Homonymy in the Developing Mental Lexicon

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1. Introduction

Homonyms are words that have one phonological form but two distinct meanings (e.g., 'bat' referring to an animal or 'bat' referring to a type of sporting equipment used in baseball). This paper focuses on homonymy in preliterate children, and thus spelling similarities and differences will be ignored (e.g., 'bat' viewed as equivalent to 'bear/bare'). Controversy exists regarding the impact of homonymy on word learning in children with three differing hypotheses attested in the literature. One view is that children may avoid homonymy in word learning because of the expectation of a one-to-one mapping between form and meaning. This preference has been formalized in constraint theories of word learning as the *mutual exclusivity constraint* (e.g., Markman, 1989; Markman & Wachtel, 1988; Merriman & Bowman, 1989). In support of this hypothesis, children reportedly alter productions of words to avoid homonymy (e.g., Drachman, 1973; Ingram, 1975). In addition, children appear to be less accurate interpreting the secondary meaning of a homonym than interpreting the primary meaning of a novel word (e.g., Mazzocco, 1997). The second view is that children collect homonyms. Here it is suggested that children attempt to reduce the phonological processing demands of word learning by merging two or more adult forms into a single form in the child's production (e.g., Vihman, 1981). That is, children appear to create homonyms in their own production that do not actually exist in the adult target language, sometimes leading to regression in production (i.e., words formerly produced as 2 distinct forms merge into 1 form in surface production). It is argued that collecting homonyms allows the child to maximize his or her word learning, albeit at the expense of sound sequence diversity (Vihman, 1981). The third view is that there may be no effect of homonymy on word learning because children may fail to recognize the similarity of form across different meanings of the homonym. In this view, homonymy is hypothesized to have no effect on word learning.

Past research examining the role of homonymy in the developing mental lexicon has faced several challenges. In particular, analysis of naturalistic data is complicated by the fact that the meanings of a homonym often differ in frequency of occurrence as well as grammatical class. Both frequency and grammatical class have been shown to influence word learning (e.g., Rice, Oetting, Marquis, Bode, & Pae, 1994). For this reason, it can be difficult to

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attribute differences between learning the secondary meaning of a homonym and learning a novel word to homonymy alone, unless careful controls are employed. Relative to empirical studies, double violations of mutual exclusivity have occurred. Specifically, experimental homonyms have sometimes consisted of known forms used as the name of known objects (Mazzocco, 1997). For example, 'rope' might be used as the name for the object 'hammer.' In this case, there is both a synonym and a homonym relationship. Learning words with double violations of mutual exclusivity may not accurately reflect the underlying processes involved in learning of naturally occurring homonyms, which typically only incur a single violation of mutual exclusivity. The goal of the current study was to build upon previous work by comparing homonym learning to novel word learning while avoiding these potential confounds. Specifically, we examined children's ability to learn a known form paired with a novel object referent compared to their ability to learn a novel form paired with a novel object referent.

In addition to examining the effect of homonymy on rate of word learning, we also were interested in examining the role of form related variables in homonym learning. Past research has shown that form related variables have a robust influence on novel word learning. To illustrate, word length appears to influence inferences concerning the grammatical class of novel words (Cassidy & Kelly, 2001). In addition, productive phonology influences rate of acquisition of novel words in production based tasks (e.g, Schwartz & Leonard, 1982). Finally, phonotactic probability, the likelihood of occurrence of a sound sequence, influences acquisition of novel nouns and verbs with novel words labeled with high probability sound sequences being learned more rapidly than novel words labeled with low probability sound sequences (Storkel, 2001, 2003; Storkel & Rogers, 2000). While there is strong evidence that form characteristics influence novel word learning, it is unclear what role form characteristics would play in word learning when the form is already known, as in the case of homonyms. Thus, a secondary purpose of the current study was to examine whether phonotactic probability would influence homonym learning.

2. Methods

2.1 Participants

Twenty-eight typically developing preschool children participated (*M* age = 4 years, 1 month; *SD* = 6 months). All children exhibited age-appropriate vocabulary and productive phonology as shown by performance at the 25^{th} percentile or above on standardized tests (Dunn & Dunn, 1997; Goldman & Fristoe, 2000; Williams, 1997).

2.2 Form stimuli

Stimuli consisted of eight known words and eight novel words. Within the sets of known and novel words, half the stimuli were high phonotactic probability and half were low. Phonotactic probability was measured using procedures described in Storkel (2001). Known words met the additional criterion of being early acquired based on age-of-acquisition ratings. In addition, children were tested to verify that they knew the primary meanings of the known words. All children spontaneously produced or comprehended all of the known word stimuli. Within the known words, word frequency was matched across high and low phonotactic probability. Figure 1 shows the word frequency for the known words. Finally, known words and novel words were matched in phonotactic probability as shown in Figures 2 and 3.

