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The Influence of Two Cognitive-Linguistic Variables on Incidental Word Learning in 5-Year-Olds

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Abstract

The relation between incidental word learning and two cognitive-linguistic variables—phonological memory and phonological awareness—is not fully understood. Thirty-five typically developing, 5-year-old, preschool children participated in a study examining the association between phonological memory, phonological awareness, and incidental word learning. Children were exposed to target words in a read-aloud story that accompanied a wordless picture book. Target word comprehension was assessed before and after two readings of the story. Phonological awareness predicted incidental word learning but phonological memory did not. The influence of phonological awareness and phonological memory on word learning may be dependent on the demands of the word learning task.

Keywords

Language development; Word learning; Phonological awareness; Phonological memory

Introduction

Young children demonstrate an impressive ability to learn words. Although full knowledge of a word is constructed over a protracted period of time, preschool children add new words to their lexicon at a rate of at least several words per day (Templin 1957). The size of a child's vocabulary at school entry may be 6,000–10,000 words. However, there is substantial individual variability in vocabulary knowledge; for example, children from more educated families tend to have much larger vocabularies than children from less educated families (Hart and Risley 1995; Hoff 2003; Huttenlocher et al. 1991; Qi et al. 2006).

The importance of vocabulary knowledge to reading comprehension (see National Institute of Child Health and Human Development 2000) has focused educators on the need to improve vocabulary in young children who come to school with limited word knowledge.

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Intervention efforts can be optimized to the extent that factors that influence vocabulary learning are understood. Broadly, these factors include the lexical characteristics of individual words (Storkel 2001, 2004), the nature and extent of language input (e.g., Hart and Risley 1995; Hoff 2003; Huttenlocher et al. 1991), and children's cognitive-linguistic abilities. The current investigation explored the influence of two cognitive-linguistic variables—phonological memory and phonological awareness—on 5-year-old preschool children's incidental word learning.

Although phonological memory and phonological awareness are strongly correlated with static assessment of vocabulary (Bowey 1996; Gathercole and Adams 1993; Metsala 1999), few studies have explored the role of phonological memory and phonological awareness in experimental word learning studies (de Jong et al. 2000; Gathercole and Baddeley 1990b; Gray 2004, 2006; Ramachandra et al. 2011). In initial encounters with a new word, a child must formulate a phonological representation for the word and associate it with a meaning. If phonological memory and phonological awareness support the construction of phonological representations, then children with stronger phonological memory and stronger phonological awareness should be better initial word learners.

Initial word learning has been studied using explicit teaching tasks as well as incidental word learning tasks. Although the term *incidental learning* has been used to describe different types of learning, for the purpose of this study we adopted the Rice (1990) description of Quick and Incidental Learning (QUIL); "much of initial word learning is accomplished incidentally, without ostensive reference provided by an adult" (p. 176). Our interest in incidental word learning paradigms stems from the presumed greater ecological validity of these tasks. Although preschoolers encounter some new words in contexts that provide explicit support for learning (e.g., Beals and Tabors 1995), they likely encounter new words more frequently in contexts that provide little explicit support—for example, conversations, watching television, and being read to (Akhtar et al. 2001; Rice et al. 1990; Senechal and Cornell 1993; Senechal et al. 1995b). Importantly, the relation of cognitive-linguistic abilities to word learning may be contingent on the specific demands of the word learning task.

Phonological Memory

There is strong evidence for a bidirectional relation between a child's static vocabulary knowledge and phonological memory. Phonological memory, as measured by nonword repetition tasks, at age four drives vocabulary knowledge at age five. Beyond 5–6 years of age, however, vocabulary knowledge influences phonological memory (Bowey 1996, 2001; de Jong et al. 2000; Gathercole and Baddeley 1989, 1990b; Gathercole et al. 1991; Metsala 1999). Gathercole and Colleagues (Gathercole 2006; Gathercole and Baddeley 1990b) have argued that phonological memory assists in the construction of phonological representations for young children, a critical step in word learning. The stronger a child's phonological memory the more easily the child retains an unfamiliar phonological sequence and the more readily the phonological representation is stored in the lexicon.

Explicit teaching studies—where the link between word and referent is explicitly taught by the examiner—consistently report that stronger phonological memory provides an advantage in word learning (de Jong et al. 2000; Gathercole and Baddeley 1990b; Gray 2004, 2005). But in an *incidental* word learning task, Ramachandra et al. (2011) did not find that children with better phonological memory were better word learners. Thus, there is initial evidence that the influence of phonological memory on word learning varies depending on the demands of the word learning task.

