}$].
  - Visual presentation was either /ɑbɑ/ or /ɑdɑ/.
  - The visual cue biases the identification of the audio stimuli (McGurk and MacDonald, 1976).
- Listeners identification function shifted depending on which visual cue they were presented during training.

Audio-Visual Recalibration (Bertelson et al., 2003)



Comparison of Paradigms

- Comparison of Lexical retuning and Audio-visual retuning (Van Linden and Vroomen, 2007):
  - [t] $\sim$ [p] continuum.
  - 5 experiments showing lexical retuning and audio-visual recalibration are similar.
- However there's some evidence that the two paradigms are different:
  - Lexical retuning supports generalization across syllabic position (Jesse and McQueen, 2011).
  - Audio-visual recalibration is strongly contextually bound (Reinisch et al., 2014).

Differences

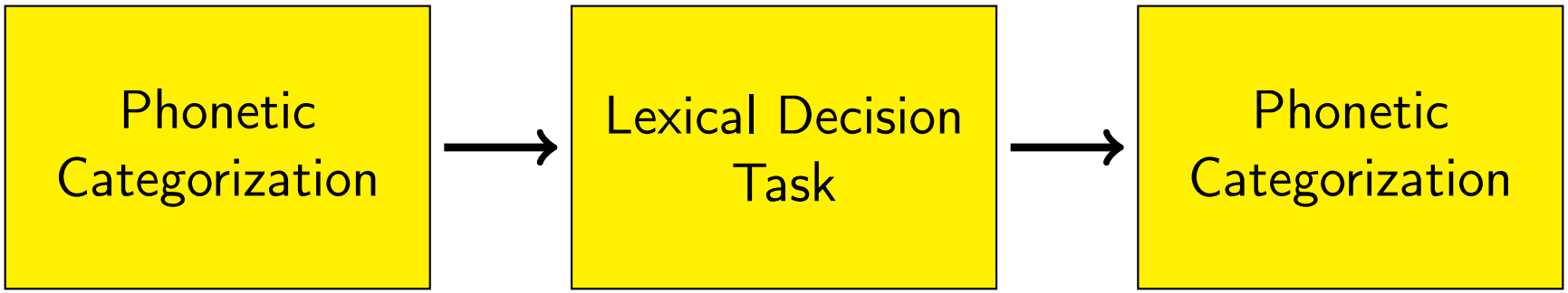
- There are difference between the two paradigms.
- What about stimulus variation within each paradigm?
  - Audio-visual recalibration presents the same string (typically VCV) continuously.
  - Lexical retuning presents multiple, unique words during the LDT.
- What would happen if you removed the within-experiment stimulus variation found in lexical retuning experiments?

Two New Experiments

- Today I will report on two experiments:
  1. Experiment 1: Can the lexical retuning effect generalize to new phonological environments?
  2. Experiment 2: Does the size of the lexical retuning effect decrease if you remove the stimulus variation?

General Experiment Design

- The addition of a pre-LDT phonetic categorization allows for a within-subject analysis.
- Comparing before/after results.



