Phonological Sensitivity as a Cornerstone
of Language Learning and Literacy Acquisition

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A large body of empirical research has consistently demonstrated that phonological processing skills, especially phonological awareness (the ability to manipulate the sound structure of words at the phoneme level), are significantly related to early reading achievement and predictive of later reading achievement (Stone & Brady, 1995; Lonigan et al., 1998). Further, researchers have suggested that the quality of a word's phonological representation in the lexicon and in working memory (referred to here as phonological precision) may influence the development of phonological awareness and thus decoding skills (Bradym 1995; Fowler, 1991; McBride-Chang, 1995; Lonigan et al., 1998; Elbro, Borstrom, and Petersen, 1998).

These studies are valuable in helping us see the relation of the precision of phonological representations and the development of phonological awareness, with the purpose of taking a closer look at the development of phonological processes that influence decoding. However, it seems quite possible that the precision of children's phonological representation may influence their language learning, more generally. Two particular areas of learning that might be affected are vocabulary (i.e., precision affecting the child's encoding of sound strings with sufficient identifiable features to make them distinct in memory) and morphology (i.e., children's sensitivity to the grammatical endings of words and thus the semantic and syntactic roles they play in sentences). A second issue that is important to understand is the nature of the relation of phonological sensitivity to outcome measures of language and literacy. We might ask, for instance, whether phonological precision is important because of its influence on phonological awareness or whether it is important because it has a direct effect on children's language learning. The purpose of this study, then, was to investigate the relations of phonological precision and outcome measures of vocabulary, word reading, and reading comprehension with a special interest in the mediating role of phonological awareness.
Phonological Sensitivity

Phonological Precision, Phonological Awareness, and Reading

Speculation about the role of phonological precision in early reading ability is based on investigations of speech perception and production, memory and lexical access (Fowler, 1991; McBride-Chang, 1995; Stone & Brady, 1995; Elbro, Borstrom, & Petersen, 1998). Various studies have found that poor readers are less able to distinguish between speech contrasts, repeat and produce phonologically complex or unfamiliar words and sentences, retain lists of words, numbers, and objects, and to rapidly and accurately name familiar items (Fowler, 1991). Performance in each of these areas is not dependent on phonological awareness, but is indicative of the construction, retrieval, and preservation of a word’s phonological representation in the lexicon.

Phonological precision appears to be developmental, as words stored in children’s lexicons evolve from more holistically represented units into more precisely represented word parts, progressing from the syllable eventually to the phoneme (Fowler, 1991). Changes in phonological precision are evidenced in children’s performance on phonological awareness tasks. For example, preschoolers are able to categorize words by syllable structure but not by phoneme, and they tend to group words based on global similarity while adults tend to group by similar phonemes (Fowler, 1991).

Though research suggests that phonological precision is a phonological processing skill that is independent of phonological awareness, there is reason to believe that phonological precision supports the development of phonological awareness, and thus reading development (Fowler, 1991; McBride-Chang, 1995; Stone and Brady, 1995; Elbro, Borstrom, and Petersen, 1998). It may be difficult to manipulate the sound structure of words that are not precisely formed. Further, precise representations of words may aid in accurate recoding of grapheme-phoneme correspondences from memory.

In a recent longitudinal study, Elbro, Borstrom, and Petersen (1998) followed children of parents with and without dyslexia from the beginning of kindergarten until the
beginning of second grade. In addition to administering decoding and linguistic awareness tasks, the researchers also administered two phonological precision tasks: picture-naming accuracy and speed task (to assess ease of access to phonological representations) and phonological distinctness (a pronunciation task in which the experimenter produced an ill-formed pronunciation of a word and then asked the child to give a clearer pronunciation of the word). They considered that there might be two avenues through which phonological distinctness might affect literacy acquisition. One was through its influence on the development of phonological awareness, and the other was a direct impact of word reading: “The automatic extraction of grapheme-phoneme correspondences operating at levels above single letters may be directly dependent on the quality of the phonological representations” (p. 40). These researchers found that the measures of phonological precision were predictive of phonological awareness in second grade after controlling for articulation, vocabulary, and early phoneme awareness. Measures of phonological precision also independently contributed to the prediction of dyslexia. However, left unanswered are questions about the relationship between phonological precision and other language and literacy skills.

