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ACCEPTANCE

This dissertation, WORD READING STRATEGY DEVELOPMENT OF DEAF AND HARD-OF-HEARING PRESCHOOLERS, by VICTORIA BURKE, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Doctor of Philosophy in the College of Education, Georgia State University.

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International Reading Association
Society for Research in Child Development
Society for the Scientific Study of Reading

ABSTRACT

WORD READING STRATEGY DEVELOPMENT OF DEAF
AND HARD-OF-HEARING PRESCHOOLERS
by
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Siegler's (1996) overlapping waves model of strategy development applied to reading posits that children use multiple strategies to read words from the earliest stage of reading development, that these strategies coexist over a long period of time, and that experience results in gradual change in the strategies children use and the effectiveness with which they are executed. Phonological recoding is one of the most effective early developing reading strategies and is predictive of future reading success for hearing children (Ehri, 2005; Juel & Mindencupp, 2000; Share & Gur, 1999). However, less is known regarding the extent to which young children who are deaf and hard of hearing (DHH) develop and use phonological strategies to read words. Due to technological advances such as cochlear implants and digital hearing aids, many DHH children have sufficient functional hearing to be able to perceive and represent spoken language. For these children, beginning reading strategies may resemble those of hearing children (Geers, Tobey, Moog, & Brenner, 2008; Lederberg, Schick, & Spencer, in press). The purpose of this study was to describe changes in the word reading strategies of 15 DHH preschoolers with functional hearing. These children received explicit instruction in alphabetic knowledge, phonological awareness, and early reading strategies in a year-long intervention. Instruction was videotaped and children's overt behavior while independently reading words was coded for reading strategy and accuracy. The preschoolers used multiple reading strategies at all times including two phonological recoding strategies (segmenting phonemes only, segmenting and blending phonemes) and

retrieval. Gradual change was observed in strategy choice, execution, and accuracy. Children's use of segmenting only decreased while segmenting and blending phonemes increased between the beginning and middle of the year. Retrieval use increased between the middle and end of the year. Execution of phonological strategies gradually improved over the year. These results suggest young DHH children who have functional hearing develop and use strategies in a manner similar to hearing children and benefit from explicit instruction in the alphabetic principle.

WORD READING STRATEGY DEVELOPMENT OF DEAF AND HARD-OF-HEARING PRESCHOOLERS

by
Victoria Burke

A Dissertation

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ABBREVIATIONS

DHH	Deaf or Hard of Hearing
CI	Cochlear Implant
CVC	Consonant-Vowel-Consonant
GPC	Grapheme-Phoneme Correspondence
GRA	Graduate Research Assistant

CHAPTER 1

READING STRATEGY DEVELOPMENT OF BEGINNING READERS: A REVIEW OF THE LITERATURE

"The key to developing expertise in reading is acquiring reliable strategies for identifying unfamiliar words, based first on letter-sound knowledge and secondarily on context." (Shankweiler & Fowler, 2004, p. 306).

Evidence overwhelmingly supports the necessary but not sufficient role of alphabetic knowledge and the need for explicit tuition in applying the alphabetic principle to word reading (Shankweiler & Fowler, 2004). Theories of word recognition differ in the initial strategies children use on the path to becoming proficient readers (Ehri, 2005; Goswami, 1986). One promising model of strategy development worthy of examination is that proposed by Siegler (1996). The purpose of this review is to examine the theoretical and empirical evidence supporting Siegler's overlapping waves model of strategy development as applied to the variability, adaptive choice, and gradual change in children's development of initial strategies for reading words.

Overlapping Waves Theory

Siegler's (2000) overlapping waves theory of strategy choice is based on three assumptions: (a) children use multiple strategies when solving problems, (b) children are adaptive when choosing strategies, and (c) change in children's strategy use is gradual. This model departs from the traditional stage theories of development that propose children's thinking is characterized by a single way of thinking at each stage and progression from one stage to the next is marked by replacement of old ways of thinking with new ones (Siegler, 1996). Siegler's model proposes that children use a variety of

strategies to solve a given problem, that these strategies coexist over a long period of time, and that experience results in gradual change in the strategies children choose. Change in children's strategies occurs as new, more effective strategies are adopted and older, less effective strategies are discarded. Applied to school-based concepts, strategy choice is adaptive (Siegler, 1988). Children choose between retrieving an answer and using a back-up strategy. A back up strategy is defined as any explicit strategy other than retrieval that increases the likelihood of accurate performance (Rittle-Johnson & Siegler, 1999).

It is likely that strategy choice occurs at the unconscious level and is the result of an associative process that occurs as a result of experience solving problems and using strategies (Kerkman & Siegler, 1993). The distributions-of-associations model (Siegler, 1988) describes the mechanism by which children choose between stating a retrieved answer and using a backup strategy . Through experience with problems and strategies, children form associations of varying strengths between a problem and an answer. Siegler describes the representations that exist between problems and answers as "varying along a dimension of peakedness" (p. 834). A peaked distribution is associated with one answer and a flat distribution is spread among several answers. The child sets a confidence criterion, a threshold to be exceeded by associative strength. If the confidence criterion is exceeded by the associative strength of the answer, then the child states the retrieved answer. If the confidence criterion is not reached, then the child chooses a backup strategy. Retrieval is faster and used most often when there is confidence that its use will produce the correct answer or when speed is more important than accuracy. Backup strategies take longer to execute, but children choose them more often on difficult

problems where confidence is lower and when accuracy is the goal (Siegler, 1996; Siegler, 1988; Kerkman & Siegler, 1993).

The overlapping waves model of strategy development has been studied extensively in algorithmic domains such as arithmetic where a correct application of a back-up strategy always results in a correct answer, however, few studies have investigated the application of this model in non-algorithmic domains. Strategies for word identification can be considered non-algorithmic since accurate execution of back-up strategies does not guarantee success. Three models of reading describe development in terms of the acquisition of reading strategies, and thus may be seen through the lens of Siegler's overlapping waves model (Ehri, 2005; Goswami, 1986, ; Share, 1995).