Phonological Awareness

Phonological awareness also positively correlates with static vocabulary knowledge (Bowey 1996; Fowler 1991; Hu 2003, 2008; Hu and Schuele 2005; Lonigan et al. 1998; Metsala 1999). The lexical restructuring hypothesis (Metsala 1999;Walley 1993;Walley et al. 2003) may explain this relation. Metsala and Walley posited that the capacity to develop phonological awareness stems from changes in lexical organization that come about when preschoolers begin to rapidly add new words to their lexicons. Toddlers build an initial lexicon with the phonological structure of words represented holistically. However, holistic lexical representation makes it inefficient and perhaps impossible to build a lexicon of thousands of words. Thus, within the lexical restructuring hypothesis, it is theorized that rapid lexical development stimulates a gradual lexical restructuring process whereby children gain implicit access to the segmental features of words. They begin to store new words segmentally rather than holistically, and gradually, extant words in the lexicon are restructured from holistic to segmental representations. Metsala and Walley suggested that this implicit access to phonemes with segmental lexical representations makes possible the development of phonological awareness, that is, explicit access to phonemes.

Building from the lexical restructuring hypothesis, we propose that a child's emerging phonological awareness facilitates word learning; phonological awareness may allow for improved encoding and more detailed initial phonological representation of unfamiliar words (de Jong et al. 2000). We hypothesize that children can store meanings when phonological representations are constructed and stored more easily and perhaps more efficiently. This notion is well-stated by Fowler (1991), who suggested that:

> Young children, and potentially poor readers, whose phonological representations are not segmentally organized may not be as efficient in assigning novel stimuli into a recoverable representation (i.e., for word repetition) as would be children who can readily assign a segmental structure (p. 108).

Only de Jong et al. (2000) and Ramachandra et al. (2011) have explored the relation of phonological awareness to success in experimental word learning tasks. In a relatively straightforward paired-association word learning task, de Jong et al. (2000) reported that, for Dutch-speaking 5-year-olds, stronger phonological awareness conferred an advantage in linking unfamiliar names to referents. A second experiment by de Jong et al. bolstered the strength of this association; children who received phonological awareness training were subsequently better at associating unfamiliar names to referents. Ramachandra et al. (2011) further specified the relation between phonological awareness and word learning by studying incidental word learning in 4-year-olds. Children with stronger phonological awareness were more successful at linking monosyllabic nonsense words to referents in short stories when words were presented five times.

The present study was designed to understand the relation of phonological awareness and phonological memory to word learning in a storybook incidental word learning task with real-word stimuli. In addition, the proposal that phonological memory and phonological awareness share an underlying phonological processing component (Bowey 1996; Fowler 1991) suggests that there may be shared influence of these two variables on incidental word learning.

Latent Phonological Processing

Although phonological awareness and phonological memory often are studied as two distinct constructs, there is strong support for viewing phonological memory and phonological awareness as surface representations of a single latent phonological processing ability (Bowey 1996; Fowler 1991; but see Gathercole et al. 1991; Ramachandra et al. 2011). Evidence comes from correlations between measures of phonological memory and phonological awareness and findings that the two measures load on the same factor thought to represent phonological processing (Bowey 1996; Gathercole et al. 1991).

According to the latent phonological processing account, phonological memory and phonological awareness should associate similarly with vocabulary knowledge and word learning. Findings regarding this claim are inconsistent, however, with reports that phonological memory and phonological awareness associate similarly with static measures of vocabulary knowledge (Bowey 1996, 2001; Metsala 1999) and, conversely, that the two variables differentially associate with vocabulary (Gathercole et al. 1991; Hansen and Bowey 1994). Phonological memory and phonological awareness appear to share variance in predicting experimental word learning success (de Jong et al. 2000; Ramachandra et al. 2011); however, phonological memory contributes less to the shared variance than phonological awareness and this contribution is even less for incidental word learning (Ramachandra et al. 2011) compared to learning from explicit teaching tasks (de Jong et al. 2000). Thus, findings from studies using static vocabulary measures and experimental word learning tasks are inconsistent in whether they support the latent phonological processing account.