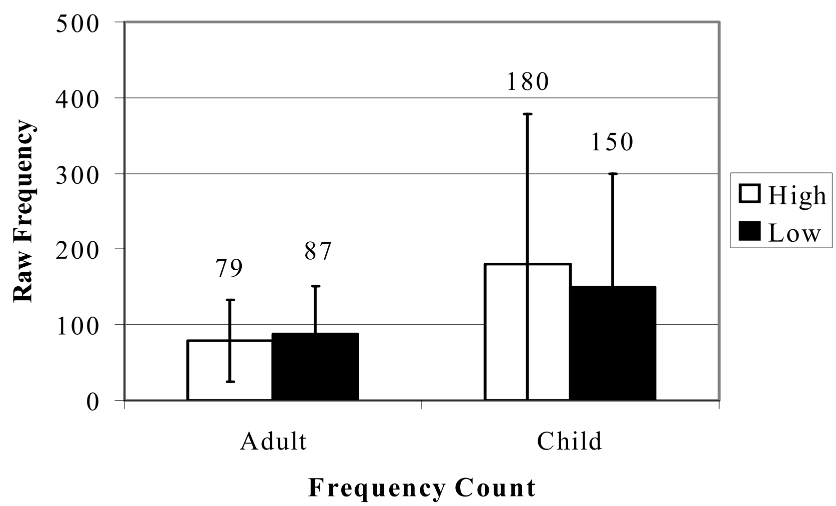

Figure 1. Mean word frequency of the high and low phonotactic probability known words based on adult (Kucera & Francis, 1967) and child frequency counts (Kolson, 1960; Moe, Hopkins, & Rush, 1982).

2.3 Referent stimuli

Known words and novel words were then paired with novel object referents. The object referents were created or adapted from children's stories. Object referents were selected in quadruplets in an attempt to equate semantic and conceptual factors across the independent variables of lexicality and phonotactic probability. Pairing of forms and referents was counterbalanced across participants.

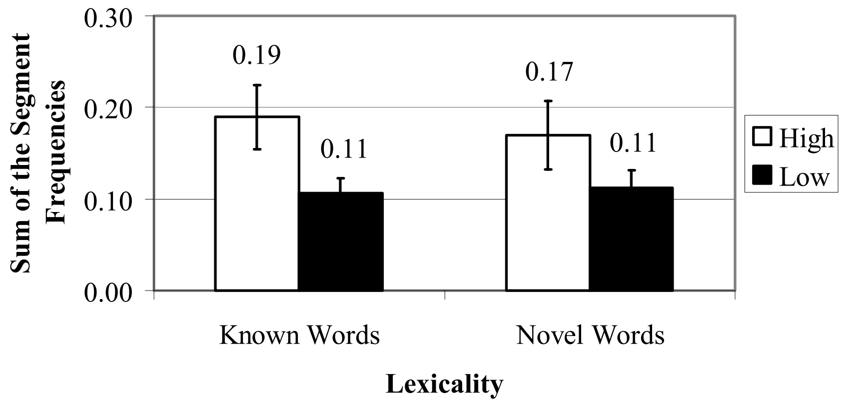

Figure 2. Mean positional segment frequency of the high and low phonotactic probability known words and novel words.

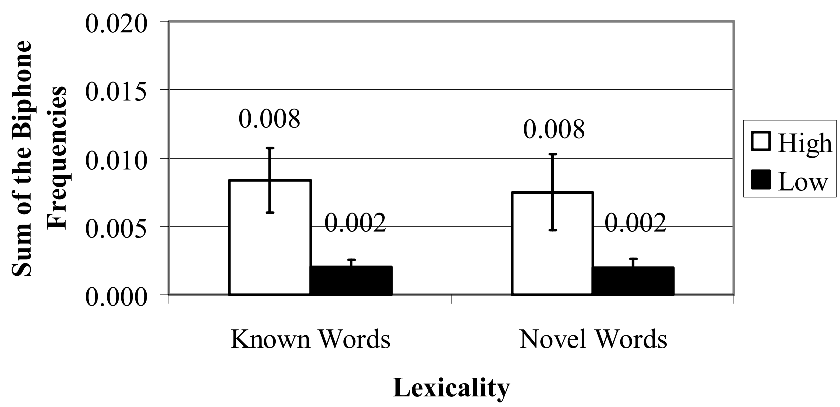

Figure 3. Mean biphone frequency of the high and low phonotactic probability known words and novel words.