Theories of Reading Development

Ehri (2005) identifies four strategies children use for identifying words in print. Children can phonologically recode individual phonemes or syllables and blend them together, analogize to a known word, predict from context, or retrieve from memory. Eventually, any word correctly identified enough times becomes a sight word and is retrieved from memory. Sight word learning occurs when connections are formed between the spellings of words and their pronunciations and meanings in memory. This is possible when children come to understand that the letters they see in print map onto the sounds they hear when they pronounce the word. According to Ehri, these "grapheme-phoneme connections provide a powerful mnemonic system" for securing words in memory (2005, p. 172).

Ehri's mediated phase model of sight word acquisition identifies four phases of development characterized by the strategies children use to read and write words (2000,

2005). Pre-alphabetic phase readers have little or no letter-sound knowledge to use in forming connections between print and sound. Instead, they rely on contextual information such as logos on signs or distinctive visual cues in the spellings of words if they attempt to read at all. The partial alphabetic phase is characterized by children's early attempts to use their beginning letter name or sound knowledge to read words. During this phase, children rely on partial letter cues to remember words, usually the initial and final letters. They often find it easier to identify words with initial letters that contain a sound heard at the beginning of the word.

Full alphabetic phase readers know all of the major grapheme-phoneme correspondences and attend to all of the phonemes in a word's spelling when decoding unfamiliar words (Ehri, 2005). They are able to make complete connections between spellings and pronunciations and rarely confuse similarly spelled words. Although not as accurate when spelling words as when reading them, children's spellings represent all of the phonemes heard in the word's pronunciation (Ehri, 2000). Finally, the consolidated phase is characterized by an increasing reliance on retrieving words from memory when reading and spelling (Ehri, 2005). Children develop knowledge of frequently occurring letter patterns, rimes, syllables, and morphemes and use these larger units to make fewer connections between spellings and pronunciations for storing words in memory.

In contrast to Ehri's (2005) phase theory of reading development which places primary importance on letter-sound knowledge and phonemic decoding skills as the basis for early word identification strategies, Goswami's (1998) interactive analogy model emphasizes the role of onset and rime in beginning word identification. Goswami believes children develop skills in rhyming and segmenting first and make use of these

skills to develop an orthographic analogy strategy. When children make analogical comparisons between words they begin to notice spelling-sound correspondences and eventually develop decoding strategies at the individual phoneme level. Thus, according to this model, the larger rime unit is more salient to beginning readers and, although children ultimately develop decoding skills at the phoneme level, orthographic analogy is the initial pathway to becoming a skilled reader. Although both theorists posit that phonological decoding and reading by analogy are strategies children use for word identification, they differ on when analogy becomes available as a strategy. Ehri's phase theory presumes reading by analogy is a later developing strategy requiring some decoding skill and experience to employ on a regular basis (Ehri & Robbins, 1992), while Goswami (1986) proposes that even nonreaders spontaneously use analogy to read when a clue word is present and pronounced for them.

According to Share (1995), phonological recoding serves as a self-teaching mechanism for fast and efficient sight word acquisition. The self-teaching hypothesis proposes children use phonological recoding to develop word-specific orthographic representations in memory and this recoding mechanism is available from the very beginning of learning to read. Children's orthographic and phonological representations develop as their phonological recoding strategies increase in sophistication as a result of experience with print. Unlike theories that describe global changes in the phonological strategies children use as they develop (Ehri, 2005; Goswami, 1998), Share's (1995) model is item-based and proposes children use either a phonological strategy when they encounter an unfamiliar word or retrieve word-specific orthographic information from memory for words they have successfully decoded previously.

Models of reading development described in this section are characterized by the processes children use to read the words they encounter in print. These processes form the basis for the strategies children develop in the course of word learning and spelling and are often described in terms of the strategies available to children during a particular phase of learning (Ehri, 2000, 2005). The following sections describe the variability, adaptive choice and gradual change observed in studies of young children's development of strategies to read and spell words.

Variability

Strategies develop early and are influenced by the knowledge and skills a child possesses in a given domain. In reading, many children know the names of letters before beginning formal reading instruction. Share (2004) examined the causal connection between knowing letter names and learning sounds by teaching Israeli kindergarten children names of six English letters for six letter-like symbols. Some of the names contained the sounds for the letter while others did not. The children then were taught the sounds for each of the symbols without reference to the previously learned names. A second group of children served as controls and were taught meaningful names for the symbols as well as sounds that were unrelated to the names. Results indicated that meaningful names were easier to learn and remember, but learning letter names that contained the letters' sounds facilitated letter sound learning. The second finding is particularly relevant to strategy development. Children who began the training with phonemic segmentation ability used a name-segmentation strategy to remember the letter sounds when letter names contained the relevant letter sound.

Previous research supports a view that young children use a logographic strategy for early word reading, relying on the visually distinct features of a word for its identification (Ehri, 2005). Bowman and Treiman (2008) investigated whether young children could make use of their letter-name knowledge to generate an additional strategy for reading words. Prereaders who could not read any words on a 22-item screening test of simple, high-frequency words were taught sets of words through a paired-associate method. Primarily two-letter non-words were presented in one of four conditions representing two phonologically motivated conditions and two arbitrary conditions. In the phonologically motivated conditions, the vowel name was heard in the word's pronunciation and appeared as either the initial or second sound. In the arbitrary conditions, the letters from the words in the motivated condition were scrambled so that neither phoneme was pronounced in a plausible manner. At pretest, prior to the training sessions, none of the children were able to pronounce or spell any of the training words in the targeted manner and few were able to produce a conventional pronunciation or spelling. Across eight learning trials and a post-test after a brief delay, all children performed better in the phonologically motivated conditions for both reading and spelling the target items. Although the performance difference between the motivated and arbitrary conditions increased across the learning trials, the greatest difference was observed for the phonologically motivated condition where the vowel name was in the initial position of the word. Results from general letter knowledge pretests indicated that these children had considerable letter-name knowledge and perhaps used this knowledge to their advantage in the phonologically motivated conditions. Children who possessed more letter knowledge performed better in all conditions, significantly so in the

phonologically motivated conditions. The authors concluded that 4-year-olds who possess some letter knowledge, but who do not read any words, may use this knowledge strategically and are not limited to a logographic strategy in reading novel words.