In sum, phonological memory and phonological awareness positively correlate with static measures of vocabulary knowledge. Stronger phonological memory and phonological awareness confer an advantage in word learning tasks of an explicit nature. In the current investigation we evaluated the role of phonological memory and phonological awareness on children’s success in an incidental word learning task that reflected the learning challenges preschoolers encounter daily. The words were presented in a read-aloud story that accompanied a wordless picture book. Storybooks are common contexts in which preschool encounter unknown words. Embedded in the story text were words (i.e., word learning targets) likely to be unfamiliar to 5-year-olds. The word learning targets were not explicitly defined or highlighted for the children. The research question addressed by this study was whether phonological memory and phonological awareness influence incidental word learning.

Methods

Participants

Five-year-old preschool children (*N* = 35; 20 girls; mean age 5;0; age range 4;10 to 5;6) from Nashville, TN community preschools, serving primarily children of college-educated parents, participated in the study. By parent report all participants were monolingual English speakers and had typical speech-language development and normal hearing acuity. Children completed two eligibility measures, the Peabody Picture Vocabulary Test (PPVT-III; Dunn and Dunn 1997) and the Expressive Vocabulary Test (EVT; Williams 1997) to document vocabulary knowledge within the normal range.[1] Mean standard score on the PPVT-III was 108.43 (SD = 9.51) and on the EVT was 105.34 (SD = 11.13).

Word Learning Task

Storybook Stimuli—A story text with 19 target words (14 nouns, 4 verbs, 1 affective state word) was written to accompany the wordless picture book *Pancakes for Breakfast* (DePaola 1978). The book has 26 pages and the story text averaged 3.8 sentences per page (range 1–8). Based on Hall, Nagy and Linn's (1984) corpus of words spoken by 5-year-old children, the target words were considered unlikely to be in the lexicons of 5-year-olds. Each target word appeared 3 to 12 times in the story text (*M* = 5.4 times). Word exposure variability was not considered problematic because the focus was general word learning, not whether specific words were learned.

Word Learning Task—A research assistant (graduate student in speech-language pathology with experience reading to children) who was blind to children's performance on study measures read the story to individual participants twice, once on each of 2 days. To mirror typical book reading and draw attention to certain story elements, the research assistant pointed to picture referents for some of the unfamiliar and familiar words (Murphy 1978; Senechal et al. 1995a). Picture pointing was planned a priori and was consistent across all readings. If a child became distracted or spoke during the story reading, the research assistant regained the child's attention to the story with verbal (e.g., *listen to the story*) or visual (e.g., pointing) prompts.

Independent Measures

Phonological Awareness—Children completed two phonological awareness tasks—alliteration oddity and rhyme oddity—that have been demonstrated to be sensitive to young children's emerging phonological awareness knowledge (Lonigan et al. 1998). We anticipated that alliteration oddity might be a better measure to capture individual differences in this population. However, we also administered the rhyme oddity measure in case there were floor effects on the alliteration oddity measure.

[1]Because we sought to explore the word learning and cognitive-linguistic abilities of typically developing children, our initial eligibility range on these two measures was a standard score between 85 and 115 (± one standard deviation of the test mean). After evaluating 17 children for eligibility, nine children were deemed ineligible because their PPVT-III and/or EVT standard score exceeded 115. Based on the extant literature on child vocabulary and maternal education, we expanded the eligibility range to 85–130 (Dollaghan et al. 1999). Thirty-seven of the initial 48 children assessed were eligible for participation. Two children did not complete the study procedure due to preschool absence; thus, complete data were available for 35 children.

The alliteration oddity measure, designed for this study, included 3 trial items and 20 test items. For each item, three pictures were presented: two pictures that represented words beginning with the same initial sound and one that did not (e.g., *cat*, *kite, bell*). The foil did not have a semantic association with either word in the alliteration pair. The examiner named each picture and asked the child to point to the picture of the word that did not begin with the same sound. Test item responses were scored as correct or incorrect and the total number correct was tallied (max 20 points). Children received feedback on the accuracy of their response on each trial item but did not receive feedback for the test items.

The rhyme oddity measure was parallel in format to the alliteration oddity measure, with 3 trial items and 20 test items (Schuele and Larrivee 1995). For each item, three pictures were presented: two representing words that rhymed and one that did not (e.g., *king, ring, shoe*). The examiner named each picture and asked the child to point to the picture of the word that did not rhyme. Test item responses were scored on-line as correct or incorrect and the total number correct was tallied (max 20 points). Children received feedback on the accuracy of their response on each trial item but did not receive feedback for the test items.

