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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

- Do older adults remain perceptually flexible when lexical context is not available?
- Does performance in one perceptual learning task predict learning in the other?
- 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)

Stimuli

- Endpoints of continua recorded by 2 speakers (1 male, 1 female)
- Lexically-guided Learning**
 - 40 word-nonword continua
 - 20 word-medial /ε/ words; 20 word-medial /ɪ/ words (E.g., **chest-chist**, **dish-desh**)
- Distributional Learning**
 - 11 minimal pair continua from /ε/ - /ɪ/ (E.g., **bed-bid**, **mess-miss**)
 - Continua made in Tandem STRAIGHT [7]

Procedure

Pretest

- 2AFC categorization of /εd/ - /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 ε group hears only words with ambiguous /ε/ and only clear /ɪ/ (see Figure 1)

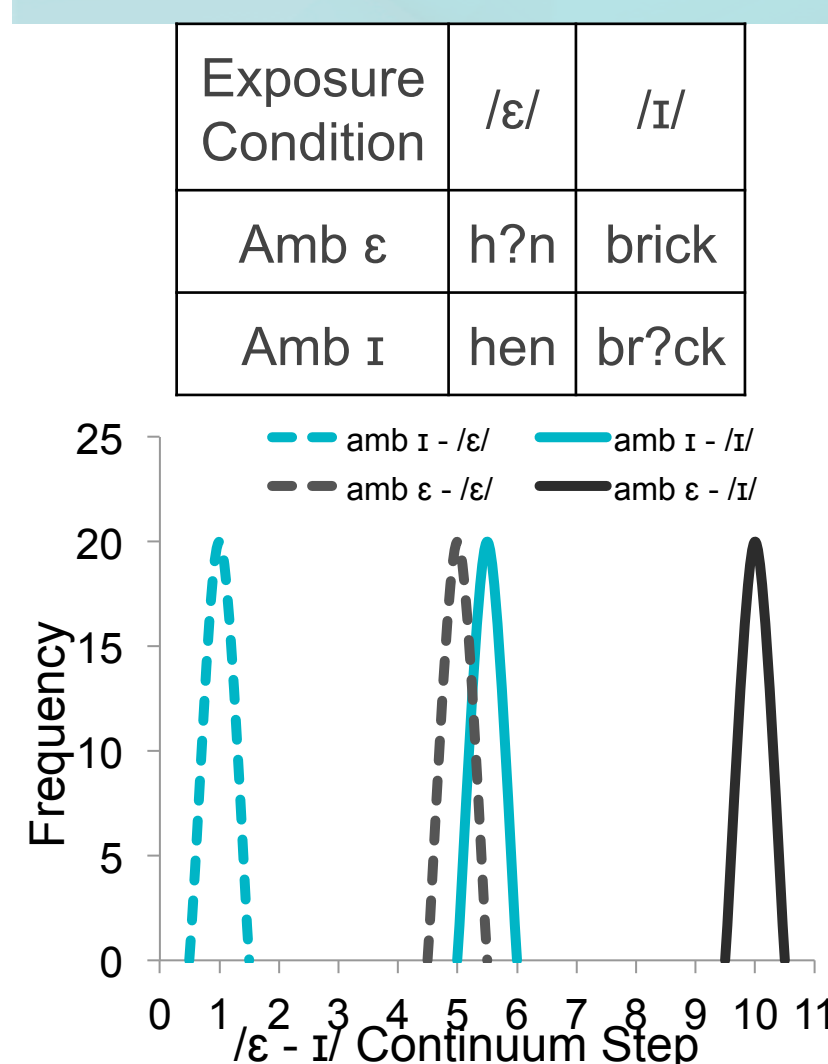


Figure 1. Distribution of targets for exposure phase of lexically-guided learning task.

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 /ε/ (see Figure 2)