Consistent with overlapping waves theory of strategy development, Share and Gur (1999) observed a variety of strategies employed by 4-year-olds and 5-year-olds when reading environmental print, specifically the names of classmates printed on individual lockers in their preschool classrooms. They asked 15 prekindergarten and 15 kindergarten children enrolled in a Hebrew preschool to read the names of their classmates in context on the children's lockers and printed in Hebrew on cards. Although regularly exposed to storybook reading, teacher's writing of names on artwork, access to books for browsing and occasional rhyming and syllabication games, the children received no formal instruction in grapheme-phoneme correspondences or explicit reading strategies. In each classroom children's names were printed in Hebrew on their lockers, sometimes along with stickers appropriate for this age group. The experimenter pointed to a locker and asked each child individually to identify the owner. If the locker's name was correctly identified, the child was immediately asked "how did you know?" Next, each child was presented with the names he or she had correctly identified printed on cards and asked to read the name. This was the without context condition. At a later time, all names correctly identified out of context were presented with the initial letter hidden and then the final letter hidden. The last task involved presenting each child who correctly identified any names out of context with novel names made up of the letters from previously identified names.

Both age groups identified a similar number of names in the context condition but the 5-year-olds identified more names out of context. Less than half of the younger group were able to identify any names out of context while more than 75% of the older children identified at least one name out of context lending support to the hypothesis that the younger children relied primarily on a contextual strategy to identify the names of their classmates. In the novel name task, most 5-year-olds were able to read some new names but the 4-year-olds were unable to name any. The 5-year-olds were not limited to a contextual strategy for reading names and may have used their alphabetic knowledge to read the novel names.

The authors conducted a qualitative analysis of the name identification task, literacy pretest measures, children's self-reports, and errors to determine the individual strategies the children used for identifying names. At least six different strategies were identified ranging from purely contextual, (relying on locker position or stickers on the locker), logographic (relying on visually salient letter information), partial-alphabetic (relying on initial letter cue), and alphabetic (relying on letter by letter recoding of all the letters in the name). More than 60% of the 5-year-olds used more than one strategy and adapted their strategy use to the task. Several used one strategy for reading familiar words and another strategy for novel words. When identifying familiar names, one child used the visual features of the word such as length or the initial letter but when presented with novel names, he used letter by letter decoding. When asked to read six high frequency words, he retrieved two words but would not attempt any others.

Although all of the children used multiple strategies to identify names, most demonstrated a preference for a single, dominant strategy. The four-year-olds

predominantly used context to identify the names. However, none of the 5-year-olds used only contextual strategies. Forty percent of the 5-year-olds used a partial-cue or alphabetic strategy, relying on the initial letter of the name to provide the phonological cue or, as in the case of alphabetic strategy users, using all or nearly all the letters in the name for identification. Of significance was the evidence that the 5-year-olds were spontaneously generating a partial-alphabetic strategy for reading names in a naturalistic setting. Prior to this study, this strategy was observed only in experimental settings.

In a similar study, Levin and Ehri (2009) investigated preschool children's ability to read and spell personal names in Hebrew. They asked 4- and 5-year-old native Hebrew speakers to read their own and classmates' names in and out of context and to write the names they were able to identify out of context. They also investigated the role reading and writing personal names played in developing early reading strategies using acquired letter knowledge and asked the children to report the strategies they used on each reading and spelling task. The children were recruited from three classrooms in a middle-high socioeconomic neighborhood in Israel. The children received no formal instruction in letter knowledge, phonological awareness, word reading or spelling, although teachers wrote children's names on artwork and lockers and encouraged the children to attempt to write their own names. The testing consisted of six sessions with several days between each session. In the first session, children were asked to identify names in context on their lockers. In the second and third sessions, the children were asked to read the same names printed on cards (out of context) they identified correctly on the lockers and then write those names from memory. Four novel names were included in the name reading task to detect if children had access to a decoding strategy. A series of phonological

awareness, letter knowledge, and general cognitive ability assessments were administered.

Most of the children were able to identify their own names in context on their lockers, printed on cards, and write most of the letters in their names. Many children were able to identify some names on the lockers. Almost half of the names on the lockers were identified and approximately two-thirds of these names were identified when printed on cards. The spelling task was more difficult. Though fewer complete spellings were made, many spellings contained a large percentage of correct letters indicating partial cue use. The authors speculated the children may have retrieved an incomplete spelling from memory or attempted to write letters for the sounds they heard in the name. Performance on the phonemic awareness and letter knowledge tasks varied greatly and was used to determine whether these skills were related to success on the name reading and spelling tasks. As predicted by Ehri's phase theory of word identification, letter name knowledge significantly predicted children's ability to read and write names. Phonemic awareness did not explain any additional variance.

They classified children's performance on the reading and spelling tasks based on the strategies the children reported. These explanations fell into three developmental categories: contextual (based on the location of the locker or stickers on the locker), visuo-graphic (visual similarity to another name, letter shape or other visually salient feature of the name), or alphabetic (reference to one or more letters in the name). Based on these categories, 35% of the children gave a contextual explanation, 26% relied on visuo-graphic features, and 24% used letter knowledge to identify names. Over 70 percent of the children reported using more than one strategy. Letter knowledge played a

significant role in the type of strategy the children used. Children with high letter knowledge reported using an alphabetic strategy 48% of the time, children with moderate letter knowledge used alphabetic strategies 18% of the time, and children with low letter knowledge reported an alphabetic strategy 5% of the time. The children used multiple sources of information to read and write personal names including letter knowledge, letter shape, letter position, name length, and contextual cues.