**Phonology and Language Learning**

It is quite likely that phonological processing plays a role in language development, not just reading development. Reading is a language-based task, and it is possible that all components of the linguistic system must work interactively as children learn language (oral and written). Studies of phonological processing have indicated that phoneme awareness, naming, and phonological short-term memory are three factors that affect reading development (Wagner & Torgesen, 1987). However, the precision of phonological representations might affect word learning and thus vocabulary acquisition. When lexical encoding (perception) is incomplete or imprecise, formation of lexical representations in memory might be problematic (Fowler, 1991). Thus, the child who does not have a complete encoded representation of a word might not recognize it as a
familiar lexical item when that word is heard again. The reinforcement of multiple exposure to words used incidentally in different contexts is the basis for word learning (Nagy & Anderson, 1984; Nelson, 1986).

Along with vocabulary acquisition, children's developing morphological knowledge and morphological might be affected by the degree to which child's phonological representations of words are precise. Though there is considerably less research on morphological than phonological contributions to early reading development, there is evidence of a relationship between morphological awareness, phonological awareness, and decoding ability in young children (Carlisle & Nomanbhoy, 1993; Fowler & Liberman, 1995). Morphemes carry syntactic and semantic meaning through the phonological analysis of word endings. Inadequate phonological representations of words may lead to incomplete understanding and production of lexical items, further impeding decoding and comprehension of words.

In past studies, the construct of precise phonological representations has been referred to in different ways. Brady (1997) reviewed the literature on categorical perception and found that categories of phonemes are sometimes perceived less well by children who are poor readers. In addition, children were likely to have difficulties distinguishing phonetically similar items, even when they were not categorically ambiguous. She also reported studies that indicated that children used lexical information to aid in identification of words that varied on syllable contrasts.

A second type of task used to assess the precision of children's phonological encoding involves speech repetition. Numerous studies have found that less skilled readers have more difficulty repeating back words, nonwords, or phrases than more skilled readers. The effects are more pronounced when longer words or pseudowords are used in the repetition task. Speech repetition tasks place a number of demands on children. The stimulus must be perceived and encoded, and it must be held in memory while the process of articulating the same word aloud is completed. Even if nonwords are
used as stimuli, known words and components of words may be used to process the phonological representation provided by the examiner. Thus, the less familiar the individual sounds or sound patterns within a word, the more difficult the item will be for the child to encode, hold in memory and reproduce accurately. Thus, we might suppose that sounds within words and nonwords that are not part of an individual child's spoken language or dialect would be prone to error. For example, an African American dialect speaker who is likely to use unmarked forms of verbs (e.g., "He go to the store") might be less likely to include inflections when asked to repeat words or nonwords with inflectional endings.

Brady discussed the concern that vocabulary may affect performance on word repetition tasks. That is lexical mediation may provide a basis for processing even pseudo words. However, while it is common to find that vocabulary knowledge is significantly related to performance on repetition tasks, this finding does not specify the nature of the relation in terms of children's language and literacy learning. As noted above, it is likely that the precision of children's phonological representations affect their language learning over time.

**Research Questions**

The study is focused on the development of phonological processing at the point when children start formal schooling and instruction in reading, the design is cross-sectional and seeks to map out relations of language learning and literacy development through examination of concurrent performances on different measures. Developmental and causal relations are cautiously inferred from the results of regression and path analyses. The research questions were as follows:

(a) Is there a significant relationship of phonological precision measures and measures of phonological awareness for kindergartners and first graders? Is there developmental growth in these years in performance on measures of phonological precision (in and out of context) and measures of phonological awareness?
(b) Is there a relation between phonological precision and representation of inflectional endings in sentence repetition?
(c) Do phonological precision contribute directly and indirectly (i.e., through phonological awareness) to performance on vocabulary, word reading, and passage comprehension measures for kindergartners and first graders?