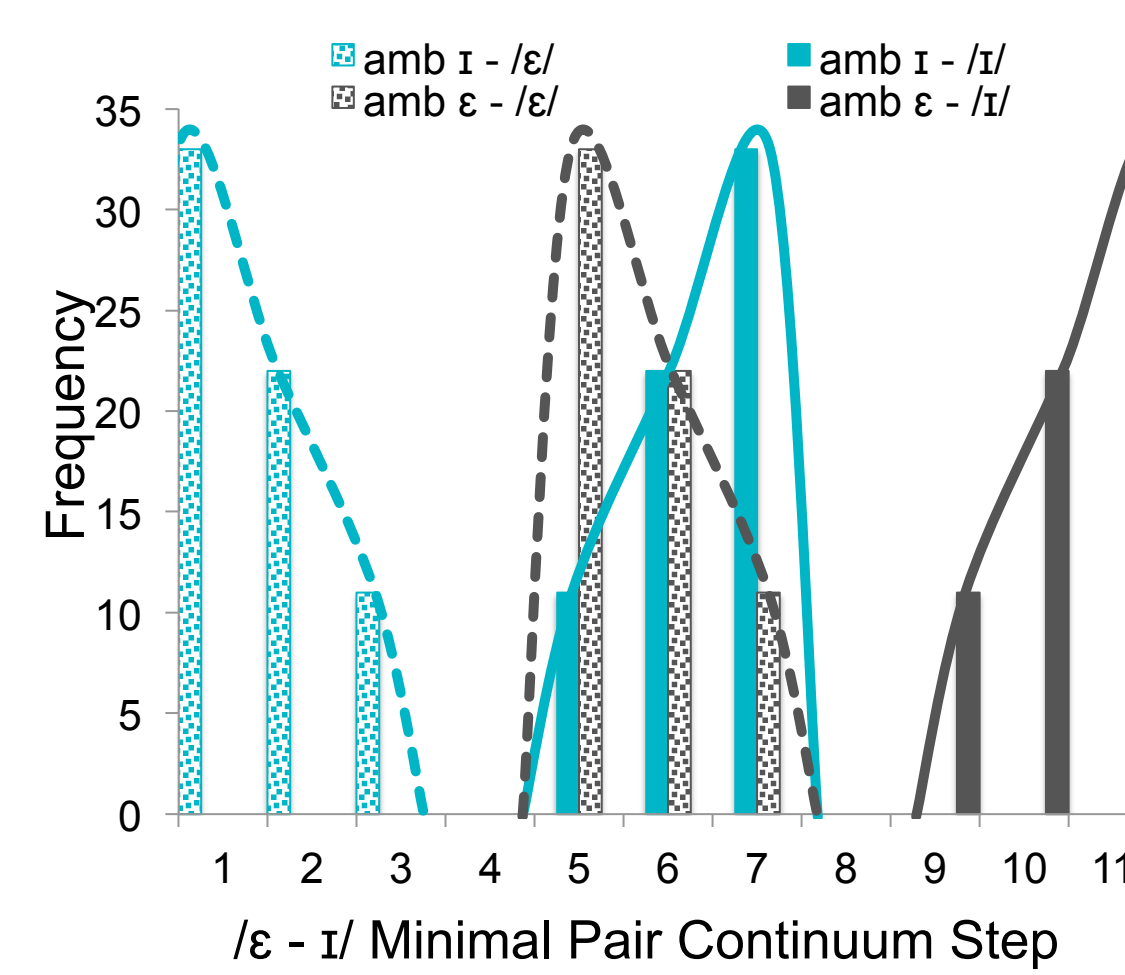
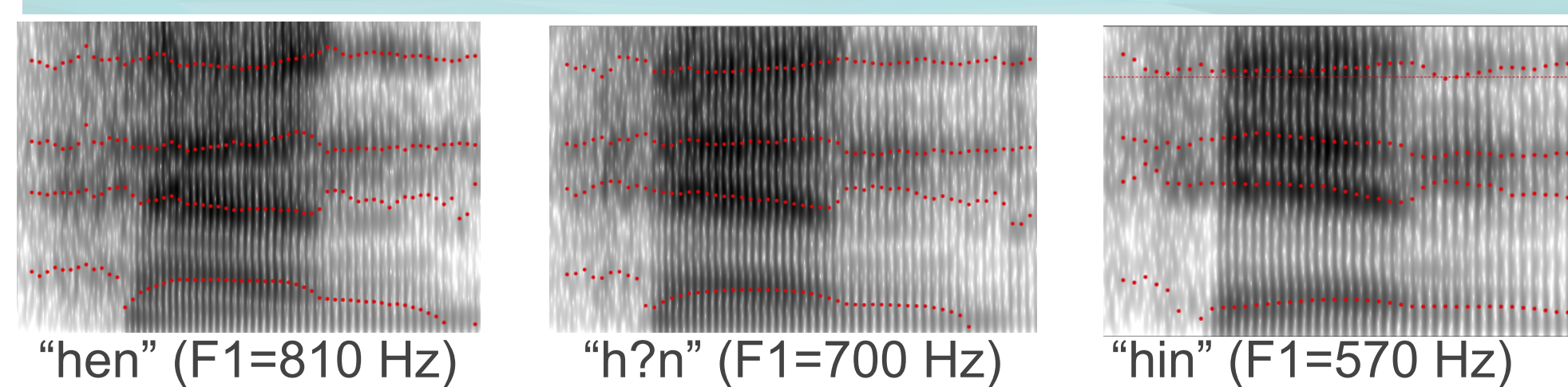


Figure 2. Distribution of tokens for exposure phase of distributional learning task.