All word stimuli in the phonological awareness measures were monosyllabic, picturable nouns easily recognized by young children and highly likely to be in a preschooler's lexicon. Word stimuli in the alliteration oddity measure began with either stop consonants (e.g., /b/, /p/) or continuant consonants (e.g., /v/, /f/). The three pictured words in each item followed one of four variations, randomized across the 20 items: (a) foil word with a continuant initial sound and target word pair with stop initial sounds (e.g., *fan, bed, bear*), (b) foil word and target word pair with continuant initial sounds (e.g., *ship, vase, van*), (c) foil word and target word pair with stop initial sounds (e.g., *can, car, pool*), or (d) foil word with a stop initial sound and target word pair with continuant initial sounds (e.g., *game, shirt, sheep*).

Initial Analysis of Phonological Awareness Measures—As phonological awareness develops and children's skills become more complex, the phonological awareness measure(s) that best captures developmental variability changes (Schatschneider et al. 1999). Alliteration oddity score was the sole measure of phonological awareness in all statistical analyses because visual examination of alliteration and rhyme score histograms revealed that the alliteration oddity measure better captured the developmental variability (see Lonigan et al. 1998; Schatschneider et al. 1999).

Phonological Memory—The phonological memory measure was a shortened version of the Children's Test of Nonword Repetition (CNRep; Gathercole and Adams 1993; Gathercole et al. 1994). The stimuli for this study included 33 of the 40 nonsense words from the CNRep. The three training stimuli were monosyllabic and the 30 test stimuli were two to four syllables in length (10 stimuli at each of 2, 3, and 4 syllables in length). Stimuli were consistent with stress patterns in English and conformed to the phonotactic rules of English (Gathercole and Adams 1993). The pronunciation of each word was consistent with Standard American English (see "Appendix 1"), and thus, word pronunciations varied from Gathercole and colleagues (Gathercole and Adams 1993; Gathercole et al. 1994, 1992). A shortened version of the CNRep was used to minimize the length of the task to avoid child fatigue. Support for this decision was provided by evidence that repetition of 5-syllable nonwords does not differ from repetition of 4-syllable nonwords in preschool-aged children (Gathercole et al. 1994) and by a precedent for including only 2-, 3- and 4-syllable nonwords in repetition tasks (i.e., Dollaghan et al. 1993, 1995; Gathercole and Baddeley 1989, 1990a,b).

CNRep stimuli were recorded and digitized using the Kay Elemetrics Computerized Speech Lab (CSL model 4500) at 22,050 kHz sampling rate. A 26-year-old adult male who was a native speaker of mainstream American English produced the word stimuli. The three practice stimuli were presented to the child by live voice and the 30 test stimuli were presented at a comfortable listening level via computerized audio clips on a laptop computer at the rate of one word every 6 s. Participants were asked to repeat the nonsense words. If extraneous noise occurred during presentation of the target stimulus or the child did not respond before the presentation of the following word, the experimenter re-played the target stimulus. Responses were scored on-line; incorrect responses were productions that differed phonemically from the target word. If a child presented with a systematic misarticulation (e.g., /w/ for /r/ substitution), credit was given for any substitutions consistent with the systematic misarticulation (Gathercole and Adams 1993). The total number of correct productions was tallied for each child (max 30 points).

Dependent Measure: Word Comprehension

Children's learning of the target story words was assessed with a comprehension picture pointing task similar in format to the PPVT-III. Nineteen picture plates were constructed, one for each target word. Each plate included four pictures: one target word picture and three foils. Target pictures and foil pictures were extracted from the pictures that appeared in the *Pancakes for Breakfast* storybook. Each test plate contained three types of foils: (a) a picture that appeared at least once on the same book page as the target word picture, (b) a picture that never appeared on the same page as the target word picture, and (c) a picture of one of the other target words. For each item the four pictures were randomly placed on the picture plate. Responses were scored on-line and the total number of correct responses was summed (max 19 points).

Procedure

Children were tested individually at their childcare centers in two sessions (see Table 1) separated by no less than 1 day and no more than 9 days (M = 4.45 days, SD = 3.09). The first session lasted approximately 75 min and the second session approximately 30 min. The comprehension pretest may have prompted the children to pay more attention to the target words when they heard the story. However, the placement of the rhyme oddity and alliteration oddity measures aimed to prevent priming or carryover of target word exposure from the word comprehension pretest to the word learning task (story reading). Scoring accuracy on response forms was checked by the research assistant after all data had been collected. Any disagreements were resolved by the first author's review of response forms.

