Attention and salience in lexically-guided perceptual learning

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530 final presentation

Research Questions

- Listeners are constantly adapting to speech
- How automatic is this process?
- How context-independent or context-dependent is this process?

Outline

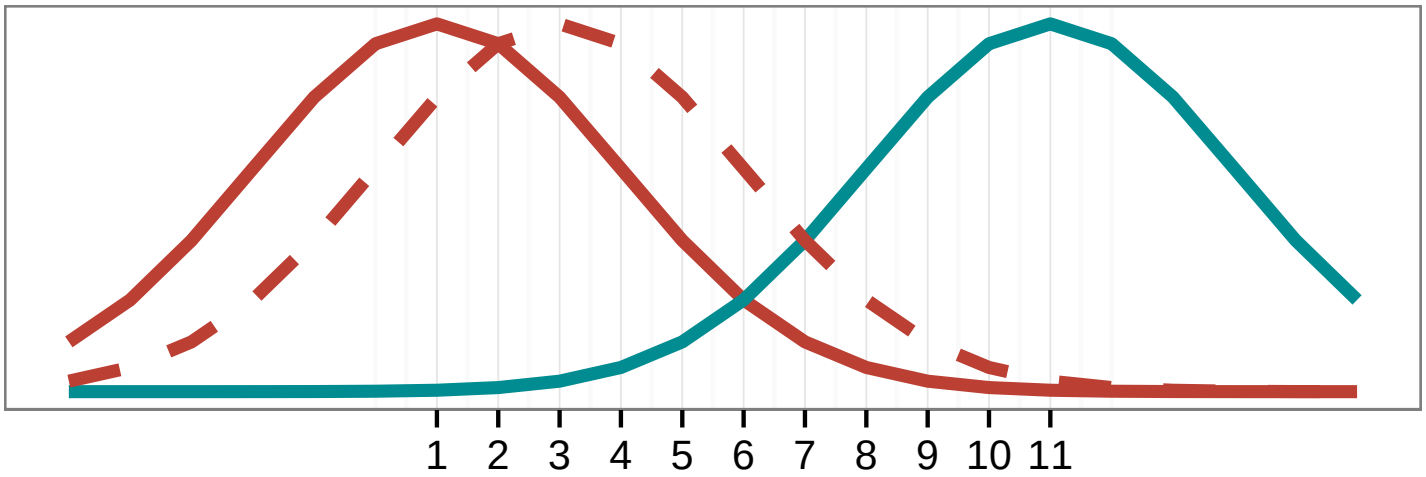
1. Background
2. Experiments
   - Experiment 1
   - Experiment 2
   - Experiment 3
3. Discussion