Method

Participants

Participants were 51 kindergarten and 54 first-grade students who had received parental permission and who did not exhibit severe articulation, fluency, and/or language problems participated in the study. The children attended kindergarten and elementary schools in a small Midwestern town. The kindergartners included X boys and X girls; first graders included X boys and X girls. The ethnic characteristics of the schools are shown in Table 1. The performance of the children on the standardized reading and language tests is shown in Table 2.

Materials and Measures

Measures used for this study were drawn from a larger battery of tests administered to the kindergarten and first-grade children. Only those measures used for this study are described here. The following standardized tests were administered to the children.

Phonological Processing: Children were administered two subtests of the Comprehensive Test of Phonological Processing (CTOPP, Wagner, Torgesen & Rashotte, 1999): Sound Matching, Elision. Sound matching involved identifying a word from a set that began or ended with the same letter as the word spoken by the examiner, with pictures used to support children’s memory for the options. Elision involved asking the children to say a word and then delete a specific sound from that word.

Reading and Pre-reading Skills: To assess reading and pre-reading skills, children were administered three scales from the Woodcock-Johnson III Tests of Achievement (WJ-III,
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Woodcock, McGrew & Mather, 2001). The three subtests used were Letter-Word Identification, Passage Comprehension, and Word Attack.

Receptive Vocabulary: The Peabody Picture Vocabulary Test-III, Form A, was used to measure children’s receptive vocabulary (PPVT-III, Dunn & Dunn, 1997).

A battery of experimental linguistic awareness tasks was also administered. The two measures reported here are Nonword Repetition and Silly Sentence Repetition. The two tasks were designed to assess the precision of children’s phonological representations in different ways.

Non-word Repetition Task: This task was designed to measure children’s phonological precision, or their ability to remember and reproduce all of the sounds in words. Nonsense words were used so that differences in children’s word knowledge would not influence their performance on the task. Each nonsense words ended with an inflectional form (e.g. seekt, fets, lutting). Children were instructed to repeat the word said by the examiner. (e.g. “Listen to this word: seekt. Now can you say the word just as I said it?”). Two training items were administered to all children. All children were administered all items. The total score in this task was the number of items answered correctly.

Silly Sentence Repetition: The purpose of this task was to measure the child’s ability to remember and reproduce words in short sentences, thus having context to aid in processing the phonological representation of the words. The sentences contained high-frequency words and familiar names and were controlled for length so that memory load would not be a significant factor in recall of the précis lexical items in the sentences. In addition, one or more words in each sentence ended with an inflection (e.g., plural or past tense). The task consisted of ten “silly” sentences so that the children were required to process the particular words in each sentence (e.g. “Sue cooked two black dresses”). The task contained a total of 21 inflected words (4 past tenses, 9 plurals, 2 present progressive forms, 2 third person inflections, 2 possessives and 2 superlatives). Children were asked to repeat each sentence exactly as said by the examiner. Two training items were
administered to all children. Two scores were obtained from this task. The first was a sentence-score obtained by counting the number of sentences that the child successfully reproduced verbatim (hereafter referred to as SSR). The second was based on the number of inflected words for which the child successfully produced the correct word ending (hereafter, Word Ending).

Procedures

The children were tested individually at their schools during the school day in two sessions of 25-30 minutes each. Sessions were randomly ordered and administered on different days. Session one included the Comprehensive Test of Phonological Processing, the Linguistic Awareness Test, and the Alphabet Test. Session two was comprised of the Woodcock Reading Mastery subtests, the Peabody Picture Vocabulary Test, and two measures not included in the present report (a Picture Description task and a Narrative Comprehension measure).