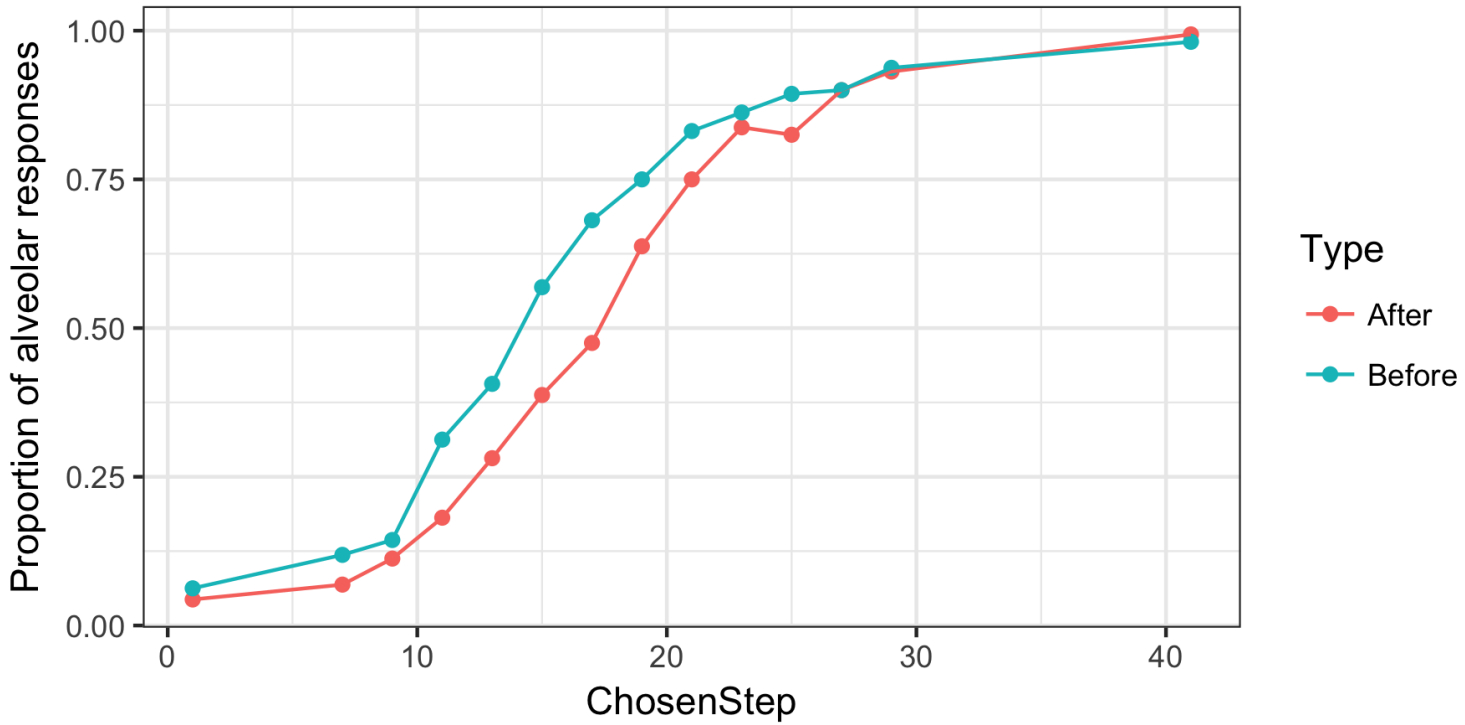
General Experiment Design

- A 14-step continuum was created:
  - Blended fricative portions of [fɑ] and [sɑ] tokens.
  - Fricative continuum spliced onto [ɑ] taken from [fɑ] token.
- This was pre-tested on 12 native English speakers using a 2AFC task.
  - "f" or "s"?
  - Each step presented four times each in random order.
- Ambiguous midpoint used as [?$_{fs}$] in /f/ words for lexical decision task.
- The pre-test design was used as the phonetic categorization task for all experiments.

Experiment 1

- Lexical decision task:
  - 150 words total.
  - 34 total training words containing /f/ or /s/ (17 of each segment; non-minimal pairs).
  - All training words were positioned next to [i] or [ɪ] (13 onset).
    - e.g. - “fiend” & “seek”
  - Remaining 116 words were filler (75 phonotactically licit English nonce words; no instances of /f s v z/)