Results

Descriptive Statistics

Descriptive statistics on all independent and dependent variables are presented in Table 2. Means and standard deviations indicated that there were no floor or ceiling effects. As expected, the group means on the norm-referenced vocabulary measures (PPVT-III and EVT) are at the upper end of the normative distribution given that children were recruited from mostly college-educated families and given the inclusionary criteria (85–130 standard scores).

Word Learning

Inclusion of Target Words—To examine ceiling effects for individual target words, percent correct for each word at pretest and posttest, and percent gain for each word were calculated (“Appendix 2”). At pretest, 75% or more participants provided a correct response for four target words (*apron, disappointed, spatula, ingredient*). Thus, these words were eliminated from the word learning analysis and the outcome variables of pretest, posttest, and gain were based on responses to the remaining 15 target words.

Word Comprehension Measure—The group mean on the word comprehension posttest was significantly higher than pretest, t (34) = −7.52, $p < .001$, two-tailed, $d = 1.34$. Children successfully learned words presented in the incidental word learning task (see Table 2 and “Appendix 2”).

Word Frequency Analysis—Rice et al. (1994) demonstrated an association between presentation frequency of unfamiliar words in an incidental word learning task and word comprehension posttest; typical language 5-year-olds learned 2.6 words when words were presented ten times but only 1.3 words when words were presented three times. In the current study, although there was variability in presentation frequency for target words (M = 5.42, range 3–12), there was no association between word frequency presentation and gain for each word, $r = .414$, $p > .01$, two-tailed.

Correlation Analysis

A correlation analysis explored potential relations between variables (Table 3). Standard scores on the PPVT-III and the EVT correlated significantly, $r = .368$, $p > .05$, two-tailed. There was also a significant correlation between the alliteration oddity measure and PPVT-III standard score as well as EVT standard score, $r = .503$, $p > .01$ and $r = .391$, $p > .05$, two-tailed, respectively. Gain score on target words from pretest to posttest was not significantly correlated with the independent variables. Additionally, phonological memory did not correlate significantly with any of the variables. Because of anticipated interrelatedness of some of the variables, a series of multiple regression analyses were conducted to parse the unique contribution of each variable to word learning.

Multiple Regression Analyses

The dependent variable for the multiple regression analyses differed from that used in the correlation analysis. Specifically, because of the variability in pretest scores across children, variance in posttest (dependent variable) was assessed with pretest as a predictor variable. This method of analysis allows for the controlling of the number of words known at pretest leaving words learned from the experimental word learning task functioning as the dependent variable. Pretest was entered as the first step in all regression analyses and was a significant predictor of posttest, accounting for 16.4% of variance ($p < .05$).

Following a priori predictions, three multiple regression analyses were conducted to examine the amount of variance in word learning accounted for by phonological awareness (as measured by alliteration oddity) and phonological memory, together and individually. When alliteration oddity and phonological memory were entered together in the second step (see Table 4), they accounted for 10.5% of the variance and were significant predictors of posttest ($p < .05$). When entered individually in the second step, alliteration oddity accounted for a significant 10.5% of variance in posttest ($p < .05$) and phonological memory, entered in the third step, did not account for any additional variance in posttest. Similar results were seen when phonological memory was entered individually in the second step and alliteration oddity was entered in the third step, with phonological memory accounting for 0.1% of variance and alliteration oddity accounting for a significant 10.4% of variance ($p < .05$). In summary, alliteration oddity and phonological memory together account for a significant amount of variance in word learning; however, when the unique amount of variance for each variable was assessed, alliteration oddity was the only significant predictor of word learning.

Discussion

A thorough explication of the factors that influence children’s word learning and vocabulary knowledge will allow for consideration of how to improve the word knowledge of preschool children. The importance of vocabulary to school success has been recognized for quite some time. Although a child’s phonological awareness may influence word learning, there has been very limited exploration of this potential relation. In contrast, there has been more exploration of the relation of phonological memory and word learning, although much of this work has focused on word learning from explicit teaching. The primary purpose of this study was to examine whether phonological awareness and phonological memory predicted the outcome of incidental word learning in a group of typical preschool children.

Children’s incidental word learning was assessed by measuring comprehension (gain from pretest to posttest) on a set of words heard within a storybook read to each child two times. The completion of the pretest comprehension measure prior to the experimental word learning task resulted in children hearing each target word, thus gaining limited exposure to the word set prior to the story readings. Beyond this though, children did not know specifically what words, or how many words, they were to learn in the story readings.