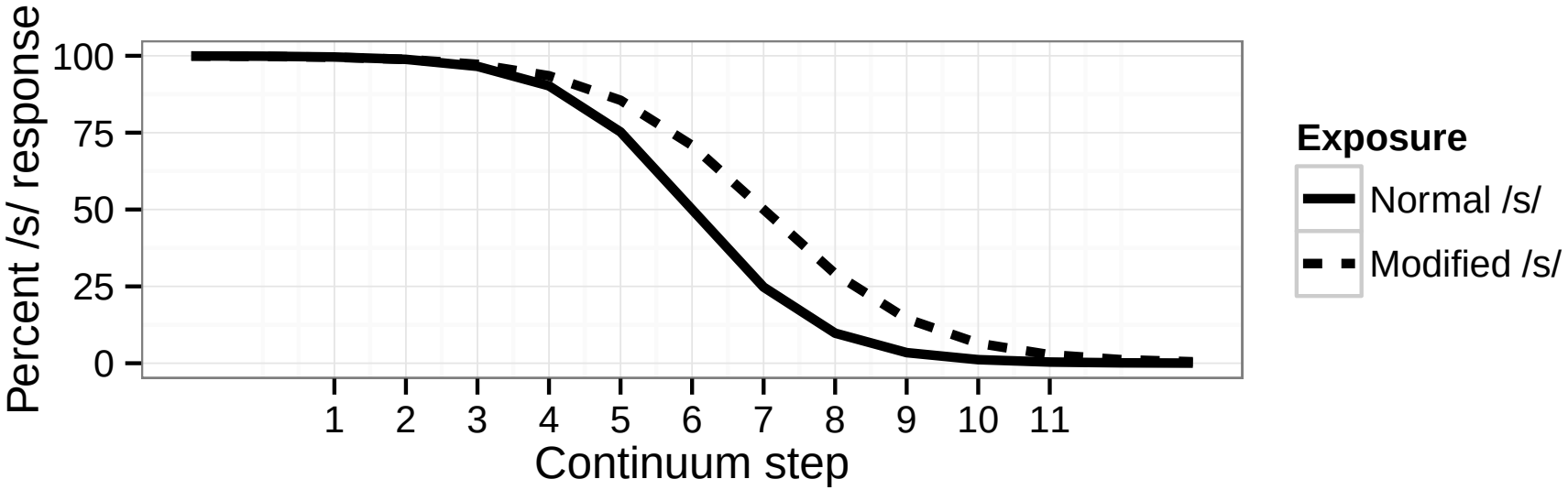
Definitions

Perceptual learning

- Psychophysics: updating of categories to reflect actual stimuli (Gibson, 1953)
- Speech perception: updating sound categories in response to exposure (Norris et al., 2003)

Perceptual learning





Definitions

Attention

- Selective attention to a particular sound category (/s/)
- Feature-based attention (as opposed to singleton-based attention)

Salience

- Linguistic: word-position or semantic predictability
- Signal/linguistic: category typicality (/s/-/ʃ/)

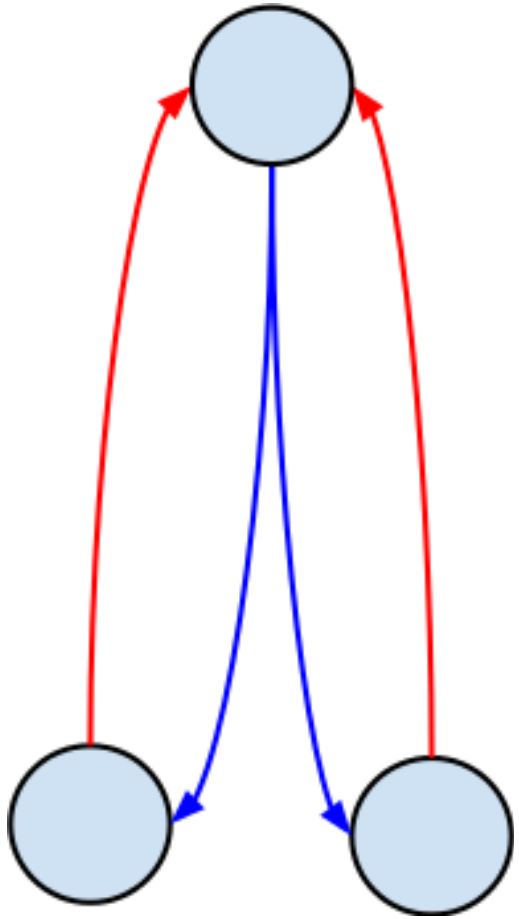
Attentional sets

- Comprehension-oriented attentional set
- Perception-oriented attentional set

Theoretical framework

Predictive coding model of the brain (Clark, 2013)

- Hierarchical
- Expectations propagate to lower levels
- Error signals from unmet expectations propagate to higher levels
- Similar computational models can account for perceptual learning (Kleinschmidt and Jaeger, 2011)



Attention in predictive coding

Clark (2013)

- Gain-based attention mechanism
  - Attention increases weight of error signals
  - Predicts greater updating of expectations when listeners attend to the signal