Children who had better name reading skill did not limit their explanations to alphabetic strategies. They also reported using visual and contextual cues as often as children who had less success reading names and possessed less letter knowledge. These findings supported Siegler's (1996) overlapping waves model of strategy development as applied to preschoolers' early strategies for reading and writing personal names. Children used multiple strategies on the same task and use of less sophisticated strategies (e.g., contextual cues) declined as use of alphabetic strategies increased through improved letter knowledge and experience with print (Levin & Ehri, 2009). The authors speculated that exposure to and interest in personal names in the classrooms led to incidental learning of letter names and letter-sound mappings which enabled many of the children to read names from memory and spell at least partial letters in the names (Levin & Ehri, 2009).

Rieben and Saada-Roberts (1997) examined the word-search strategies and word-copying strategies of 11 kindergarteners (mean age 5.5) and 10 first graders (mean age 6.4) at four points during the school year. Children were asked to construct a story from a children's book read to the children by their teacher. The story was dictated to the teacher and the resulting text was displayed on the wall in the classroom. The children then were

asked to draw a picture representing an episode from the story and to write about their drawing using the displayed text as a reference. The researchers inferred seven types of word-search and word-copying strategies from the children's actions.

Strategies for word searching changed from less to more sophisticated during the course of the school year and most children used alphabetic knowledge to search for words despite receiving no explicit instruction in the alphabetic code in the classroom. Between and within child variability was observed during development. Individual children varied in the speed with which they made the transition from less to more advanced strategies and in the types of strategies they used. Further, within child variability was observed with at least four types of strategies used by individual children at each time point. Earlier-developed, less effective strategies continued to be used even as more effective, sophisticated strategies were developing.

Strategies for word-copying were determined by the size and type of the print unit transferred from the larger, visual display to the child's paper. Units included single letters, double letters, digrams, syllables, morphemes, and words. As observed for word-search strategies, as more complex strategies were developed, older, less sophisticated strategies were abandoned. All children demonstrated a variety of strategies at all time points. Again, between and within variability in strategy development was observed as individual children used a variety of different strategies at each time point and discovered new strategies at different times.

This study demonstrates that although typically developing children do move from less to more sophisticated strategies as their knowledge of the domain increases, there is no distinct shift from one way of thinking in one phase to a qualitatively different

way of thinking in the next. Instead, as predicted by overlapping waves theory, there was considerable variability within children's strategy use with early developing, rudimentary strategies coexisting with more advanced strategies for both word searching and word copying. These findings also provide support for Ehri's phase model of word identification and spelling acquisition. Although children progress through various phases of development characterized by the predominant strategy used for reading and spelling words, older strategies persist and are not completely discarded.

Adaptive Choice

When children encounter a problem, whether in an everyday or academic context, they have several competing strategies to choose from. How do they make the choice? Siegler (1996) proposes children and adults adapt their strategy choices based on problem characteristics, task demands, and strategy characteristics.

Even very young children use strategies adaptively. How are strategies for pronouncing novel words influenced by preschoolers' knowledge of reading and letters as well as task difficulty? Ross, Treiman, and Bick (2004) divided 115 preschool children into three groups based on their letter knowledge: pre-readers with low letter knowledge, pre-readers with high letter knowledge, and readers. To determine whether children's knowledge of letter names influenced strategy selection, they presented each group of children with novel words in two conditions, name and visual. In the name condition, the name of the first letter was heard in the word's pronunciation (e.g., TZ for tease). In the visual condition, the first letter did not correspond to the word's pronunciation, but the word was presented in a visually distinctive style to facilitate use of visually salient features (e.g., K_Z for tease). Each set of words was taught to criteria

during three training sessions. Further, to determine if task demands would influence strategy choice, they varied the number of items to be learned from four to five items per session. Children who possessed little letter name knowledge appeared to rely on rote memorization using a non-systematic, visual salience strategy, as described by Ehri's (2005) pre-alphabetic phase. This worked reasonably well for sets containing four items, but less well for the five-item sets. The other two groups, children with high letter knowledge and readers, appeared to have two strategies available to them, the visually-based memorization strategy and an analytic, letter-based strategy for remembering words in the name condition. It appeared that letter knowledge and task demands influenced the strategies these two groups of children used. In the name condition with four items, there was little evidence that the children used their letter knowledge to remember words, preferring the easier strategy of memorizing visually salient features. However, when presented with five items to learn, these children used an analytical, letter-based strategy when the visual strategy appeared to be inadequate. The children responded to the increased task demands of the five-item condition by using a more advanced, though perhaps more effortful strategy, when they possessed adequate knowledge of letters to make use of it.

Brown and Deavers (1999) investigated the question of whether children use an analogical strategy first as proposed by Goswami (1986) or rely on letter-by-letter recoding as described by Ehri & Robbins (1992). Sixty children in first through fourth grade, native English speakers, who received a mixed phonics and whole language literacy curriculum participated. They were presented with two lists of nonwords. One list contained less regular nonwords that only could be read correctly by applying an analogy

strategy rather than a grapheme-phoneme correspondence strategy. The second list contained more regular non-words that could be read correctly by applying grapheme-phoneme correspondence rules. In order to use an analogy strategy to read an unfamiliar word there must be an analogous word stored in memory to serve as a model. To determine whether the children had a basis for the analogy, an equal number of real words sharing the rimes of the nonwords also were presented following the presentation of the nonwords.