At pretest the mean score was 6.5 words and at posttest the mean score was 10.4 words. Thus, children were successful in gaining information about unfamiliar words from the story script and the story pictures; that is, word learning took place. That word learning, as measured by gain score from pretest to posttest on the word comprehension measure, did not correlate significantly with either of the phonological awareness measures was unexpected;

however, the lack of a significant correlation between nonword repetition and both word learning and phonological awareness is consistent with previous findings (Ramachandra et al. 2011). Possible explanations for this finding are presented below.

To evaluate the predictions that the independent variables would predict variance in word learning, a series of multiple regression analyses were completed. Together, phonological awareness and phonological memory accounted for a significant amount of variance in word learning. Individually, however, phonological awareness accounted for a significant amount of variation in incidental word learning (10.5%) whereas phonological memory did not. In the following paragraphs, each of these findings is considered.

The finding that children who had better phonological awareness performed better on the incidental word learning task is consistent with de Jong et al. (2000) and Ramachandra et al. (2011). Thus, this finding adds to the support for the proposal that the relation between vocabulary and phonological awareness is bidirectional. We hypothesized that the phonological awareness that is made possible by lexical restructuring and segmental representations provides greater ease in initial word storage. Children use their metalinguistic ability to more easily and quickly create phonological representations, suggesting that segmental representations lead to more efficient lexical storage. This conclusion is tentative in that our methods did not allow for separate consideration of the influence of vocabulary knowledge and phonological awareness on word learning. Vocabulary knowledge correlated 0.53 with phonological awareness. To more clearly consider the separate influences of extant vocabulary and phonological awareness on word learning, a study examining the effects of phonological awareness intervention on word learning while controlling for receptive vocabulary is needed.

Findings that phonological memory did not predict word learning contradict prior findings that phonological memory is important to word learning (de Jong et al. 2000; Gathercole and Baddeley 1990b; Gray 2004, 2006). Our results do, however, support Ramachandra et al.'s (2011) report that phonological memory did not correlate with learning in an incidental word learning task. As previously mentioned, the role of phonological memory in word learning may depend on the nature of the word learning task that confronts the preschool children. Phonological memory may help children quickly acquire new words in cases where the explicit teaching of the word cues the child to remember specifics about the word, thus promoting intentional learning. Therefore, the explicit identification and teaching of novel words in explicit word learning tasks may result in phonological memory playing a greater role in success on these tasks compared to incidental word learning tasks. In incidental tasks, like that used in the current study, children are not guided to remember details about the target words and instead recruit more processes than just phonological memory (i.e., parsing the sentence, identifying the novel word and referent) to successfully learn the novel word. Thus, phonological memory does not play as big of a role in incidental word learning compared to explicit word learning, as evidenced by the lack of correlation between phonological memory and learning and the lack of variance in word learning contributed by phonological memory.

Another possible explanation for the null effect of phonological memory on incidental learning in this study is the use of whole-word versus phoneme-level scoring of the nonword repetition task. Although it has been suggested that phoneme-by-phoneme scoring of non-word repetition task production may be a more sensitive measure of phonological memory (Dollaghan et al. 1993, 1995) the decision to use the whole-word method in this study was based on the previous research of Gathercole et al. (1994). Gathercole et al. (1994) used the whole-word scoring method for their nonword repetition task, the CNRep, reporting that phonological memory, when reported this way, associated with word learning via an explicit teaching task. The current study used the same phonological memory measure and method of scoring as Gathercole et al. in its investigation into whether phonological memory associates with *incidental* word learning. That the results of this study contradicted those of Gathercole et al. lends support to the supposition that phonological memory plays a different role in different word learning scenarios. To explore the proposal that phonological memory differentially influences word learning occurring in different contexts, additional research is needed comparing potential effects of phonological memory on different experimental word learning tasks (i.e., explicit and incidental) within the same sample of children.

Results from this study converge with those of Ramachandra et al. (2011) by reporting that phonological awareness, but not phonological memory, associates with incidental word learning. This is particularly significant, considering methodological differences between the studies. In this study, we used real words, unlikely to be familiar to 5-year-olds, rather than nonsense words, as used by Ramachandra et al. Real words and nonsense words have been shown to differ in phonological structure (Storkel 2013) and, according to Rice (1990), children are sensitive to differences between nonwords and unfamiliar, real words from their native language. Additionally, Ramachandra et al. restricted their target words to nouns, whereas the target words used in the current study included verbs and an affective state word in addition to nouns. Regarding the comprehension task, measurement of comprehension occurred after the children had heard the entire story on two separate days with a delay (administration of the phonological memory task) between the final story reading and the comprehension measure. Conversely, Ramachandra et al. tested comprehension of the target words immediately following the word learning task. Considering these differences, it seems that the demands of the word learning task, rather than factors such as word type, drive whether phonological memory influences word learning.