This dissertation

- Propagation-inhibiting attention mechanism
  - Attention resolves expectations at the attended level, inhibiting further propagation of error signals
  - Predicts that perception-oriented attentional sets will generalize less, showing smaller perceptual learning effects

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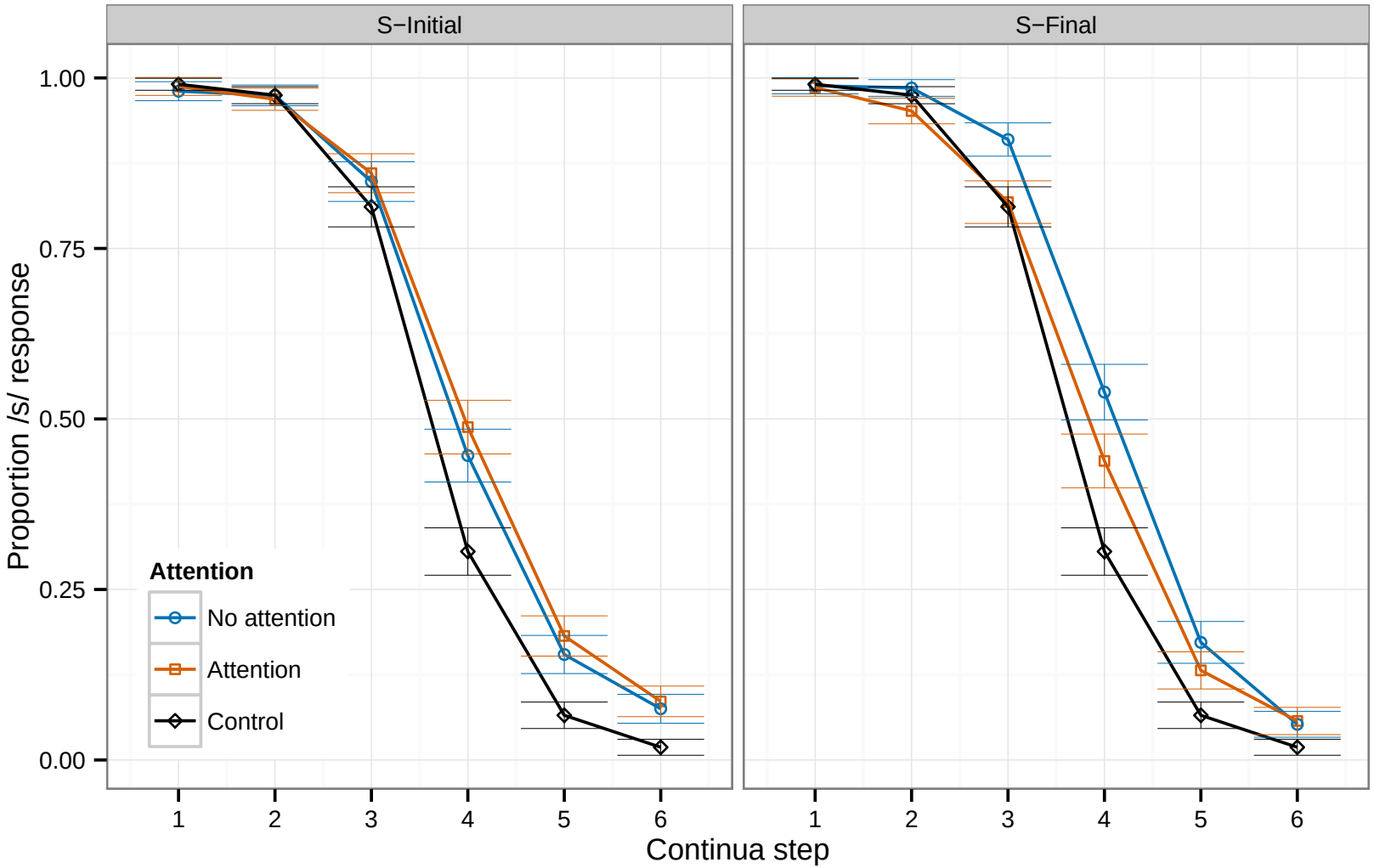
Experiment 1