Although younger and less experienced readers used both analogy and grapheme-phoneme strategies, they did so less often than older and more experienced readers. A developmental trend was observed in that the less experienced readers relied most often on a grapheme-phoneme strategy, while the more experienced readers used analogy more often on the less regular nonwords. Though the children in the early stages of learning to read used analogy, it was not observed to the extent described by Goswami (1986) nor was it used consistently. Instead, the authors sought to explain their findings by proposing that task demands may influence strategy choice and conducted a second experiment to test the hypothesis that rather than large-unit first or small-unit first, a third possibility they called the flexible-unit-size approach may explain their findings (Brown & Deavers, 1999).

For this experiment, 40 children from the first three years of school, ages 5 years, 7 months to 8 years, 3 months participated (Brown & Deavers, 1999). This time, the 30 real words used in the first experiment were used as clue words for the 30 nonwords. Children were shown the clue word and told that it might help them read another word later. After the child read the clue word (or the experimenter read the clue word and the

child repeated it), the target nonword was presented. The children were classified as skilled (mean reading age of 8 years, 10 months) or less-skilled readers (mean reading age of 6 years, 10 months) based on their performance on the British Ability Scales for reading. Responses were coded for strategy into grapheme-phoneme correspondence (GPC), analogy or other. When the clue word was present, both groups used an analogy strategy on a high percentage of the irregular words and used a GPC strategy significantly less often. The percentage of correct responses on the regular nonwords indicated that the children were adapting their strategy to task demands and using analogy to read a high percentage of the regular words as well.

Finally, a third experiment was conducted to determine whether presenting multiple targets would weaken the effects of the clue word. Thirty children with reading ages ranging from 7 years 1 month to 9 years 5 months participated. The 15 irregular words from the first two experiments served as clue words and each word was paired with four target words. One target shared a rime with the clue word, one shared onset and vowel, one shared common letters in no particular sequence, and one word shared no common letters. The younger children were unable to use an analogy strategy to the same extent as the older children when faced with choosing among four alternatives. To determine whether task demands influenced strategy choice, the authors analyzed the percentage of analogy or GPC strategy on words in isolation, clue word present with one target, and clue word present with multiple targets used by a subset of the children from each of the conditions matched on chronological and reading ages. Children were more likely to use a GPC strategy when no clue word was present and more likely to use an analogy strategy when the clue word was present. The analogy strategy was used most

often when the clue word was presented with a single target than with multiple targets. When the clue was presented with a single target, all children were less likely to provide an “other” strategy response. These results indicate flexibility in strategy choice as a result of task demands. When provided with a clue word and a single target, even the less skilled readers were able to successfully use analogy, however, the results of the two other reading tasks indicate, that at least during the earlier stages of reading development, grapheme-phoneme correspondence strategies are preferred. Perhaps because beginning readers have few words stored in memory to serve as analogs, letter-by-letter recoding is the strategy most likely to result in success. As children become more proficient readers, they have larger reading vocabularies to access and reading by analogy is easier and more effective for irregular words. However, effectiveness depends on knowledge and experience, something the more proficient readers have that the younger readers do not. Reading words without the benefit of a salient clue word is more indicative of most reading activities, however, the results of this study do show that children are adaptive in their strategy choices.

Roberts and McDougall (2003) investigated whether the clue word acted as an orthographic memory aid when the target word shared the orthographic rime as the clue word or whether children were more likely to use phonological rather than orthographic processes when responding to the clue word task. They included words that were analogous phonologically and orthographically, ambiguous words that shared orthography but not phonology and words that shared phonology but not orthography. On each trial, the clue was present and pronounced prior to the presentation of the target word. They found the 4- and 5-year old children in this study most often used a

phonological rhyming strategy on all the word types when the clue word was present and pronounced rather than an orthographic rime strategy.

Reading instruction in the classroom did not place much emphasis on the use of rhyme and the primary strategies children did use to read new words consisted of whole word reading and initial phoneme identification combined with guessing from contextual information. However, in these orthographic analogy tasks, the children appeared to be using a letter naming strategy combined with a phonologically based rhyming strategy to read the target words. In fact, rhyming skills predicted success for the orthographic and phonologically analogous words but not the ambiguous words in the task whereas phoneme awareness and letter knowledge were key predictors for words in that condition. It appears that the children adapted their strategy for reading novel words in response to the demands of the task. One boy described the experience by saying "Reading like this is easy, you just say the first sound and make a rhyme!" (Roberts & McDougal, 2003, p. 328).

Gradual Change

The overlapping waves model assumes that change in strategy choices, execution, and accuracy occur gradually over time (Siegler, 2000). Change occurs in one of four ways: (a) acquisition of new strategies, (b) more frequent use of the most effective strategies, (c) more effective execution of existing strategies, and (d) more adaptive selection of the possible alternatives. Farrington-Flint, et al. (2008) analyzed the frequency, accuracy, and response time for the word identification strategies of 5- to 7-year old children who were in either their first or second year of formal reading instruction. Using a microgenetic method, they observed changes in reported word

reading strategies once a month for a three-month period. Based on children's self-reports and observation of overt behavior while reading lists of words, strategies were identified as retrieval or backup strategies. Backup strategies included any observable behavior such as sounding out, using analogies, or morphological rules, and were classified as phonological strategies, analogical strategies, and other (guessing and inconsistencies between self-report and overt behavior). The majority of the children, regardless of age group (86%), reported using three or more strategies on the first word reading trial. Over the three months, most children continued to report a range of strategies despite a small, but significant shift in reliance on a single strategy reported by the older children.

Gradual change was observed in the type of strategy reported, the effectiveness of the strategy, and efficiency of execution (Farrington-Flint, et al., 2008) consistent with Ehri's phase theory that posits global changes in children's reading strategies with development. Older children were more accurate and used reported strategies more efficiently. Reports of retrieval increased over time for both groups, but the older children were more accurate and faster when using retrieval than the younger children. A small number of children reported changing from retrieval to backup strategy use. This change in strategy resulted in better performance on those items for the younger children, but not for the older children. However, consistent with Share's theory (1995), word specific changes were observed in children's strategy reports when analyzed at the word level indicating adaptive choice. Children reported retrieval most often on high frequency and shorter words and reported phonological strategies more often for low frequency and longer words. Change in strategy reports, from backup strategies on the

initial observation to retrieval on the final observation, was greater for shorter words than longer words.

