Lexically-guided and distributional learning for speech in younger and older adults

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Introduction

- Perceptual flexibility is an important aspect of successful speech perception
- Older adults (OA) have been shown to remain flexible when perceiving ambiguous speech in a lexically-guided learning paradigm [1]
  - OA are known to take greater advantage of context [2] and show larger lexical effects [3] when processing speech
- Younger adults (YA) will adapt after exposure to a distribution of ambiguous tokens, with no additional lexical information ([4]; for example)
  - OA may not remain flexible in the absence of helpful lexical or contextual information
- Various cognitive tasks have been linked to perceptual learning performance in YA (e.g., vocabulary size [5]) or OA (e.g., attention-switching control [6])

Research Questions

1. Do older adults remain perceptually flexible when lexical context is not available?
2. Does performance in one perceptual learning task predict learning in the other?
3. What cognitive factors influence perceptual flexibility? Are they different across age groups?

Methods

Participants

- Older adults: n=27; ages 63-86 (M = 68.7)
- Younger adults: n = 31; ages 18-29 (M = 20.7)

Procedure

Pretest

2AFC categorization of /ɛd/ - /ɪd/ continuum
- 5-step continuum x 6 repetitions = 30 trials

Exposure

Lexically-guided

Lexical Decision Task
- 20 ambiguous target words
- 20 control target words
- 60 fillers
- 100 nonwords

E.g., amb ɛ group hears only words with ambiguous /ɛ/ and only clear /ɪ/ (see Figure 1)

Distributional

2AFC Task
- 2 Distributions arranged to shift category boundary
- 528 trials

E.g., amb ɪ group hears only ambiguous tokens of /ɪ/ and only clear /ɛ/ (see Figure 2)

Exposure Condition	/ɛ/	/ɪ/
Amb ɛ	h?n	brick
Amb ɪ	hen	br?ck

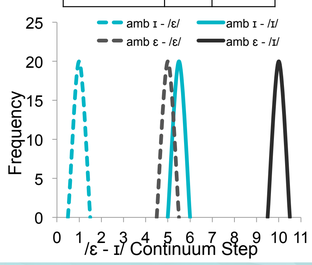


Figure 1. Distribution of targets for exposure phase of lexically-guided learning task.

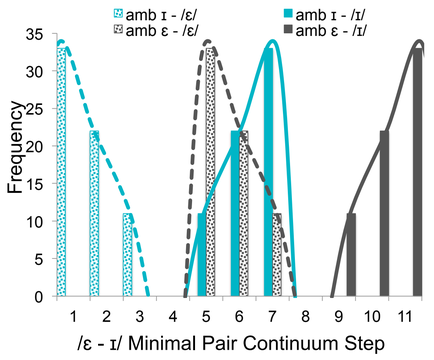


Figure 2. Distribution of tokens for exposure phase of distributional learning task.

Posttest

2AFC categorization of /ɛd/ - /ɪd/ continuum
- 5-step continuum x 6 repetitions x 3 blocks = 90 trials

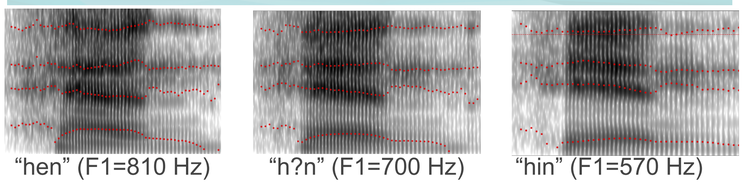
Stimuli

- Endpoints of continua recorded by 2 speakers (1 male, 1 female)

Lexically-guided Learning
- 40 word-nonword continua
  - 20 word-medial /ɛ/ words; 20 word-medial /ɪ/ words (E.g., **chest-chist, dish-desh**)

Distributional Learning
- 11 minimal pair continua from /ɛ/ - /ɪ/ (E.g., **bed-bid, mess-miss**)
- Continua made in Tandem STRAIGHT [7]

Example endpoints and ambiguous target for lexically-guided task.

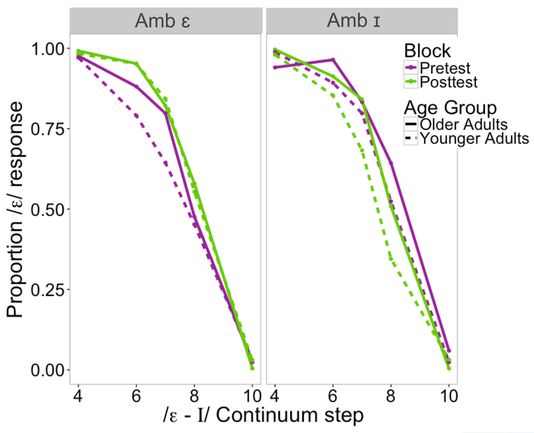


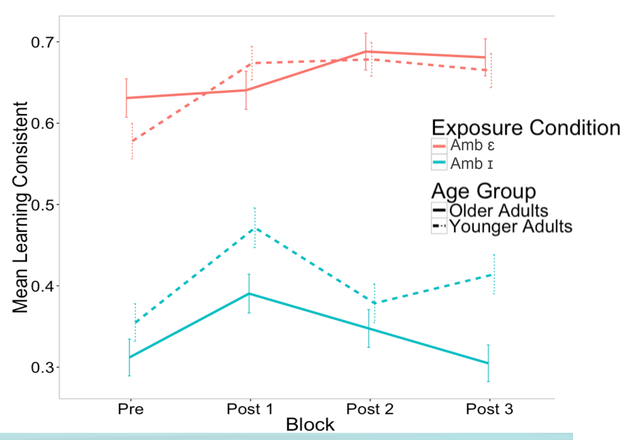
"hen" (F1=810 Hz) "h?n" (F1=700 Hz) "hin" (F1=570 Hz)