One notable difference between the two studies was that the task that best measured phonological awareness changed from Ramachandra's 4-year-old participants to the 5-yearold children who participated in the current study. Ramachandra et al. (2011) did not report differences in performance by their 4-year-old participants on two phonological awareness tasks (alliteration awareness $M = 6.08$; rhyme awareness $M = 7.95$) that parallel those used in this study. However, the current investigation identified that the alliteration oddity measure best captured variation in task performance, whereas performance on the rhyme oddity measure neared ceiling levels, indicating that that measure no longer accurately tapped emerging phonological awareness. These findings are consistent with those of Lonigan et al. (1998).

This study also examined the proposal that phonological awareness and phonological memory are surface manifestations of underlying latent phonological processing (Bowey 1996; Fowler 1991). If the latent processing model is correct, phonological awareness and phonological memory should relate to one another and should also similarly predict word learning success. Data from the current study do not support the latent processing model. Results from a correlation analysis revealed that phonological memory did not significantly correlate with phonological awareness or word learning. Also, while phonological awareness was a significant predictor of incidental word learning, phonological memory was not. This pattern of findings suggests that phonological awareness and phonological memory do not tap into the same underlying construct.

Limitations to the target words in the word learning task may have influenced the results of this study. Post hoc analysis revealed that at pretest, 75% or more children responded correctly on four words with low gain score on these four words. Therefore, these words were excluded from further analysis resulting in the 15 word subset used during evaluation of the research questions. Additionally, at pretest, participants performed at or near chance level on only seven words (*sifting, dollop, anticipate, skillet, feline, pitcher, canine*). Thus, due to potential prior knowledge of the target words, the word learning task was not as powerful as desired.

High performance on the word comprehension pretest by the children in the current study could be the result of the inclusion of target words that were believed to not be in the lexicon of 5-year-old children based on a potentially outdated corpus. During the development of the word learning task, target words not considered likely to be known by 5-year-old children were selected according to the Hall et al. (1984) corpus of words spoken by 4½ and 5-year-old children. The target words were not piloted prior to beginning data collection to establish that preschool children were unfamiliar with the target words. It is possible that children are now exposed to a greater variety of words from conversations, television, and books than during the creation of the Hall et al. (1984) corpus. Therefore, words previously thought to be unfamiliar to 5-year-old children might now be known to them, resulting in decreased validity of the word learning task. A revision to the word learning task might include a pilot investigation to establish a set of target words that are documented to be unfamiliar to preschool children.

Beyond strengthening the word learning task, future directions for this line of research include exploring the role of phonological awareness in word learning in a more diverse sample of children, including children with language impairments and children from socioeconomically disadvantaged backgrounds. Further, because phonological awareness is known to be a malleable ability in preschool, investigation of phonological awareness training on word learning abilities can be explored. The benefit of phonological awareness training is consistent with wide individual variation; if phonological awareness influences word learning, we might expect to see similar variation in the improvement in word learning ability.

Appendix 1

See Table 5.

Table 5

Pronunciations of the words used in the CNRep and in this study's phonological memory measure

Word	Gathercole et al. (1994) pronunciation	Current study pronunciation
ballop	|baləp|	|bæləp|
bannow	|banəʊ|	|bæno|
diller	|dIlə|	|dIlɚ|
glistow	|glIstəʊ|	|glIsto|
hampent	|hampənt|	|hæmpənt|
pennel	|pɛnl|	|pɛnl|
prindle	|prIndl|	|prIndl|
rubid	|rubId|	|rubId|
sladding	|sladIŋ|	|slædIŋ|
tafflest	|tafləst|	|tæflIst|
bannifer	|bənIfə|	|bænəfɚ|
barrazon	|bərəzən|	|bɛrəzɑ n|
brasterer	|brastərə|	|bræstɚ Ir|
commernie	|kɑ mərIn|	|kɑ məra In|
doppelate	|dɑ pəleIt|	|dapəleIt|
frescovent	|frɛskəvɛnt|	|frɛskoəvɛnt|
glistering	|glIstərIŋ|	|glIstɚ Iŋ|
skiticult	|skItIkʊ lt|	|skIdəkɑ lt|
thickery	|θIkərI|	|θIkəri|
trumpetine	|trʊ mpətin|	|trʌ mpətin|
blonterstaping	|blɑ ntəsteIpIŋ	|blɑ ntɚsteIpIŋ
commeecitate	|kəmisəteIt|	|komisəteIt|
contramponist	|kəntrampənIst	|kɑ ntræmpənIst|
empliforvent	|ɛmplIfɔ vənt|	|ɛmplIfɚ vɛnt|
fenneriser	|fɛnəraIzə|	|fɛnərɑ Izɚ|
loddenapish	|lɑ dəneIpIʃ|	|lɑ dənæpIʃ|
penerriful	|pənɛrIfl|	|pɛnərIfl|
peplisteronk	|pɛrplIstəroŋk|	|pɚplIstɚ ɑ ŋk|
stopograttic	|stɑ pəgratIk|	|stɑ pəgrætIk|
woogalamic	|wugəlamIk|	|wugəlæmIk|