Results

Relation of Phonological Precision and Phonological Awareness

The first question concerned the relationship of phonological precision measures and measures of phonological awareness for K and grade 1 children, and further asked whether performances suggest developmental growth on measures of phonological precision (in and out of context) and measures of phonological awareness. The phonological precision variables included Nonword Repetition (NR) and Silly Sentence Repetition (SSR). Scores for these measures were total items correct; the performances were then converted to z-scores. The phonological awareness variables included the Elision and Sound Matching subtests of the CTOPPP; performance on these subtests were also converted to z-scores. As a follow-up measure, we also calculated the performance of the students on the inflectional endings of the words on SSR (e.g., past tense of verbs, plurals and possessives). This measure of Word Endings (WE) was used.
to address the specific question of children's encoding and ability to reproduce phonological markers that serve grammatical roles at the ends of sentence.

The correlation matrix in Table 3 shows the relations among these variables for the kindergartners in the top half and for the first graders in the bottom half. In general, the relations that involved experimental measures were somewhat stronger for the kindergartners than the first graders. An important finding was that NR was not significantly related to performance on the phonological awareness measures whereas SSR was.

To address the second of these questions, separate ANOVAs were run for the phonological precision measures and the phonological awareness measures. In each case, grade level was the between-subjects factor. The performance of the grade-level groups on these measures is shown in Table 4. For the ANOVA focused on phonological precision, context was treated as the within-subjects factor (words in isolation on the Nonword Repetition task vs. words in context on the Silly Sentence Repetition task). The results showed that the effect for group was not significant, $F(1, 102) = .851, p = .34$, the effect for context was not significant, $F(1, 102) = .007, p = .93$. However, the interaction was significant, $F(1, 102) = 6.96, p < .01$. Post hoc (Tukey's HSD) showed that the kindergartners were significantly stronger than the first graders on NR but weaker than the first graders on SSR, although this difference was not significant.

A second ANOVA was run to compare performance on NR and the Word Endings from the SSR. (See Table 5 for performance of the grade-level groups). Again, grade-level group was a between-subjects and task was a within-subjects factor, so that precision of whole word and word-ending performance could be compared. Three children who were unable to repeat sentences accurately were eliminated from this analysis. Results showed that there was no significant effect for group, $F(1, 99) = 2.04, p = .16$, but the effect for task was significant, $F(1, 99) = 15.18, p < .001$. The interaction was not significant, $F(1, 99) = 2.73, p = .10$. 

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A third ANOVA was run to compare performance on the two phonological awareness measures, Elision (EL) and Sound Matching (SM). The results showed that there was a significant effect for group, $F(1, 102) = 14.26, p < .001$. The effect for task was not significant, $F(1, 102) = .07, p = .78$. The interaction was significant, $F(1, 102) = 3.77, p < .05$. Post hoc analyses showed that the first graders performed significantly better than the kindergartners on both EL and SM. In addition, there was a greater difference for the two groups on SM than EL.

**Contribution of Phonological Precision and Awareness to Literacy and Vocabulary Measures**

The question concerned the contribution of phonological precision and phonological awareness, together and independently, to performance on vocabulary, word reading, and passage comprehension for kindergartners and first graders. To answer this question, we first combined the performances on the two phonological precision tasks and the two phonological awareness tasks by averaging the z-scores; thus PP was the average of NR and SSR while PA was the average of EL and SM. A correlation matrix giving the relation of PP, PA and three outcome measures (Letter Word Identification, Passage Comprehension, and Receptive Vocabulary) is found in Table 6.

Then standard regression analyses were carried out to determine the direct relation of phonological precision and three outcome measures: LW, PC and RV. In addition, the indirect influence of PP on these outcome measures (that is, effects of PA, which then affect the outcome measures) were calculated. The results of these analyses for each grade level group are shown in Tables 7 and 8. The only path that did not have a significant beta weight was the contribution of PP to PC for the kindergartners.