As part of a longitudinal study of reading development, Chiappe and Siegal (2006) analyzed change in word identification strategies of native English speakers and English language learners between first and second grade. The authors only analyzed backup strategies identified through error analysis. Overall, changes in the types of errors committed between first and second grade reflected growth in alphabetic knowledge and skill in applying GPC strategies. No response errors decreased significantly, use of GPC strategies increased, and instances of guessing and use of semantic and/or first letter strategies gradually declined as reading skill improved. Over the course of the first two years of reading experience, these children demonstrated a greater reliance on using strategies that capitalized on GPC rules. In addition, use of GPC strategies in first grade explained significant variance in second grade word reading.

Instruction

How does reading instruction influence the strategies children choose and use for word recognition? Juel and Minden-Cupp (2000) observed word recognition development in the naturalistic settings of four classrooms from September through May of first grade. The strategies children were taught differed significantly in the four classrooms and ranged from systematic, explicit phonics instruction emphasizing grapheme-phoneme correspondence strategies to an exclusive reliance on visual recognition for sight word learning. For the most part, children used the strategies modeled in their classrooms. These included segmenting and blending individual phonemes, segmenting and blending onset and rime, analogy to a known word, GPC

rules, meaning-based strategies, visual similarity, and retrieval from memory. All of the children attempted to sound and blend individual phonemes, however, successful execution of this strategy depended on the children's phonological processing skills at the beginning of the year and the type of instruction they received. Children who began the year with better phonological skills were able to sound and blend individual phonemes as well as larger chunks in words. In contrast, the children who began first grade with limited letter knowledge and poor phonemic awareness who successfully executed phonological strategies at the end of the year received explicit instruction in the use of an orthographic rime analogy strategy and a sequential, letter-sound strategy along with experience applying these strategies in reading and spelling words. The results of this study support Share's (1995) self-teaching hypothesis for children who enter school with some literacy skills, however, for those children with little alphabetic and/or phonological knowledge, explicit instruction in phonological recoding strategies is necessary before these children can benefit from self-teaching (Juel & Mindencupp, 2000).

Phonological strategies may develop independently from instruction, but successful execution depends on the learner's letter knowledge and phonemic awareness skills. Sears (1999) conducted a longitudinal study of the word reading strategies of 15 children from November through May of first grade observing the children's oral reading of classroom texts on eight occasions throughout the year. Errors were analyzed to infer strategies. Reading instruction focused on using context and text-based strategies to identify words consistent with whole language philosophy. Children used a variety of strategies classified as phonologically based (indicating use of phonological strategies that utilize grapheme-phoneme correspondences), contextually acceptable (semantically

or syntactically consistent with the text), combined, and other (including wild guessing and no response). While not explicitly taught, phonologically-based strategies developed and gradual change was observed as phonological, contextual, and combined strategies increased in frequency across the year, while guessing and no attempts decreased. Further, children's execution of phonological strategies progressed from reliance on initial letter sounds to gradually attending to most or all of the letter sounds in words. The type of text influenced children's errors indicating adaptive choice in strategy selection. When passages were more predictable, children anticipated words that were semantically or syntactically consistent; when passages were not predictable, errors reflected increased use of phonological strategies. Individual differences in strategy choice and change over the course of the year were observed when strategy preferences for high and low progress readers were analyzed. Although both groups used phonological strategies more often than contextual strategies, high progress readers used phonological strategies most often and produced a higher percentage of graphically acceptable errors. Low progress readers made many more word reading errors overall and were less effective in executing whatever strategy they selected. It appears that in the absence of instruction to use letter-sound relationships to read unfamiliar words, many of the children used their letter knowledge to develop phonological strategies for decoding words.

Ryder, Tunmer, and Greaney (2008) conducted an intervention study to determine whether instruction in word level strategies would improve the reading skills of struggling readers. The children were in their second or third year of reading instruction and received exclusive instruction in text level strategies that emphasized using

contextual, semantic, syntactic and visual cues from text to predict words, typical of the whole language approach to reading instruction. Based on their low reading performance, matched pairs of children were assigned to an intervention or control condition. The intervention consisted of 24 weeks of explicit instruction in letter-sound decoding strategies with practice reading decodable texts. The children in the control group received the standard whole language instruction and individual remediation by their classroom teachers. The intervention group significantly outperformed the control group on reading related measures including phonemic awareness, pseudoword decoding, context-free word reading and connected-text reading at the end of the intervention. The children learned phonetically based word-level strategies and continued to use the strategies following intervention. By the time of follow-up testing two years later, the children were within the average range of performance on standardized measures of reading skills.

Although many children will make use of their phonological and alphabetic skills to generate or induce phonological recoding strategies (Tunmer & Chapman, 2002), early reading instruction may influence the strategies children use initially when beginning to read (Walton, Walton, & Felton, 2001). Deavers, Solity, and Kerfoot (2000) observed the influence of instructional approaches that emphasized the development of either large-unit (onset-rime) or small units (individual phonemes) of spelling-to-sound relationships. They were particularly interested in investigating the spontaneous use of orthographic analogy. Children were presented nonwords in isolation or with a clue word present. The type of instruction influenced children's strategy preference, however, instruction in one strategy did not prevent the development of the other. The children who relied most often

on grapheme-phoneme strategies had received the most instruction in letter-by-letter recoding but they often used analogy on the clue word task with the clue word present.