Experiment 1 - Results

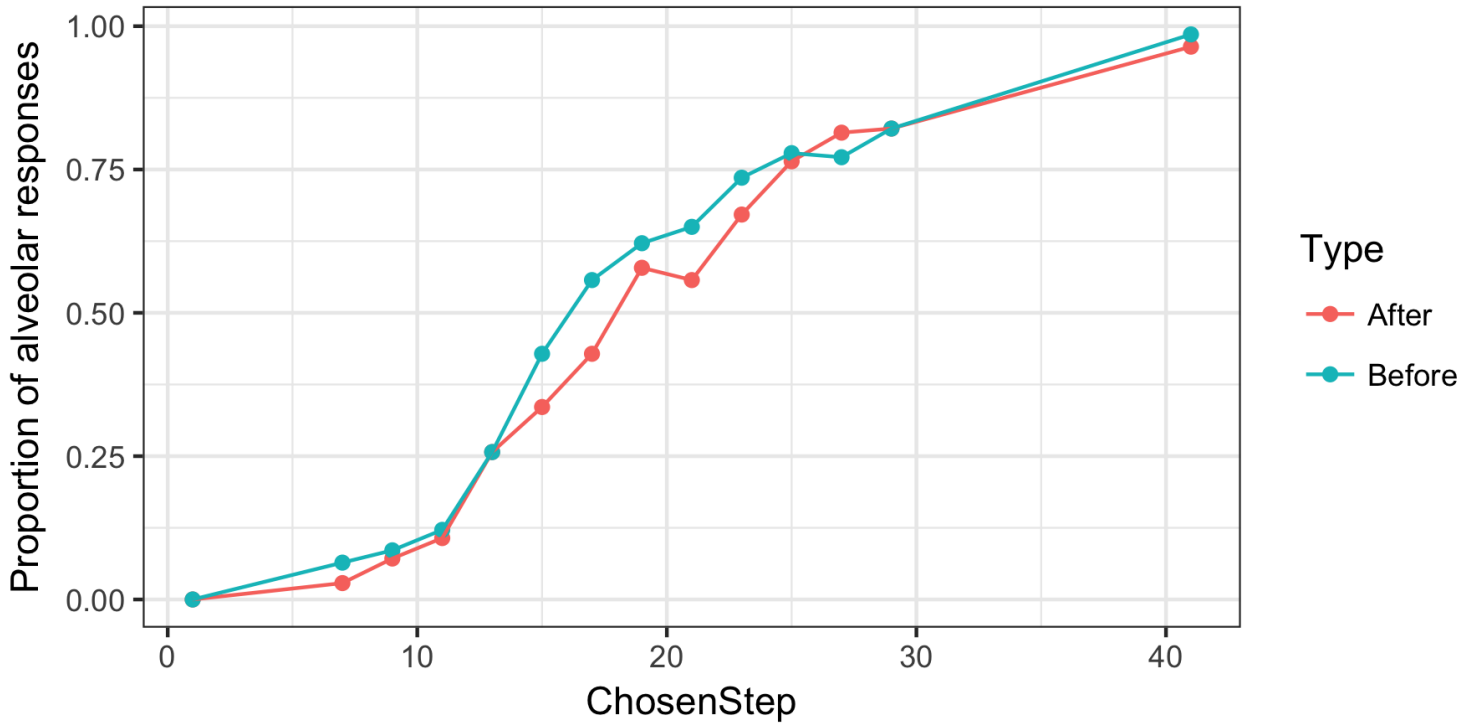


- 41 native English speakers participated (1 removed from analysis).
- 7.3% reduction of alveolar ("s") responses from before to after.
- A one-tail paired Welch test showed that there was a statistically significant decrease in alveolar responses [$t(39)=-5.51, p<0.001$].

Experiment 2

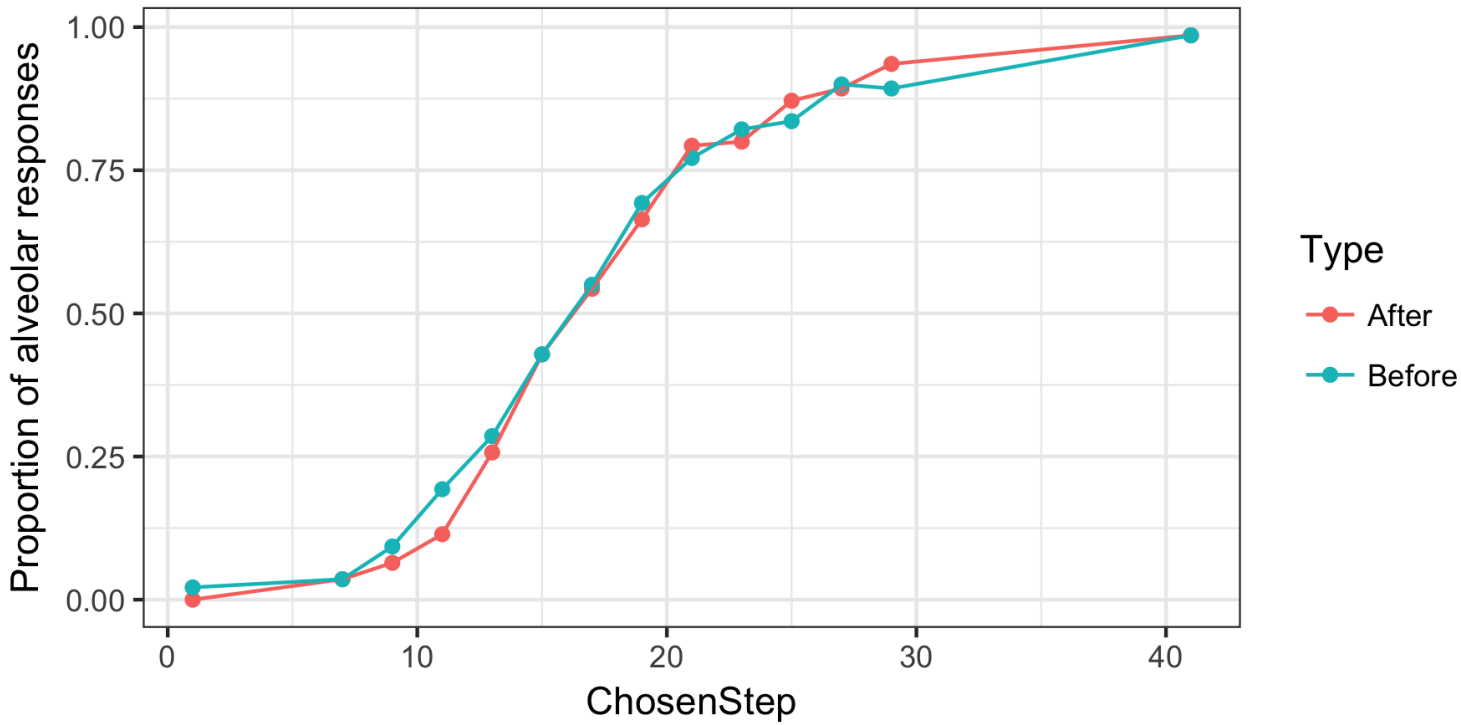
- Lexical decision task:
  - 8 words total (sampled from previous experiment's LDT).
  - Repeated each word 17 times.
  - Only two training words (one of each segment)
    - "female" & "seated"
    - Therefore no stimulus variation for /f/ or /s/.
  - Remaining 6 words were filler (4 phonotactically licit English nonce words; no instances of /f s v z/)