The three path analyses for each grade level are shown in Figures 1 and 2. These indicate that the PP makes a significant direct contribution to the each of the outcome measures except (as noted above) in the case of PC for kindergartners. PP also
contributed significantly to PA at both grade levels, and the contribution of PA to the three outcome measures was significant for both grade-level groups. The unexplained variance is estimated for PA and for the outcome measure; the high values of U indicate that much of the variance in PA and the outcome is not explained by the variables included in this model.

Discussion

The purpose of the study was to consider the role of phonological sensitivity in language learning and literacy acquisition. Of particular interest was the precision of children’s phonological representations to their developing phonological awareness and literacy and language skills. Phonological precision refers to the quality of a child’s encoding of the phonological features of words and nonwords and their ability to reproduce words and nonwords accurately. Several researchers have suggested that phonological precision plays a role in children’s literacy acquisition in two ways: it influences the development of their phonological awareness (e.g., Brady, 1997; Elbro et al., 1998) and it influences their ability to learn letter-sound relations (for letters, letter patterns, syllables, and morphemes) that are at the heart of the decoding process (e.g., Elbro et al., 1998; Fowler, 1991). We revisit these issues for several reasons. One is to consider the role of phonological precision in morphological learning and vocabulary development. A second reason is to examine the direct and indirect roles of phonological precision for both kindergartners and first graders.

The results of the study indicated that

NOTES:

1) Phonological precision contributes both directly and indirectly (through its influence on developing phonological awareness) to performance on word reading, reading comprehension and receptive vocabulary development. The only exception was that phonological precision did not contribute directly to passage comprehension for kindergartners. This may not be surprising, because
performance on reading comprehension for kindergartners largely hinged on their ability to identify pictures that represented a small number of sight words.

2) Phonological precision contributes to the development of phonological awareness. However, when a breakdown of the two tasks (NR and SSR) is considered, it appears that SSR was responsible for this significant relation. It may be that the NR task was less challenging for the children, thus had less power to discriminate children with varying degrees of precision in their ability to reproduce words spoken to them. As Brady (1997) commented, speech repetition tasks are most likely to tap differences in phonological processing when they are long words, more unusual sound structures, or pseudowords. While pseudo words were used for this task, they contained either one or two syllables with an inflected ending.

3) Phonological precision and phonological awareness contributed not only to word reading and reading comprehension but also to reading vocabulary. Thus, the results are similar to those of Elbro et al (1998) but extent them to vocabulary as well. The premise in this study was that over time, phonological precision would affect word learning. This premise appears to be supported by the results of the regression analyses. In terms of phonological awareness, other researchers (refs) have found that the extensiveness of a child’s vocabulary explains in part the development of phonological awareness. The reverse is apparently also supported here: the development of phonological awareness contributes to the child’s developing vocabulary. It is possible that the phonological awareness measure is a proxy for the child’s ability to take an analytic approach to working with words.

4) Our investigation of phonological precision included one measure of sensitivity to morphological markers on words, specifically inflections at the end of words (e.g., plurals, past tense markers). The children’s word endings on the SSR task were overall quite accurate. Even though there were a number of children who spoke to us with African American dialect, they were able to hear the word
endings and reproduce them on the Silly Sentence Repetition task with greater than 90% accuracy for the two grade levels. This finding is of some interest not only because of issues of dialect use in schools but also because children who are poor readers and children with speech and language disabilities are known to have significant difficulties using inflectional forms (Leonard, 1998).