Standard lexically-guided perceptual learning paradigm

- Exposure
  - Lexical decision task
  - Words with /s/ in them that sound halfway in between /s/ and /ʃ/ (50% /s/ response in a pretest)
  - 2x2 design (100 participants total)
    - Word-initial or word-medial
    - Attention to /s/ or no attention to /s/
- Categorization
  - Four minimal pair continua
    - *sin-shin*, *sack-shack*, *sock-shock*, *sigh-shy*
  - Middle six steps of each continua (as determined by a pretest)
  - Control group completed just the categorization for comparison to experimental groups

Experiment 1 results



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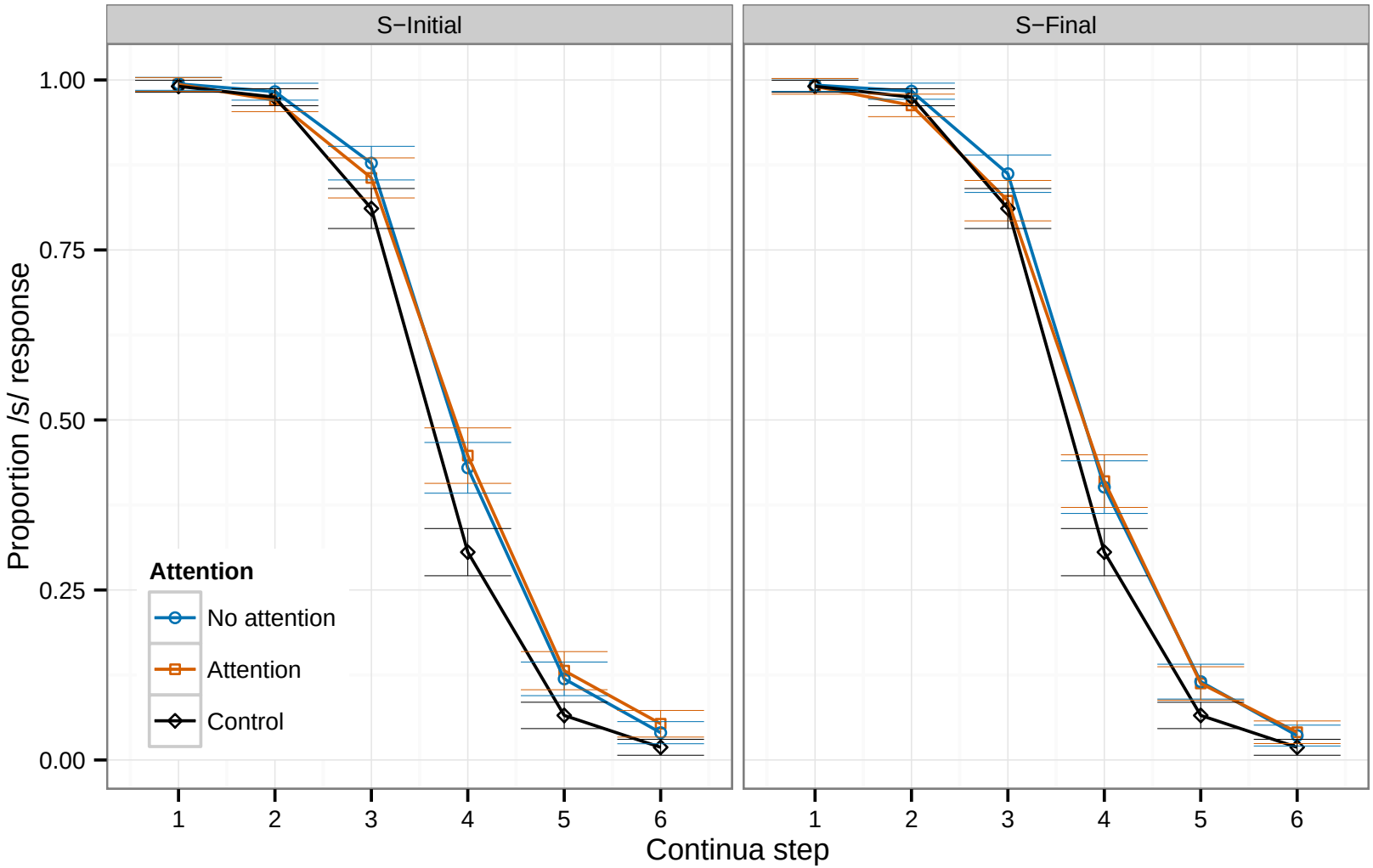
Experiment 2