Posttest

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

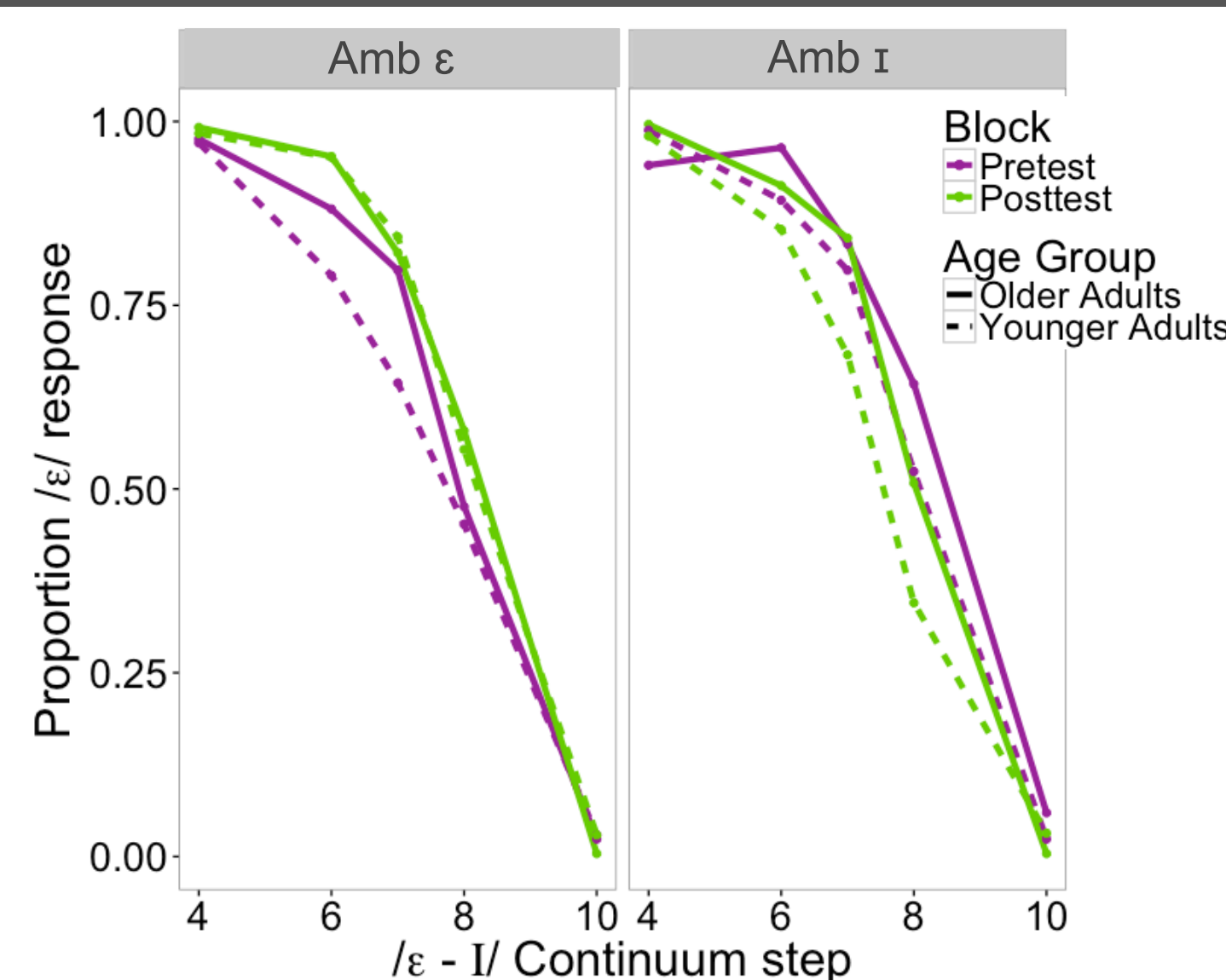
Example endpoints and ambiguous target for lexically-guided task.