2.4 Exposure and testing

The 8 known words were embedded in a story that provided a total of 7 exposures to the known words paired with the novel objects. Likewise, the 8 novel words were embedded in a story that provided 7 exposures to the novel words paired with the novel objects. The auditory narrative and object pictures were presented via a computer using commercial software to control the timing of the presentation of auditory and visual stimuli. The order of the stories was counterbalanced across participants. Learning was tracked in a picture naming task where children saw a picture of one of the object referents on the computer screen and were asked to produce the name of the referent. A response was coded as correct if it contained 2 of the 3 target phonemes in the correct order. The picture naming task was administered prior to story exposure, following 1, 4, and 7 exposures during the story, and 1 week post-exposure.

3. Results

Preliminary data from the picture naming task following 7 exposures were analyzed using a 2 Lexicality (known vs. novel word) x 2 Phonotactic Probability (high vs. low) ANOVA. Results showed a significant effect of Lexicality, F (1, 27) = 20.38, $p < 0.001$. Figure 4 shows the proportion of correct responses for each Lexicality x Phonotactic Probability condition. As shown in this figure, responses to known words were more accurate than responses to novel words. The main effect of Phonotactic Probability and the interaction Lexicality x Phonotactic Probability failed to reach traditional criteria for statistical significance, Fs <2.70, ps > 0.10. The trend was for more correct responses to high probability sound sequences than to low probability sound sequences. This trend was observed for both known and novel words.

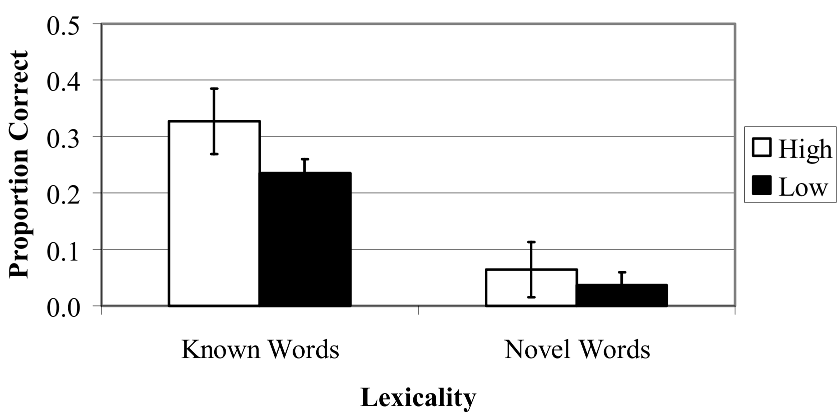

Figure 4. Mean proportion of correct responses for the high and low phonotactic probability known words and novel words.

4. Discussion

The goal of this study was to examine the effect of homonymy on word learning and the role of form characteristics in homonym learning. Results showed that homonyms were learned more rapidly than novel words. That is, known phonological forms appeared to facilitate learning. This suggests that children were able to recognize that a form is known and that this, in turn, decreased phonological processing demands, thereby speeding word learning. This result supports the hypothesis that children collect homonyms to promote rapid expansion of the lexicon and appears counter to claims that children avoid homonymy in word learning or fail to recognize form similarity. Additional longitudinal studies are needed to integrate past research findings. It is possible that children's treatment of homonymy may vary throughout development, such that children might avoid homonyms at the onset of word learning but might later collect homonyms when their knowledge of form is more mature.

Relative to the role of phonotactic probability in homonym learning, trends showed that high probability known words were learned more rapidly than low probability known words; however, this trend was not statistically significant. Importantly, the trend of a high probability advantage in homonym learning parallels previous findings for novel word learning (Storkel, 2001, 2003; Storkel & Rogers, 2000). It is possible that this result will obtain significance when greater power is achieved by adding more participants to the analysis. Thus, additional data are needed before strong claims can be made concerning the role of phonotactic probability in homonym learning. It seems plausible, however, that phonotactic probability may have a robust influence on acquisition even when the form is known. This may be attributable to the reported correlation between phonotactic probability and neighborhood density, the number of words that are phonologically similar to a given word (Vitevitch, Luce, Pisoni, & Auer, 1999). Specifically, high probability sound sequences tend to have many phonological neighbors (i.e., reside in high density neighborhoods); whereas low probability sound sequences tend to have few phonological neighbors (i.e., reside in low density neighborhoods). In fact, the high probability stimuli used in the current study were from high density neighborhoods (M = 15 neighbors, SD = 2) and the low probability stimuli were from low density neighborhoods (M = 6 neighbors, SD = 2), as would be expected given this previously reported correlation. This is relevant to the current discussion because it has been suggested that words in high density neighborhoods may have more segmentally detailed representations in memory than words in low density neighborhoods (e.g., Garlock, Walley, & Metsala, 2001; Metsala & Walley, 1998; Storkel, 2002). Furthermore, these segmentally detailed representations are thought to facilitate recognition of form similarity (e.g., Metsala & Walley, 1998). Given these relationships, the influence of phonotactic probability on homonym learning may be attributable to the fact that high probability forms are likely to reside in high density neighborhoods, resulting in segmentally detailed representations in memory. Children may be faster to recognize that a form is known when that form is stored as a segmentally detailed representation, as hypothesized for a high density neighborhood, than when it is stored with a holistic representation, as hypothesized for a low density neighborhood, leading to more rapid acquisition of high probability/density homonyms than low probability/density homonyms. This hypothesis awaits further exploration, but it may represent an intriguing avenue for future research.