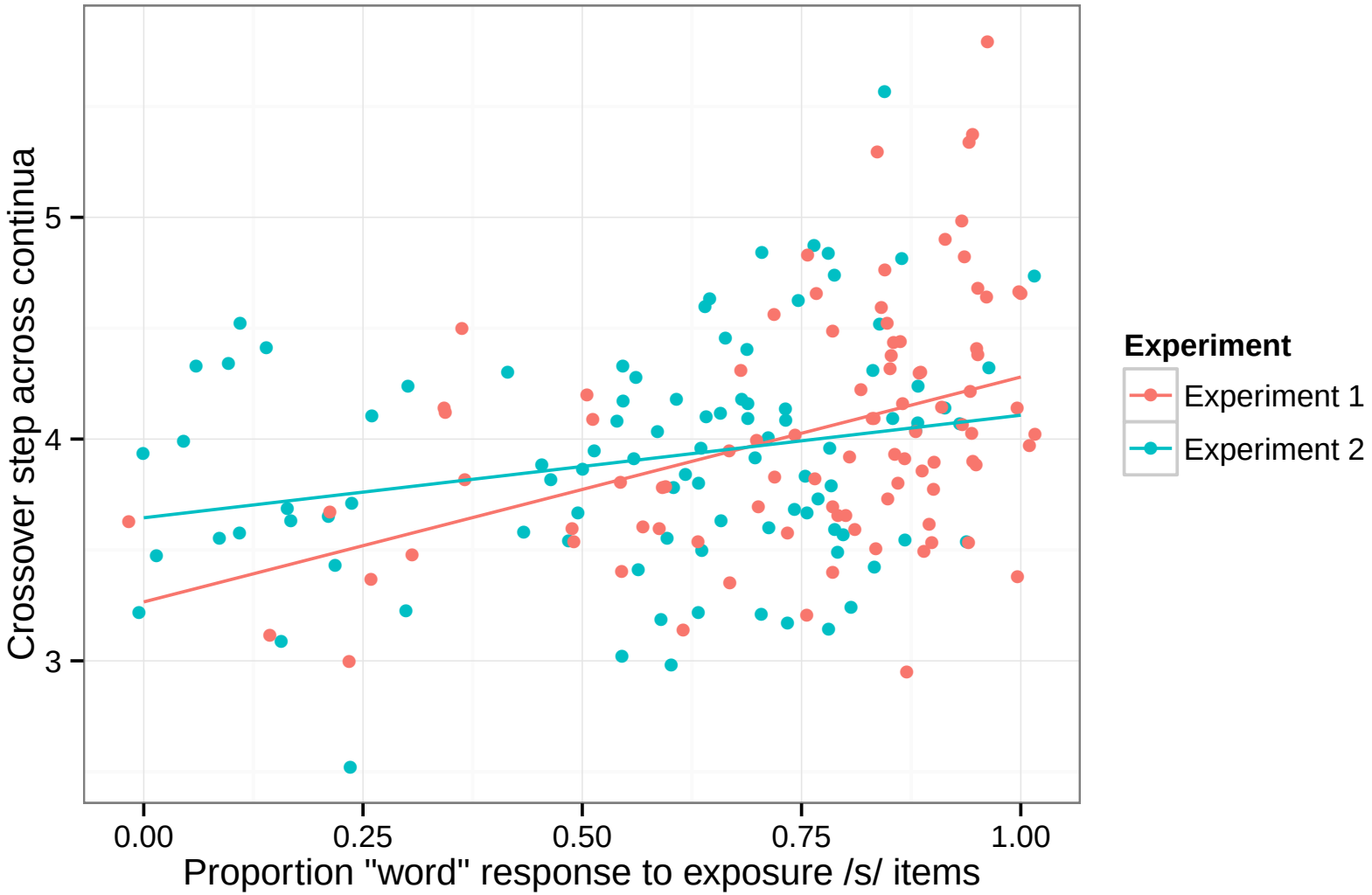
Same structure as Experiment 1

- Exposure
  - Lexical decision task
  - **Words with /s/ in them that sound more like /ʃ/ than /s/ (30% /s/ response in a pretest)**
  - 2x2 design (100 participants total)
    - Word-initial or word-medial
    - Attention to /s/ or no attention to /s/
- Categorization
