Introduction

• Phonological awareness (PA) is an important skill for learning to read (McBride-Chang, 1999; Cunningham & Stanovich, 1997).
• A variety of factors including phonological working memory (PWM), speech perception, and vocabulary skills have been shown to be related to phonological awareness.
• However, the relationships among these factors are not well understood.
• The lexical restructuring hypothesis proposes that the association among PWM, speech perception and PA is secondary to vocabulary development in children.
• Thus, PA primarily emerges as a result of the gradual reorganization of the lexicon and, to a lesser degree, the encoding (e.g., speech perception) and storage (e.g., memory capacity) of sub-lexical units.

Purpose

This study uses mediation analysis to evaluate:
• Is the relationship between speech perception and PA explained by children’s vocabulary development?
• Is the relationship between phonological working memory and PA explained by children’s vocabulary development?

Methods & Analysis

Stimuli
• 22 pairs of nonsense words adapted from Edwards et al., 2004
• Paired included a 2-phoneme sequence that contrasted in phonotactic probability
• Presented stimuli matched child’s native dialect

Procedure
• Nonwords were paired with a picture of an unfamiliar object in a picture-prompted auditory-word-repetition task

Analysis of the Nonword Repetition Task
• The 2-phoneme target sequences were transcribed and scored as in Edwards et al., 2004 by counting the number of target features produced correctly
• We fit a generalized linear mixed-effects model to predict accuracy from phonotactic probability:
  • Fixed effects: Overall accuracy (intercept) and the sequence frequency effect (slope)
  • Random effects: By-subject random intercept and random slope, and the by-item random intercept
• Outcome measure for mediation analysis: Estimated accuracy score for each participant controlling for frequency (a measure of PWM)

Mediation Analyses
• Mediated Logistic Regression Model used for Elision scores
• Mediated Linear Regression Model used for Blending scores
• Independent variables: NWR child-level intercept, EVT-2 GSV score, and % correct on Minimal Pairs
• Dependent variables: CTOPP-2 Elision Scaled Score and CTOPP-2 Blending Scaled Score

Analysis 1: Accuracy & the Frequency Effect
• As in previous research, phonotactic probability is a significant predictor of NWR accuracy

Analysis 2: Accuracy & the Frequency Effect
• A one-unit increase in phonotactic probability above the average corresponded to an increase in accuracy of 1.6% (b = 0.1, SD = 0.03 z = 3.09, p = 0.002)

Elision Results:
• There is no evidence for mediation.
• Using a boot-strapping method to evaluate mediation, there is a significant indirect effect of PWM on PA, p < .001, but the direct effect of PWM on PA remains significant at p = .04.
• 54% of the effect of PWM on PA is mediated by expressive vocabulary size.
• PWM and vocabulary size independently predict phonological awareness.

Blending Results:
• Consistent with partial mediation.
• Using a boot-strapping method to evaluate mediation, there is a significant indirect effect of PWM on PA, p < .001, and the direct effect of PWM on PA is no longer significant.
• 60% of the effect of PWM on PA is mediated by expressive vocabulary size.
• The direct effect of PWM on PA is no longer significant when the model accounts for effects of vocabulary size.

Mediation Model 1
• Consistent with complete mediation.
• A boot-strapping method to evaluate mediation yields a significant indirect effect of speech perception on PA, p < .001, and the direct effect of speech perception on PA is no longer significant.
• 94% of the effect of speech perception on PA is mediated by expressive vocabulary size.

Mediation Model 2
• Consistent with complete mediation.
• A boot-strapping method to evaluate mediation yields an additional significant indirect effect of speech perception on PA, p < .001, and the direct effect of speech perception on PA is no longer significant.

Results

Participants Summary & Descriptive Statistics

Number of males/females:
N: 66
• Ages: 3.0 (±2 months) at time 1 and 4.0 (±1 month) at time 2.
• Monolingual English speakers with typical speech and language development.

Analysis 1: Accuracy & Frequency Effect

N = 55
Mediation Model 1: PWM  Vocabulary  PA
 N = 66
Mediation Model 2: Speech Perception  Vocabulary  PA

Summary & Discussion

Summary
• Not surprisingly, words that were higher in phonotactic probability were produced more accurately than words that were lower in phonotactic probability.
• The results partially support the lexical restructuring hypothesis.
• For Blending, a substantial proportion of the effects of both speech perception and PWM on PA was explained by a child’s lexical knowledge.
• For Elision, the results were similar for the effect of speech perception on PA. However, Mediation Model 1 did not support the claim that the effect of PWM on PA was mediated by vocabulary knowledge. This finding suggests that both vocabulary size and PWM independently influence PA.

Discussion
• A primary goal of speech and language services is to provide a platform and foundation for academic success. The results of this study suggest that a comprehensive approach to treatment that emphasizes vocabulary may lead to natural improvements in the child’s phonological awareness skills.
• It is necessary to consider the differences among tasks used to measure PA.
• Elision is particularly challenging and requires children to make use of both their lexical knowledge and phonological working memory.
• By contrast, children can succeed on blending simply by relying on their lexical knowledge.

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