Observing that 4- and 5-year-old children used multiple strategies to read the names of classmates appearing in their classrooms, Share and Gur (1999) conducted training sessions to determine whether concepts about print, alphabetic knowledge or a combination of print awareness and alphabetic skills contributed to the development of more sophisticated word identification strategies. The children were divided into three groups and provided ten 30-minute training sessions in alphabetic skills, print concepts or a combination of code-related and print awareness skills. The code skills group received training in subsyllabic segmentation, initial consonant identification and letter sound knowledge. The print concepts group participated in story reading and other activities designed to promote knowledge about the functions and uses of print, concepts such as word and letter, and that the words not the picture convey the story in books. In the combined group, training was equally divided between code skills and print concepts activities. Strategy change was analyzed for each group. In the code skills group, seven of the ten children demonstrated advanced strategy use following training, while only two children in the concepts group changed strategies. Five children in the combined group utilized more advanced strategies following training. The authors posit a causal role for specific code-related skills in the development of word identification strategies, however, caution that this was a relatively small sample size. An analysis of reading related skills measured after training indicated that gains in alphabetic skills, specifically segmentation, letter names, and matching letters to names were significantly related to strategy

development while gains in print concepts were not, reinforcing the causal role of code-related skills in strategy development.

Children's strategies can be used to infer the processes involved in word recognition and spelling. Levin, Shatil-Carmon, and Asif-Rave (2006) examined the contribution of prereaders' letter-name and letter-sound knowledge to word reading in Hebrew. Children were taught letter names and letter sounds in a counterbalanced order. As a pre- and post-training measure of strategy change, children were asked to select a target word containing letters and/or sounds used during training from two words presented on cards and asked to provide an explanation for their choice. Prior to instruction in letter names or sounds, most children were unable to provide any explanation for their choices, however, explanations following training reflected instruction. Children who were taught letter names first reported using a letter-name strategy to identify words and continued to prefer this strategy following letter-sound instruction. Children who were instructed in letter sounds first reported using letter-sound and letter-name strategies following instruction in both skills. Alphabetic explanations increased over time for both groups and were reported more often for words containing trained letters.

Ouellette and Senechal (2008) described a causal link between the naturally occurring invented spelling strategy used by young children in kindergarten and learning to read words. Children were given feedback designed to gradually improve their orthographic representations when using invented spelling to write training words. Spellings in the invented spelling condition improved significantly over the course of the intervention as the children gradually improved their execution of letter-sound mappings

when writing words. Children progressed in sophistication from representing only the first and/or the last phoneme in the words to full representations of all the phonemes in the word. Further, children who used an invented spelling strategy in the spelling trials performed better on a later word-learning task than a control group who received phonemic awareness instruction but did not use an invented spelling strategy. Both groups performed similarly on a posttest measure of phonological awareness. This study demonstrated the importance of practice and feedback on strategy development and provided evidence of transfer of spelling strategies to reading. Overlapping waves theory proposes that children will use their knowledge of strategies from one domain to generate new strategies in a similar domain (Siegler, 1996).

Conclusion

Siegler described the multiple ways children approach problems as developing in a series of overlapping waves (1996). The studies presented in this paper provided evidence to support the assumption that even very young children use multiple strategies and exhibit variability in the type and frequency of strategy selection (Levin & Ehri, 2009; Share & Gur, 1999). Change is gradual and characterized by multiple ways of thinking at any given point in development as children develop new strategies, discard older, less effective strategies, and more efficiently execute existing strategies (Rittle-Johnson & Siegler, 1999). Strategy choice is adaptive and responsive to task demands. This is reflected in the choice of backup strategy children used to solve problems considered difficult, and the tendency, with experience, towards more reliance on retrieval (Brown & Deavers, 1999; Ross, Treiman & Bick, 2004). The evidence supports instructional models that recognize children solve problems in multiple ways. It is

through experience using backup strategies and feedback regarding their accuracy that children learn to choose strategies effectively and execute them efficiently (Ryder, Tunmer & Greaney, 2008).

There is evidence from observations of children's strategy development to support multiple pathways to acquiring literacy skills. Children may use their letter name and sound knowledge to sound and blend individual phonemes in words (Ehri, 2005; Rieben & Saada-Roberts, 1997) or children may use their knowledge of rimes to make orthographic analogies when it is possible to do so successfully (Brown & Deavers, 1999; Goswami, 1986). However, individual differences in alphabetic knowledge and phonological skills when children enter school significantly impact the course of their reading development (Juel & Mindencupp, 2000). For these children, it appears that explicit instruction in grapheme-phoneme correspondences is necessary if they are to progress to a level of proficient reading (Ryder, Tunmer & Greaney, 2008).

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CHAPTER 2

WORD READING STRATEGY DEVELOPMENT OF DEAFAND HARD-OF-HEARING PRESCHOOLERS

Learning to read is difficult for many children who are deaf and hard-of-hearing. Research on the development of effective word identification strategies used by hearing children overwhelmingly supports the role of alphabetic knowledge and the efficacy of explicit instruction in applying the alphabetic principle from the earliest stages of learning to read (Chapman, Tunmer, & Prochnow, 2001; Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Juel & Minden-Cupp, 2000; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). Phonological recoding is at the heart of word identification and forms the basis for developing automaticity in word recognition for hearing children (Share, 1995; 2004). Less is known regarding the extent to which young children who are deaf and hard-of-hearing (DHH) develop and use phonologically-based strategies to identify words (Harris & Moreno, 2006; Luckner, Sebald, Cooney, Young & Muir, 2005/2006). I investigated whether theories of early word identification developed for hearing children were applicable to DHH preschoolers by examining changes in their reading strategies during the course of a year-long intervention that provided instruction in alphabetic knowledge, phonemic awareness, and phonological recoding.

