Do incremental changes in phonotactic probability and neighbourhood density matter?

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Abstract

Past studies of spoken language processing, memory, and learning have examined only gross distinctions between low and high phonotactic probability (i.e., the likelihood of occurrence of a sound sequence) or neighbourhood density (i.e., the number of phonologically similar words). The goal of the current studies was to examine the influence of incremental changes in phonotactic probability (Study 1) and neighbourhood density (Study 2) on word learning by 3- and 5-year-old children. For both studies, four levels of the manipulated variable were contrasted: lowest, midlow, midhigh, and highest. Results showed a stair-step relationship between phonotactic probability and word learning accuracy with minor improvements from lowest to midlow probability followed by a significant decline in accuracy for midhigh and highest probability. In contrast, a linear relationship was observed between neighbourhood density and word learning accuracy with incremental increases in density resulting in incremental improvements in accuracy. These patterns suggest that phonotactic probability and neighbourhood density influence different processes involved in word learning and suggest the need to examine the influence of incremental changes in phonotactic probability and neighbourhood density on other aspects of spoken language processing, memory, and learning.

Context

- Phonotactic probability: Likelihood of occurrence of a sound sequence
- Neighbourhood density: Number of phonologically similar words
- Past research shows that probability and density influence word learning (Hoover, Storkel, & Hogan, 2010; Storkel & Lee, 2011).
    - Low probability learned better than high probability
    - High density learned better than low density
- Past research has only examined a median split of probability and density: low versus high
- Purpose of the current research is to examine the effect of incremental changes (lowest, midlow, midhigh, highest) in probability (Study 1) or density (Study 2) on word learning.

Methods

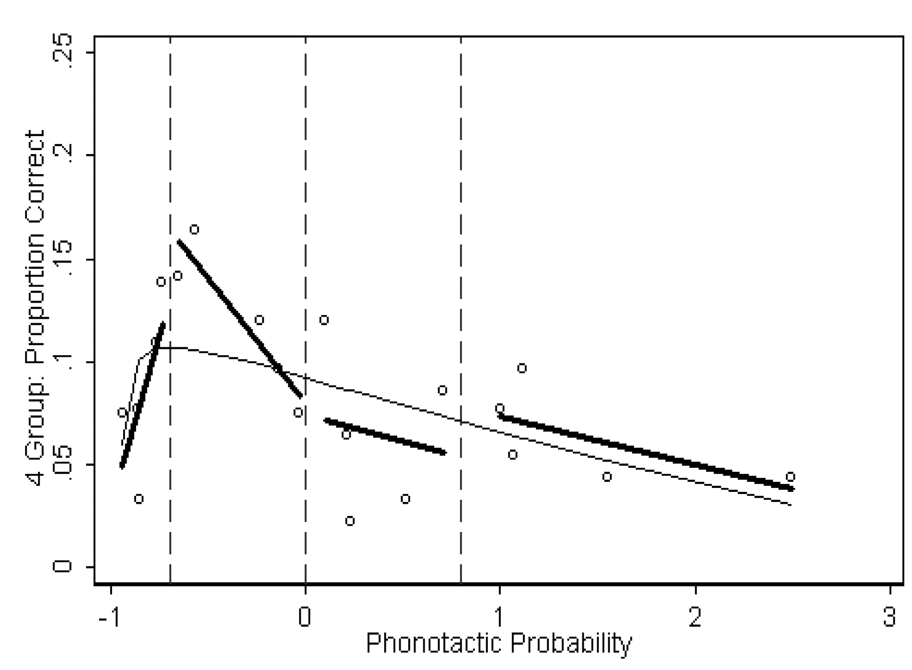
- Participants
    - Study 1: 23 3-year-old and 24 5-year-old typically developing children
    - Study 2: 33 3-year-old and 37 5-year-old typically developing children
    - Note: Neither study showed interactions with Age.
- Stimuli: Nonobjects
    - Nonobjects selected from Kroll & Potter (1984). Same 20 nonobjects used in both studies.
- Stimuli: Nonwords
    - Pool of 687 nonword CVCs was constructed
    - Probability and density were computed using an on-line calculator developed by Storkel and Hoover (2010)
    - Raw values converted to percentiles based on the pool of CVCs