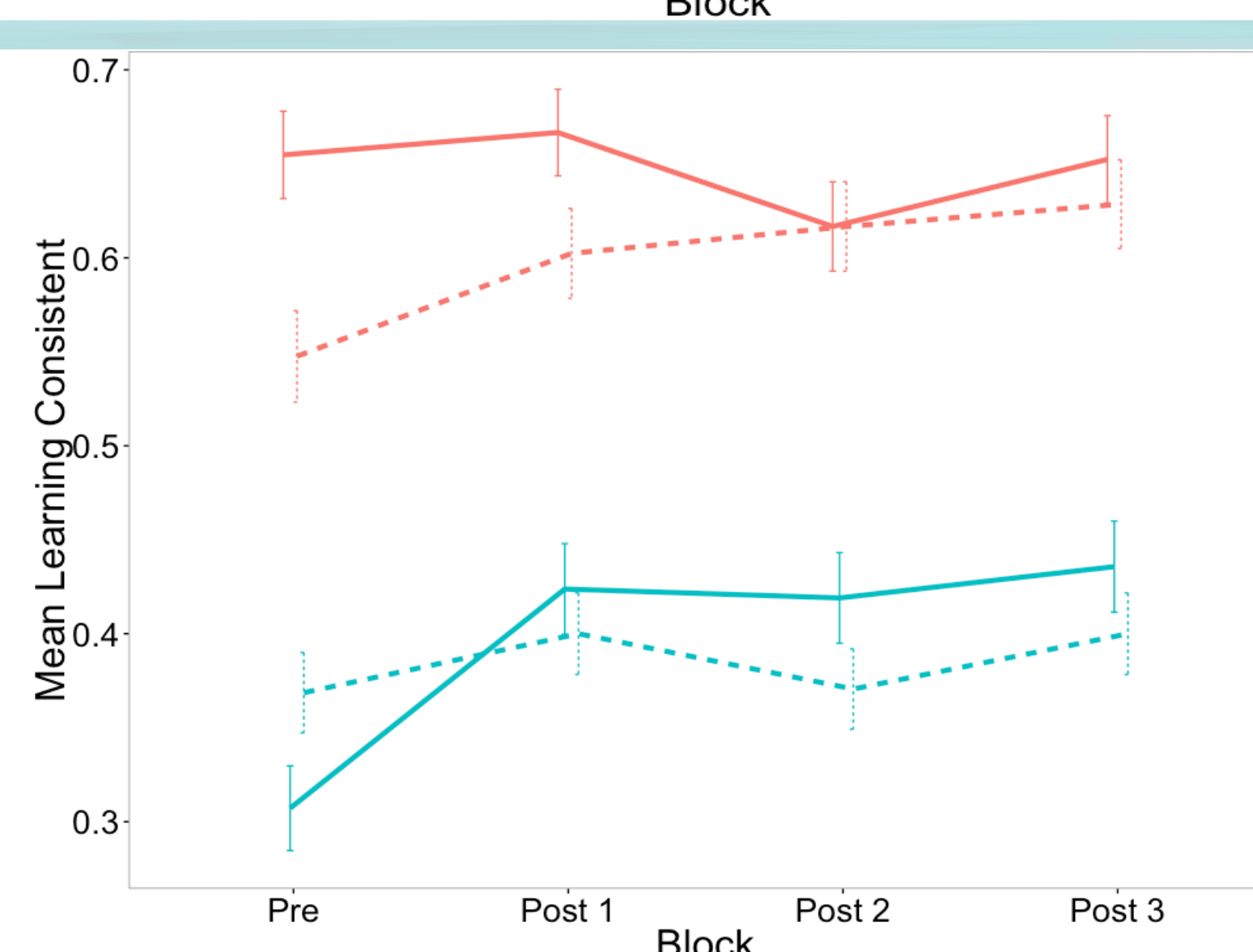
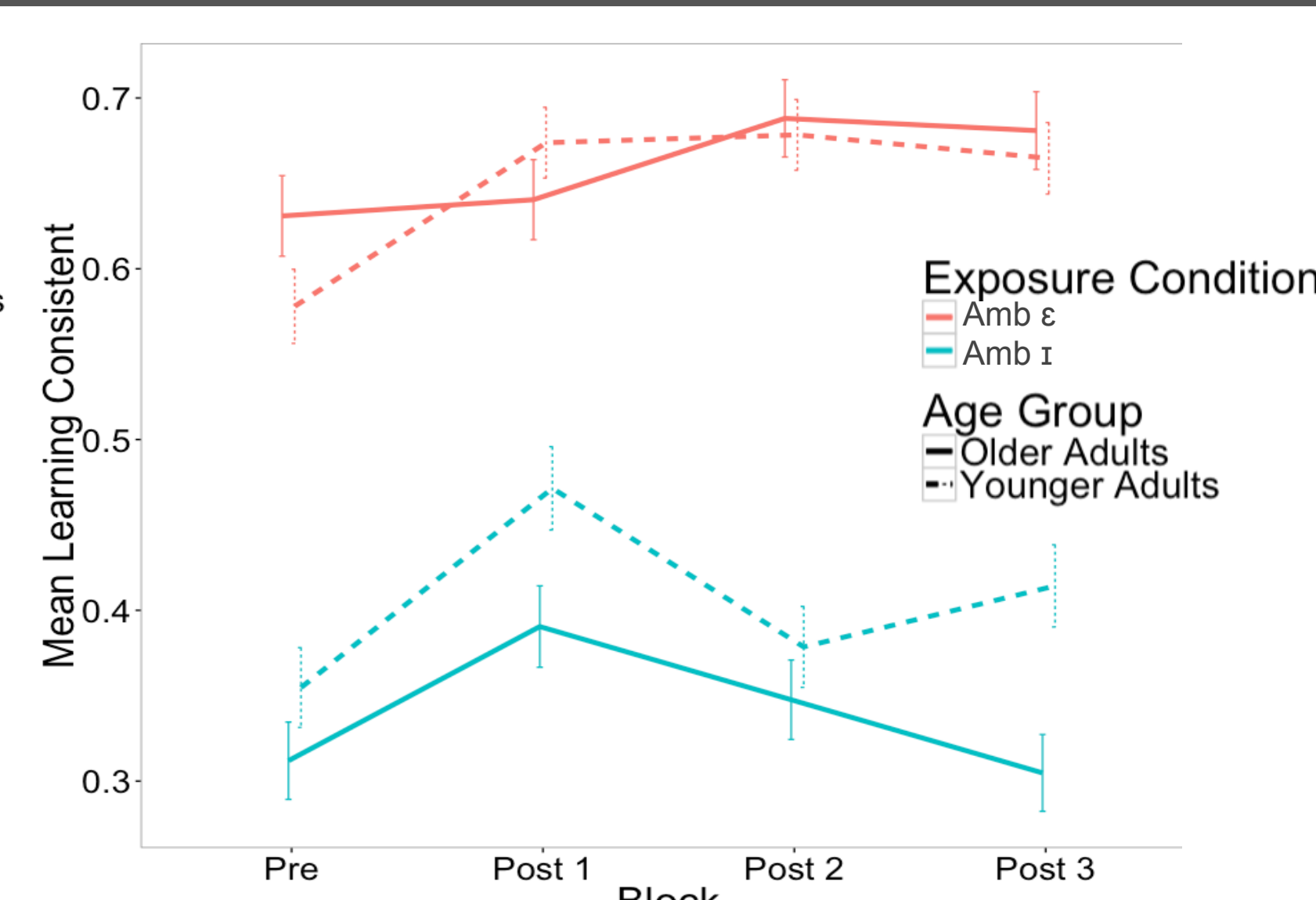