  - Four minimal pair continua
    - *sin-shin*, *sack-shack*, *sock-shock*, *sigh-shy*
  - Middle six steps of each continua (as determined by a pretest)

Experiment 2 results



Influence of endorsement rate on perceptual learning



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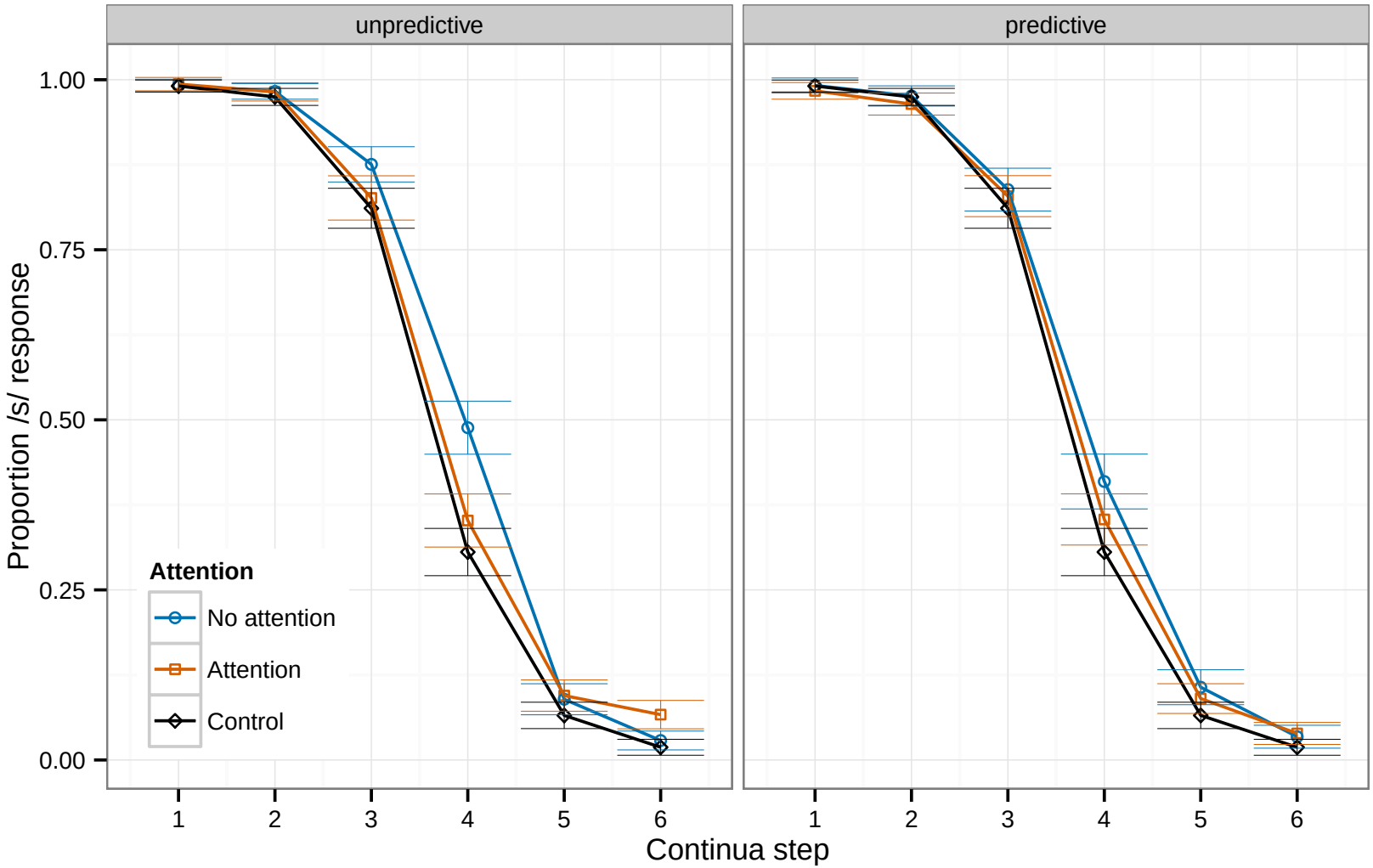
Experiment 3