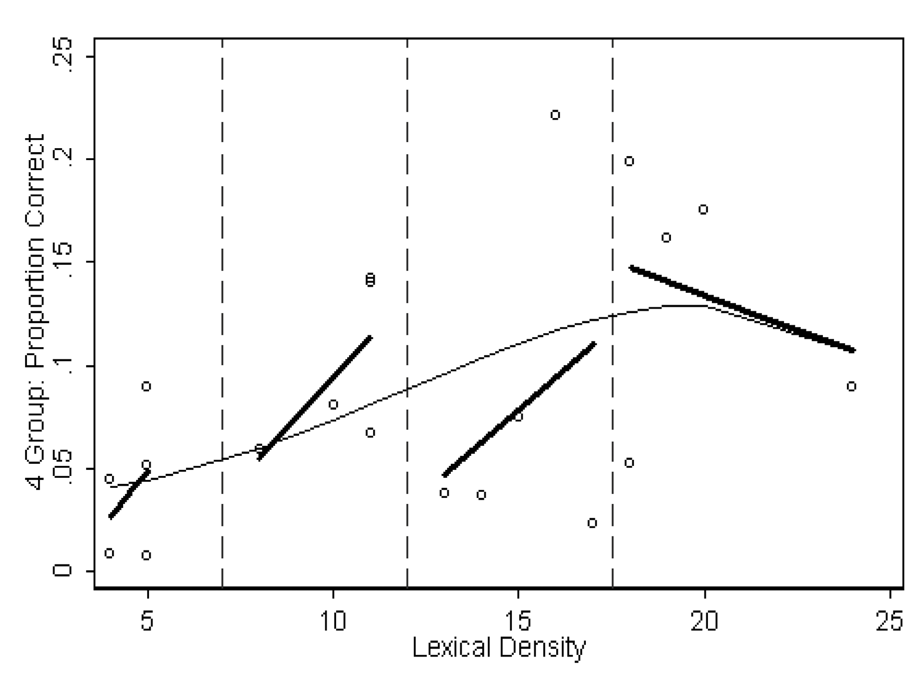
Methods (cont)

- Definition of controlled probability (Study 2) or density (Study 1)
    - 50th percentile +/- ½ standard deviation
- Definition of manipulated probability (Study 1) or density (Study 2)
    - Lowest = below the 25th percentile (n = 5)
    - Midlow = 25th to 49th percentile (n = 5)
    - Midhigh = 50th to 74th percentile (n = 5)
    - Highest = 75th percentile and above (n = 5)
- Training
    - Children received 24 exposures to all 20 nonword-nonobject pairs in a computer game
    - Learning was tested in picture-naming upon completion of training and 1-week after training
    - Note: Neither study showed interactions with time of test.

Data & Results

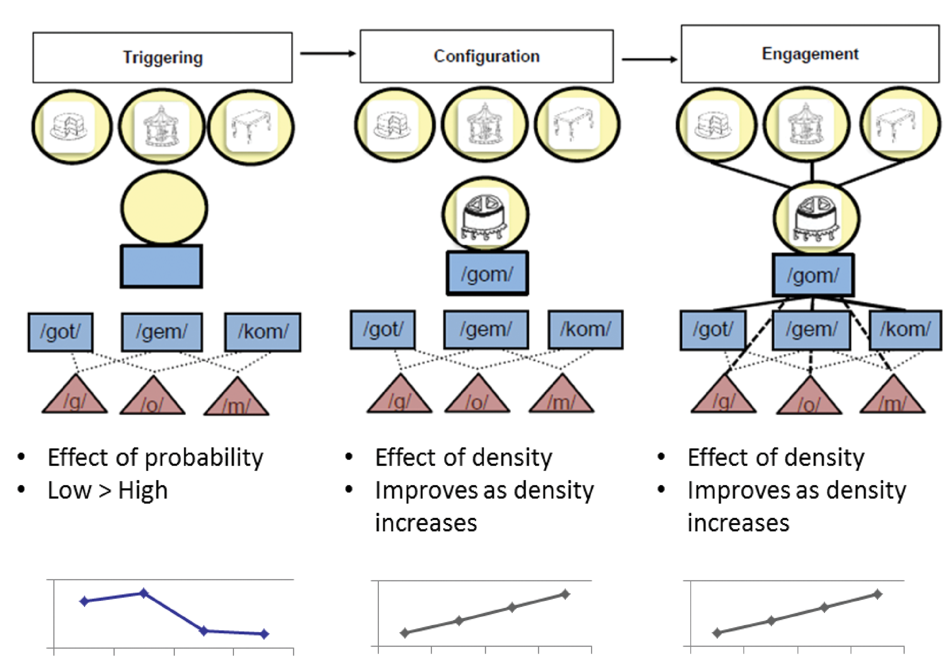
- Analysis: generalized linear mixed model with participants and nonwords as crossed random effects and logit transformed dependent variable, accuracy
- Study 1: Phonotactic probability manipulated; Neighbourhood density held constant
    - Effect of probability significant
    - Lowest, midlow > midhigh, higest
- Study 2: Phonotactic probability held constant; Neighbourhood density manipulated
    - Effect of density significant
    - Significant linear trend





Conclusion

- Phonotactic probability and neighbourhood density may influence different processes involved in word learning
    - Phonotactic probability may affect recognition that a word is new and therefore needs to be learned: triggering of learning
    - Neighbourhood density may affect creation and integration of a new representation in the lexicon: configuration and/or engagement



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