Results

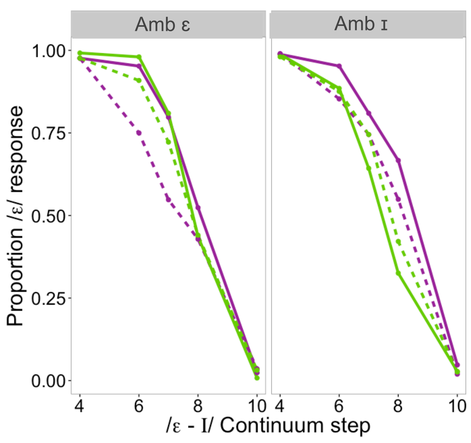
- Mixed effects logistic regression on pre- and posttest categorization data
- Effect of Block (Pre vs. Post) significant for both learning tasks (Distributional: β = 0.72, p<0.001; Lexically-guided: β = 0.63, p<0.001)
- Significant Block x Age group x Exposure interaction (Distributional: β = 1.01, p=0.03; Lexically-guided: β = -2.33, p<0.001)

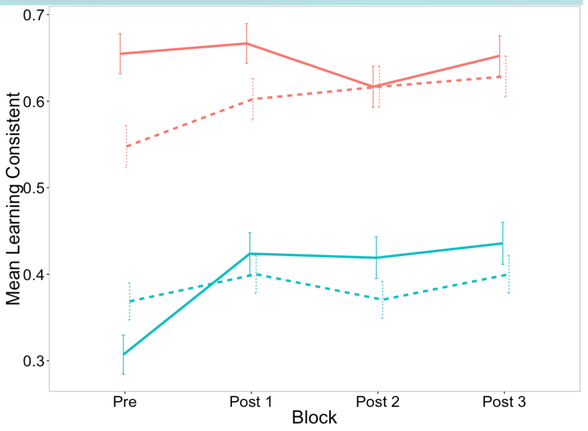
Distributional Learning





Lexically-guided Learning

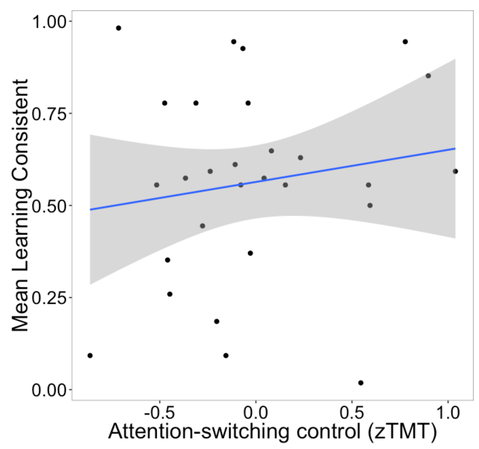




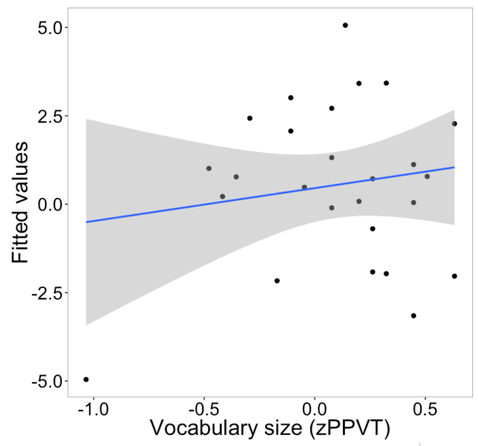
Individual Differences in OA

- Investigate role of attention-switching control, working memory, vocabulary size, hearing sensitivity on 2 types of perceptual learning
- Mixed effects logistic regression on pre- and posttest categorization data for only most ambiguous steps of continuum

Lexically-guided Learning

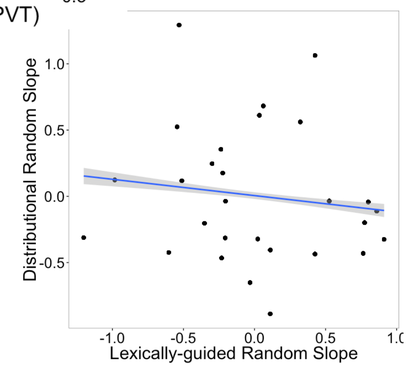


- Poorer attention switching = more learning consistent behaviour (β = 0.90, p=0.03)
- Replicate results of [6]



- Larger vocabulary = more learning consistent behaviour (β = 1.4, p=0.003)
- Extend results of [5] to OA

- No relationship between learning in distributional and lexically-guided tasks (β = -0.04, p=0.91)



Conclusion

- Older adults remain perceptually flexible even in the absence of helpful lexical or contextual information
- Poorer attention-switching control and larger vocabularies are linked to better flexibility in OA
  - Focusing attention on signal is detrimental to perceptual learning [8] versus maintaining task-level attention
  - Increased lexical connections may facilitate use of top-down knowledge for learning
- No relationship between performance in lexically-guided learning and distributional learning, despite similar underlying learning mechanism

References

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