Appendix 2

See Table 6.

Table 6

Percent correct and percent gain for words used in the word learning task

Word	Pretest % correct	Posttest % correct	Percent gain
anticipate	27.3	45.5	18.2
apron	75.8	87.9	12.1
barrel	72.7	93.9	21.2
batter	48.5	57.6	9.1
canine	21.2	57.6	36.4
churned	39.4	63.6	24.2
disappointed	84.8	90.9	6.1
dollop	33.3	51.5	18.2
feline	24.2	69.7	45.5
gallon	63.6	75.8	12.2
ingredient	78.8	84.8	6.0
pitcher	21.2	45.5	24.3
pocketbook	66.7	93.9	27.2
recipe	63.6	93.9	30.3
shawl	42.4	60.6	18.2
sifting	33.3	66.7	33.4
skillet	24.2	75.8	51.6
spatula	81.8	93.9	12.1
stroll	57.6	72.7	15.1

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Table 1

Sequence of administration of measures and tasks

Visit	Research activities and measures
First visit	1. PPVT-III
	2. EVT
	3. Word comprehension (pretest)
	4. Rhyme oddity
	5. Story reading (experimental word learning task)
Second visit	1. Phonological memory
	2. Story reading
	3. Alliteration oddity
	4. Word comprehension (posttest)

PPVT-III Peabody Picture Vocabulary Test, Third Edition; *EVT* Expressive Vocabulary Test

Table 2

Means (and standard deviations) for independent and dependent variables

Measure	Mean (SD)
PPVT-III standard score	108.43 (9.51)
EVT standard score	105.34 (11.13)
Rhyme oddity (max = 20)	11.14 (4.38)
Alliteration oddity (max = 20)	9.31 (3.52)
Phonological memory (max = 30)	19.80 (5.58)
Word comprehension pretest (max = 15)	6.51 (2.80)
Word comprehension posttest (max = 15)	10.40 (2.80)
Pretest–posttest gain score	3.89 (3.06)

PPVT-III Peabody Picture Vocabulary Test, Third Edition (M = 100, SD = 15); *EVT* Expressive Vocabulary Test (M = 100, SD = 15)

Raw scores are provided for rhyme oddity, alliteration oddity, phonological memory, word comprehension pretest and posttest and gain score

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Table 3

Correlations between dependent and independent Variables

	Gain	Pretest	Posttest	RO	AO	PM	PPVT-III
Pretest	−.546**						
Posttest	.545**	.404*					
RO	.206	−.105	.120				
AO	.165	.228	.408*	.488**			
PM	.113	−.148	−.025	.399*	.093		
PPVT-III	.077	.339	.423*	.214	.503**	−.060	
EVT	−.061	.230	.163	.353*	.391*	.277	.368*

PPVT-III Peabody Picture Vocabulary Test, Third Edition; *EVT* Expressive Vocabulary Test; *RO* rhyme oddity; *AO* alliteration oddity; *PM* phonological memory

** Correlation is significant at the 0.01 level (two-tailed),

* correlation is significant at the 0.05 level (two-tailed)

Table 4

Multiple regression analyses

Analysis	Variables (in order of entry)	R^2 change
1	1. Pretest	.164*
	2. Alliteration oddity	.105*
	3. Phonological memory	
2	1. Pretest	.164*
	2. Alliteration oddity	.105*
	3. Phonological memory	.000
3	1. Pretest	.164*
	2. Phonological memory	.001
	3. Alliteration oddity	.104*

*Correlation is significant at the 0.05 level