5) A better model for explaining variance in the outcome measures would not be hard to build—in fact, others have made such attempts (e.g. Cutting & Denckla, date?). Because the purpose of the present model was to examine specifically the role of phonological precision and phonological awareness, other measures that we have of these children’s early literacy acquisition (e.g., alphabet) were not used. Furthermore, there are ways in which other aspects of language learning may be affected by phonological sensitivity. Further research is needed to explore the relation of phonological sensitivity to aspects of morphological and grammatical awareness, for example.
References


Table 1
Characteristics of children from the kindergarten and first-grade schools

<table>
<thead>
<tr>
<th>Student Characteristics</th>
<th>School Characteristics</th>
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<tr>
<td>Grade</td>
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<td>21</td>
</tr>
<tr>
<td>1st grade – school #1</td>
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</tr>
<tr>
<td>1st grade – school #2</td>
<td>9</td>
</tr>
<tr>
<td>1st grade – school #3</td>
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Table 2
Kindergartners and First Graders Performance on Standardized Reading and Language Tests

<table>
<thead>
<tr>
<th></th>
<th>CTOPP</th>
<th>WJPB</th>
<th>PPVT-III</th>
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<tr>
<td></td>
<td>Elision</td>
<td>Sound</td>
<td>Letter Wd</td>
</tr>
<tr>
<td>Kind</td>
<td>9.6</td>
<td>9.2</td>
<td>100.9</td>
</tr>
<tr>
<td></td>
<td>(2.3)</td>
<td>(2.4)</td>
<td>(12.4)</td>
</tr>
<tr>
<td>First grade</td>
<td>9.1</td>
<td>9.2</td>
<td>101.5</td>
</tr>
<tr>
<td></td>
<td>(2.4)</td>
<td>(1.9)</td>
<td>(15.5)</td>
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Table 3

Correlations of Measures of Phonological Precision and Phonological Awareness

<table>
<thead>
<tr>
<th></th>
<th>NR</th>
<th>SSR</th>
<th>WE</th>
<th>EL</th>
<th>SM</th>
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<td>NR</td>
<td>--</td>
<td>.57***</td>
<td>.20</td>
<td>.20</td>
<td>.14</td>
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<tr>
<td>SSR</td>
<td>.42**</td>
<td>--</td>
<td>.53***</td>
<td>.52***</td>
<td>.30*</td>
</tr>
<tr>
<td>WE</td>
<td>-.10</td>
<td>-.09</td>
<td>--</td>
<td>.29*</td>
<td>.28*</td>
</tr>
<tr>
<td>EL</td>
<td>.14</td>
<td>.44***</td>
<td>-.11</td>
<td>--</td>
<td>.67***</td>
</tr>
<tr>
<td>SM</td>
<td>.23</td>
<td>.51***</td>
<td>-.09</td>
<td>.69***</td>
<td>--</td>
</tr>
</tbody>
</table>

Note. Correlations for the kindergartners are shown on the top half and for first graders on the bottom half of the matrix. NR = Nonword Repetition; SSR = Silly Sentence Repetition; WE = word ending measure; EL = Elision (CTOPP); SM = Sound Matching (CTOPP).

* p < .05, ** p < .01, *** p < .001
Table 4
Kindergartner's and First Graders' Performance on the Phonological Precision and Phonological Awareness Measures

<table>
<thead>
<tr>
<th></th>
<th>Phonological Precision</th>
<th>Phonological Awareness</th>
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<tr>
<td></td>
<td>NR</td>
<td>SSR</td>
</tr>
<tr>
<td>Kind</td>
<td>.285 (.900)</td>
<td>.051 (.998)</td>
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<tr>
<td>First Grade</td>
<td>-.104 (.939)</td>
<td>.146 (.914)</td>
</tr>
</tbody>
</table>

Note. Numbers represent z-scores. NR = Nonword Repetition; SSR = Silly Sentence Repetition; EL = Elision (CTOPP); SM = Sound Matching (CTOPP).