Novel cross-modal word identification paradigm

- Exposure
  - Auditory sentences
  - Identify the picture that corresponds to the final word in the sentence
  - Sentences can be either predictive of the final word or not
  - Words with /s/ in them that sound halfway in between /s/ and /ʃ/ (as in Experiment 1)
  - 2x2 design
    - Words with /s/ only in predictive sentences or only in unpredictive sentences
    - Attention to /s/ or no attention to /s/
- Categorization
  - Identical to Experiments 1 and 2

Experiment 3 results



Discussion

- Perceptual learning effects were present for all experimental participants
- Comprehension-oriented attentional sets
  - Word-medial, less atypical /s/ productions produced the larger perceptual learning effects
  - Words in isolation and words in unpredictive contexts showed "larger" effects than words in predictive contexts
- Perception-oriented attentional sets
  - Word-initial or more atypical /s/ productions produced smaller perceptual learning effects
  - Predictive sentences are lower cognitive load, allowing for more perception-oriented attention (Samuel, 1981)

Attention switching and individual differences

- Attentional sets are not fixed
- Attention-switching control rather than selective attention and hearing loss affect perceptual learning in older adults (Scharenborg et al., 2014)
  - Listeners with worse attention-switching control show larger perceptual learning effects
  - These listeners would be oriented more towards comprehension
- Certain individuals may be more oriented towards one attentional set or the other
  - Global versus local processing differences

Attention mechanisms

Gain-based mechanism

- Cannot account for the results of these experiments
- Increasing attention to perception always reduced perceptual learning

Propagation-inhibiting mechanism

- Accounts for the variability of perceptual learning effects across paradigms and fields
  - Psychophysics perceptual learning (Gilbert et al., 2001, for review) and visually-guided perceptual learning (e.g. Bertelson et al., 2003) use perception-oriented tasks
  - Lexically-guided perceptual learning use comprehension-oriented tasks (e.g. Norris et al., 2003)

Summary

- Perceptual learning is a largely automatic process
- However, attentional sets determine the magnitude of perceptual learning effects
- These results support a propagation-inhibiting mechanism of attention in predictive coding frameworks, rather than a gain mechanism

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