Experiment 2 - Results



- 37 native English speakers participated (2 removed from analysis).
- 3.4% reduction of alveolar ("s") responses from before to after.
- A one-tail paired Welch test showed a statistically significant decrease in alveolar responses [$t(34)=-2.75, p<0.01$].
- However, the magnitude of the effect in Experiment 2 was smaller than in Experiment 1 [$t(67.06)=2.27, p=0.027$].

Experiment 3 (a new control) - Results



- No [?$_{fs}$] in LDT.
- No difference.

Summary of Results

- Results from Experiment 1 suggest lexical retuning allows for generalization across phonological environments.
  - This result challenges previous findings in the literature (Van Linden and Vroomen, 2007; Reinisch et al., 2014).
- Results from Experiment 2 suggest that the number of unique stimuli used in the training set may play a role in the ability to generalize, but is not required.
  - This aspect of the difference between lexical retuning and audio-visual recalibration has been under explored to the best of my knowledge.

Conclusion

- Lexical retuning has shown the ability to generalize time and again:
  - Features (Kraljic and Samuel, 2006; Durvasula and Nelson, 2018)
  - Syllabic Position (Jesse and McQueen, 2011)
- It is misleading to label lexical retuning and audio-visual recalibration as parts of the same general speech perception mechanism.
  - Presence/Absence of generalization cannot simply be reduced to presence/absence of variability within the training stimuli.
  - Making general claims about pre-lexical processing using auditory recalibration should be avoided.

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Selected References

Bertelson, P., Vroomen, J., and De Gelder, B. (2003). Visual recalibration of auditory speech identification: a mcgurk aftereffect. Psychological Science, 14(6):592–597.

Durvasula, K. and Nelson, S. (2018). Lexical retuning targets features. In Proceedings of the Annual Meetings on Phonology, volume 5.

Ganong, W. F. (1980). Phonetic categorization in auditory word perception. Journal of experimental psychology: Human perception and performance, 6(1):110.

Jesse, A. and McQueen, J. M. (2011). Positional effects in the lexical retuning of speech perception. Psychonomic Bulletin & Review, 18(5):943–950.

Kraljic, T. and Samuel, A. G. (2006). Generalization in perceptual learning for speech. Psychonomic bulletin & review, 13(2):262–268.

McGurk, H. and MacDonald, J. (1976). Hearing lips and seeing voices. Nature, 264(5588):746–748.

Norris, D., McQueen, J. M., and Cutler, A. (2003). Perceptual learning in speech. Cognitive Psychology, 30(2):1113–1126.

Reinisch, E., Wozny, D. R., Mitterer, H., and Holt, L. L. (2014). Phonetic category recalibration: What are the categories? Journal of phonetics, 45:91–105.

Van Linden, S. and Vroomen, J. (2007). Recalibration of phonetic categories by lipread speech versus lexical information. Journal of Experimental Psychology: Human Perception and Performance, 33(6):1483.