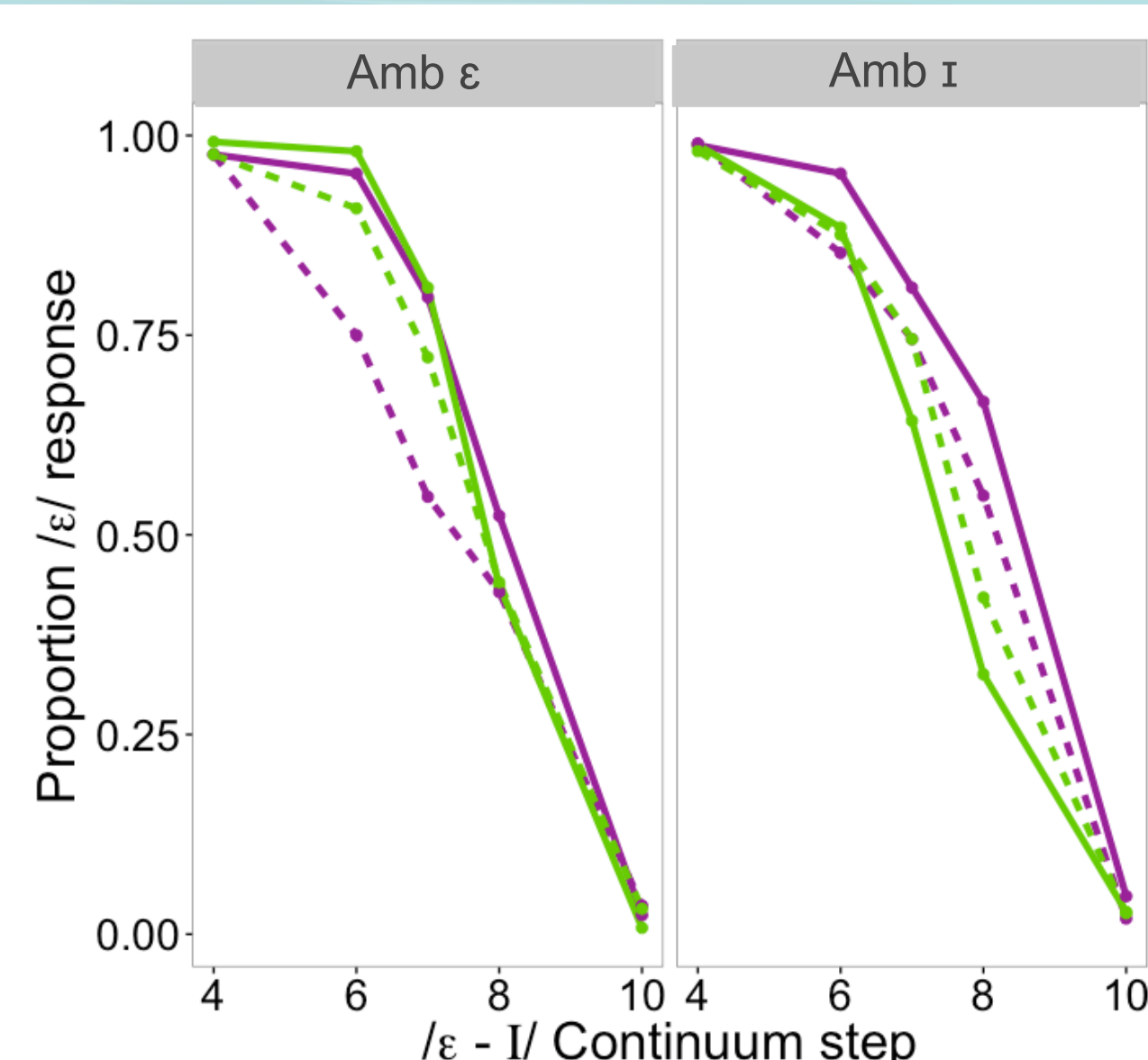
Results