Endnotes

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References

Cassidy, K., & Kelly, M. (2001). Children's use of phonology to infer grammatical class in vocabulary learning. *Psychonomic Bulletin & Review Journal, 8*, 519-523.

Drachman, G. (1973). Some strategies in the acquisition of phonology. In M. J. Kenstowicz & C. W. Kisseberth (Eds.), *Issues in phonological theory* (pp. 145-159). The Hague, Netherlands: Mouton.

Dunn, L. M., & Dunn, L. M. (1997). *Peabody picture vocabulary test–3rd edition*. Circle Pines, MN: American Guidance Service.

Garlock, V. M., Walley, A. C., & Metsala, J. L. (2001). Age-of-acquisition, word frequency, and neighborhood density effects on spoken word recognition by children and adults. *Journal of Memory and Language, 45*, 468-492.

Goldman, R., & Fristoe, M. (2000). *Goldman-Fristoe Test of Articulation-2*. Circles Pines, MN: American Guidance Service.

Ingram, D. (1975). Surface contrast in children's speech. *Journal of Child Language, 2*, 287-292.

Kolson, C. J. (1960). *The vocabulary of kindergarten children.* Unpublished Doctoral Dissertation, University of Pittsburgh, Pittsburgh.

Kucera, H., & Francis, W. N. (1967). *Computational analysis of present-day American English*. Providence, RI: Brown University.

Markman, E. M. (1989). *Categorization and naming in children*. Cambridge, MA: MIT Press.

Markman, E. M., & Wachtel, G. F. (1988). Children's use of mutual exclusivity to constrain the meanings of words. *Cognitive Psychology, 20*, 121-157.

Mazzocco, M. M. (1997). Children's interpretations of homonyms: a developmental study. *Journal of Child Language, 24*, 441-467.

Merriman, W. E., & Bowman, L. L. (1989). The mutual exclusivity bias in children's word learning. *Monographs of the Society for Research in Child Development, 54*, 1-132.
Metsala, J. L., & Walley, A. C. (1998). Spoken vocabulary growth and the segmental restructuring of lexical representations: Precursors to phonemic awareness and early reading ability. In J. L. Metsala & L. C. Ehri (Eds.), *Word Recognition in Beginning Literacy* (pp. 89-120). Mahwah, NJ: Lawrence Erlbaum Associates, Inc., Publishers.
Moe, A. J., Hopkins, K. J., & Rush, R. T. (1982). *The vocabulary of first grade children*. Springfield, IL: Thomas.
Rice, M. L., Oetting, J. B., Marquis, J., Bode, J., & Pae, S. (1994). Frequency of input effects on word comprehension of children with specific language impairment. *Journal of Speech and Hearing Research, 37*, 106-122.
Schwartz, R. G., & Leonard, L. B. (1982). Do children pick and choose? An examination of phonological selection and avoidance in early lexical acquisition. *Journal of Child Language, 9*, 319-336.
Storkel, H. L. (2001). Learning new words: Phonotactic probability in language development. *Journal of Speech, Language, and Hearing Research, 44*, 1321-1337.
Storkel, H. L. (2002). Restructuring of similarity neighbourhoods in the developing mental lexicon. *Journal of Child Language, 29*, 251-274.
Storkel, H. L. (2003). Learning new words II: Phonotactic probability in verb learning. *Journal of Speech, Language and Hearing Research, 46*(6), 1312-1323.
Storkel, H. L., & Rogers, M. A. (2000). The effect of probabilistic phonotactics on lexical acquisition. *Clinical Linguistics & Phonetics, 14*, 407-425.
Vihman, M. M. (1981). Phonology and the development of the lexicon: Evidence from children's errors. *Journal of Child Language, 8*, 239-264.
Vitevitch, M. S., Luce, P. A., Pisoni, D. B., & Auer, E. T. (1999). Phonotactics, neighborhood activation, and lexical access for spoken words. *Brain and Language, 68*, 306-311.
Williams, K. T. (1997). *Expressive vocabulary test*. Circle Pines, MN: American Guidance Services, Inc.