Table 5
Kindergartners' and First Graders' Performance on the Nonword Repetition and Word Ending Accuracy Measures (% of opportunity)

<table>
<thead>
<tr>
<th></th>
<th>Nonword Repetition</th>
<th>Word Ending Accuracy</th>
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<tbody>
<tr>
<td>Kindergartners</td>
<td>88.0 (15.1)</td>
<td>92.6 (8.0)</td>
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<tr>
<td>First Graders</td>
<td>81.9 (21.2)</td>
<td>93.0 (8.1)</td>
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Table 6

Correlations of Experimental Measures of Phonological Precision, Phonological Awareness, Reading and Vocabulary

<table>
<thead>
<tr>
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<th>PA</th>
<th>LW</th>
<th>PC</th>
<th>RV</th>
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<td>--</td>
<td>.38**</td>
<td>.37**</td>
<td>.19</td>
<td>.50***</td>
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<td>.53***</td>
<td>.56***</td>
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<td>.72***</td>
<td>.27</td>
</tr>
<tr>
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<td>.92***</td>
<td>--</td>
<td>.10</td>
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<tr>
<td>RV</td>
<td>.41**</td>
<td>.38**</td>
<td>.37**</td>
<td>.43***</td>
<td>--</td>
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</table>

**Note.** Correlations for the Kindergartners are on the top and for the first graders are on the bottom. PP = Phonological precision; PA = Phonological awareness; LW = Letter-Word Identification (WJPB); PC = Passage Comprehension subtest (WJPB); RV = receptive vocabulary (PPVT-III).  
*p < .04, **p < .01, ***p < .001
Table 7

Regression Results for Path Analyses Showing Contributions of Phonological Precision (Direct and Indirect) to Reading and Vocabulary Measures for Kindergartners

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Independent variable</th>
<th>Beta</th>
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<th>t-value</th>
<th>p-level</th>
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<td>PP</td>
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<td>.118</td>
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</table>

Note. PP = Phonological Precision; PA = Phonological Awareness; LW = Letter-Word Identification (WJPB); PC = Passage Comprehension subtest (WJPB); RV = receptive vocabulary (PPVT-III).
### Table 8

Regression Results for Path Analyses Showing Contributions of Phonological Precision (Direct and Indirect) to Reading and Vocabulary Measures for First Graders

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Independent variable</th>
<th>Beta</th>
<th>St. error of beta</th>
<th>t-value</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA</td>
<td>PP</td>
<td>.420</td>
<td>.127</td>
<td>3.30</td>
<td>.002</td>
</tr>
<tr>
<td>LW</td>
<td>PP</td>
<td>.360</td>
<td>.129</td>
<td>2.78</td>
<td>.007</td>
</tr>
<tr>
<td>LW</td>
<td>PA</td>
<td>.682</td>
<td>.102</td>
<td>6.66</td>
<td>.000</td>
</tr>
<tr>
<td>PC</td>
<td>PP</td>
<td>.444</td>
<td>.124</td>
<td>3.57</td>
<td>.001</td>
</tr>
<tr>
<td>PC</td>
<td>PA</td>
<td>.635</td>
<td>.108</td>
<td>5.87</td>
<td>.000</td>
</tr>
<tr>
<td>RV</td>
<td>PP</td>
<td>.412</td>
<td>.126</td>
<td>3.26</td>
<td>.002</td>
</tr>
<tr>
<td>RV</td>
<td>PA</td>
<td>.381</td>
<td>.129</td>
<td>2.95</td>
<td>.005</td>
</tr>
</tbody>
</table>

*Note. PP = Phonological Precision; PA = Phonological Awareness; LW = Letter-Word Identification (WJPB); PC = Passage Comprehension subtest (WJPB); RV = receptive vocabulary (PPVT-III).*
Figure 1: Path analysis showing direct and indirect effects of phonological precision on phonological awareness and word reading for kindergartners
Figure 2: Path analysis showing direct and indirect effects of phonological precision on phonological awareness and word reading for first graders
Phonological Sensitivity 24

**Diagram:**

1. **Phonological Precision**
   - (0.444***)
   - (0.420**)
   - (0.635***)
   - U = 0.742
   - U = 0.908

2. **Phonological Awareness**
   - U = 0.908

3. **Passage Comprehension**
   - (0.635***)
   - U = 0.742

4. **Receptive Vocabulary**
   - (0.412**)
   - (0.420**)
   - (0.381**)
   - U = 0.884
   - U = 0.908