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

Distributional Learning



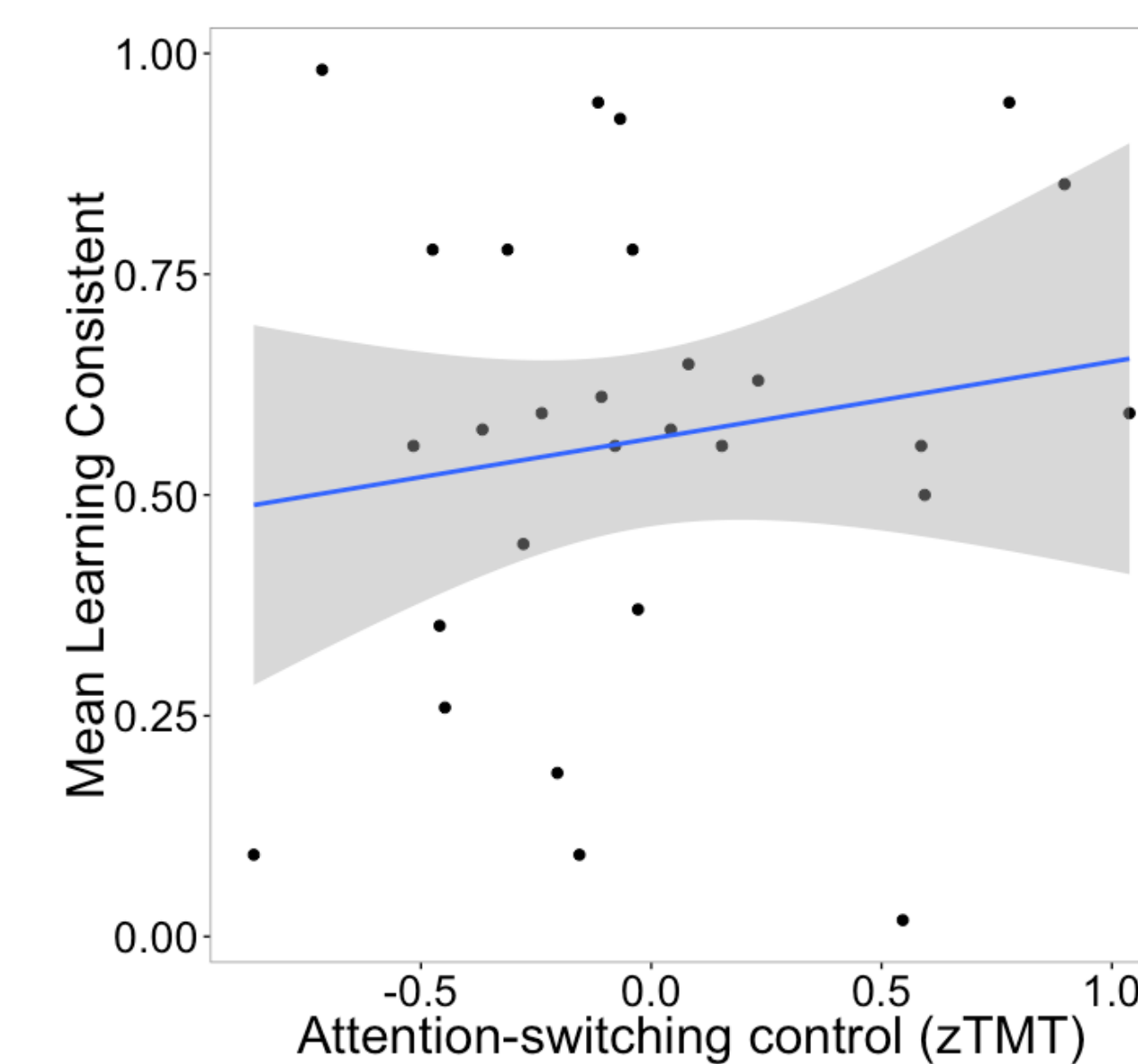
Lexically-guided Learning



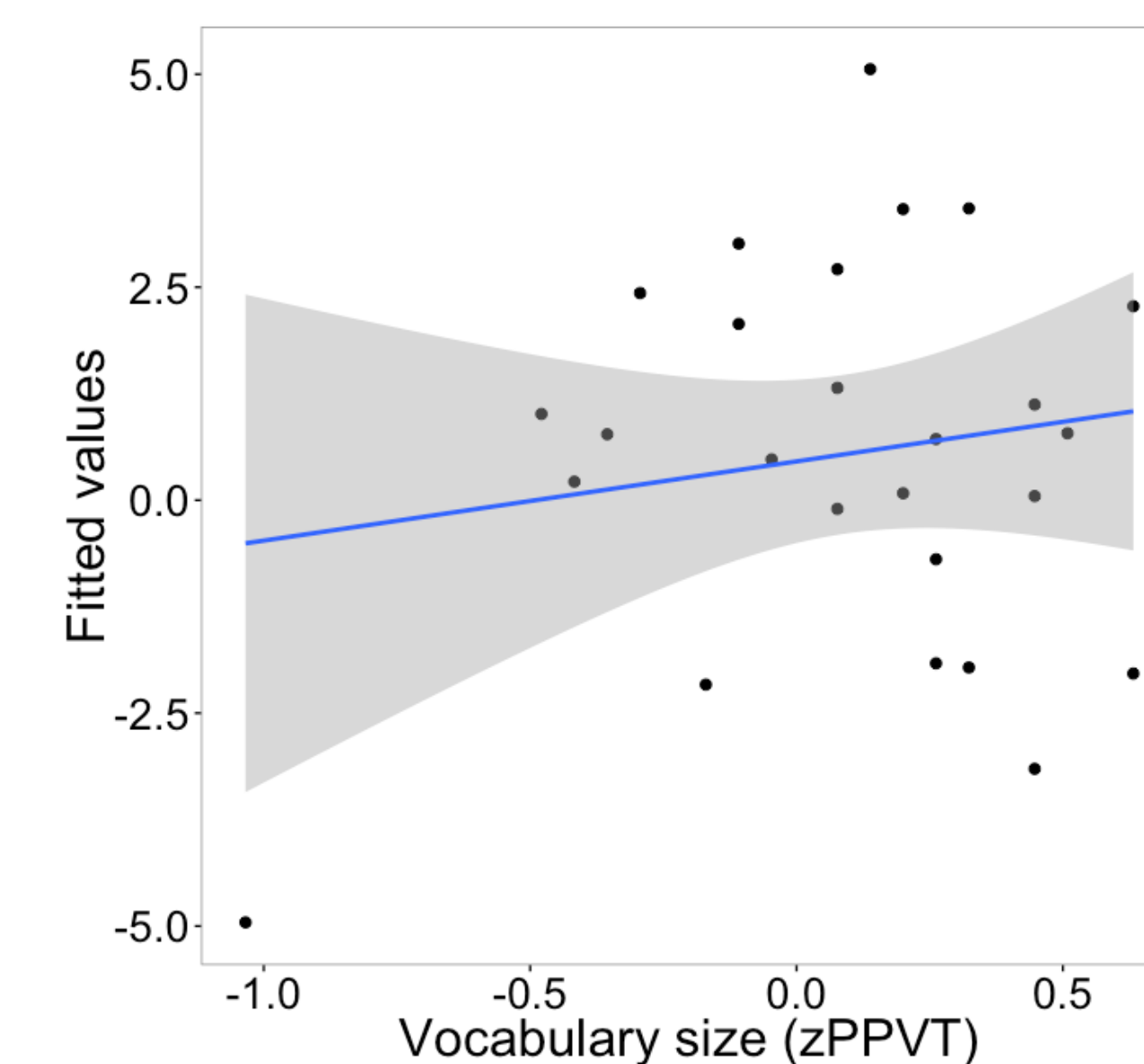
Individual Differences in OA

- 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

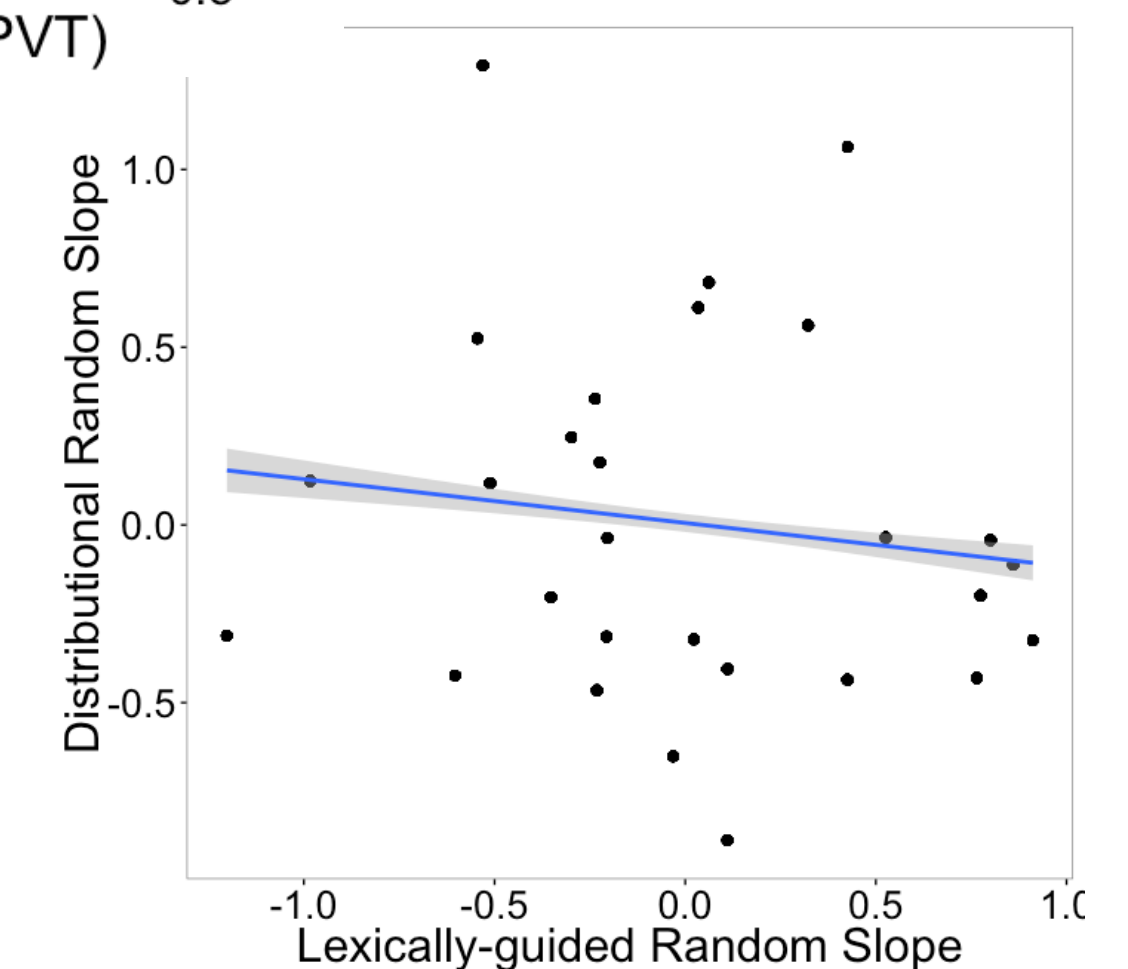


- Poorer attention switching = more learning consistent behaviour ($\beta = 0.90$, $p = 0.03$)
- Replicate results of [6]



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

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



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

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