Theories of Word Identification Development

Ehri (2005) identifies four strategies children use to read and write words. Children can phonologically recode individual phonemes or syllables and blend them together, analogize to a known word, predict from context, or retrieve from memory. Eventually, any word correctly identified enough times is retrieved from memory. Ehri's

phase model of word reading consists of four phases of development characterized by the predominant strategy children use to identify words (2000, 2005). These phases include the pre-alphabetic, partial alphabetic, full alphabetic, and consolidated phases. Pre-alphabetic phase readers have little or no alphabetic knowledge to use in forming connections between print and sound. Instead, they rely on contextual information, such as logos on signs or distinctive visual cues in the spellings of words, if they attempt to read at all. The partial alphabetic phase is characterized by children's early attempts to use their beginning letter-name or sound knowledge to read words. During this phase, children rely on partial letter cues to remember words, usually the initial and final letters. During the full alphabetic phase, readers know all of the major grapheme-phoneme correspondences and attend to all of the phonemes in a word's spelling when decoding unfamiliar words. They are able to make complete connections between spellings and pronunciations and they rarely confuse similarly spelled words. Finally, the consolidated phase is characterized by an increasing reliance on retrieving words from memory when reading. Children develop knowledge of frequently occurring letter patterns, rimes, syllables, and morphemes, and they use these larger units to make fewer connections for storing words in memory.

An early study by Ehri and Wilce (1985) provided evidence to support alphabetic knowledge as a critical element driving the shift from a pre-alphabetic phase of reading to a partial-alphabetic phase. Kindergartners identified as pre-readers, novices, and veterans according to their word reading ability (from no words read to several words read) were taught to read simplified spellings of a word that contained either the letter sounds in the spellings or arbitrary, but visually distinctive spellings. Pre-readers, the children who had

not mastered letter names, learned the visually distinctive words better and relied on a visual-cue recognition strategy for learning the words. The novices and veterans, who had mastered letter names and/or some sounds, utilized a phonetic-cue strategy and found it easier to learn the phonetic spellings. These results indicate that the shift in strategy use, from reliance on the visual features of words characteristic of pre-readers to incorporating phonetically-based strategies for word identification, depends on children's alphabetic knowledge.

A second, more general view of strategy development, Siegler's (1996, 2000) overlapping waves model, posits that children use multiple strategies when solving problems, children's strategy choices are adaptive to task demands, and change in children's strategy selection is gradual. Applied to reading development, the model proposes that children use a variety of strategies to read words from the beginning of reading development, that these strategies coexist over a long period of time, and that experience results in gradual change in the strategies children choose and the effectiveness with which they are executed. Strategy choice is adaptive; children choose between retrieving an answer from memory or using a backup strategy, defined as any explicit strategy other than retrieval that increases the likelihood of accurate performance (Rittle-Johnson & Siegler, 1999). Siegler and colleagues videotaped first-grade children's performance on a word reading task and observed variability and adaption in children's strategy choices (Siegler, 1988; Kerkman & Siegler, 1993). Using observation of overt behavior and children's immediate, retrospective self-reports of strategy use, they determined that children choose between retrieving an answer and using a backup strategy. Children were faster and more accurate when using retrieval, they used backup

strategies (most often sounding out individual phonemes) on more difficult words. Execution and accuracy of backup strategies were related to knowledge and experience.

Hearing Children's Word Reading Strategies

Extensive support for these theories can be found in studies of word reading development conducted with hearing school-aged children. During the first three years of school, children use a variety of strategies reflecting their alphabetic knowledge and gradually progress from reliance on partial letter cues to using complete phonological representations as reading skills improve (Sears, 1999; Chiappe & Siegal, 2006).

In a direct examination of overlapping waves theory applied to reading, Farrington-Flint, Coyne, Stiller, and Heath (2008) analyzed the frequency, accuracy, and response time for the word identification strategies of 5- to 7-year-old children who were in either their first or second year of formal reading instruction. They observed changes in word reading strategies once a month for three months. Self-reported strategies and overt behaviors when reading word lists were used to identify strategies as either retrieval or backup strategies, classified as phonological, analogical, or other (guessing and inconsistencies between self-report and overt behavior). Consistent with Siegler's theory, 86% of the children used at least three different strategies on the first word reading trial and all of the younger children used multiple strategies. Gradual change was observed in the type of strategy reported, the effectiveness of the strategy, and efficiency of execution. This change was also consistent with Ehri's phase theory that posits global changes in children's reading strategies with development. Older children were more accurate and used strategies more efficiently. Retrieval increased over time for both groups, but the older children were more accurate and faster when using retrieval than the

younger children. Word specific changes were observed in children's strategy use when analyzed at the word level indicating adaptive choice. Children used retrieval most often on high frequency and shorter words and reported phonological strategies more often for low frequency and longer words. Change in strategy choice, from backup strategies on the initial observation to retrieval on the final observation, occurred most often on shorter words.

Although many children will use their developing alphabetic knowledge and phonological awareness skills acquired through their experiences with print to generate or induce a phonological recoding strategy, early reading instruction may influence the initial strategies children use (Deavers, Solity, & Kerfoot, 2000; Walton, Walton, & Felton, 2001) and may be most important to those children most at risk for reading failure (Foorman, et al., 1998). Juel and Minden-Cupp (2000) investigated the effects of instruction on children's strategies for word identification when reading word lists and short stories made up of decodable and high-frequency words. Children's self-reports were used to identify eight strategies, reflecting grapheme-phoneme correspondence (GPC), onset-rime, and contextual influences, consistent with the instructional focus of individual classrooms. The weakest performers at the end of the year had difficulty executing any of the strategies they were taught, except for the children who were explicitly taught to sound and blend phonemes and provided extensive opportunities to practice this strategy. Sounding and blending was the predominant strategy of the weakest performers in all of the classrooms, but instruction and practice were the keys to their ability to execute the strategy successfully. Children who entered school with more developed phonological skills were the most successful in making use of larger chunks

and patterns in words. Children with less developed phonological skills at school entry needed more explicit instruction and more experience to execute GPC strategies effectively.

Even young children who have not received formal reading instruction possess some strategies for reading words and can choose from their strategies adaptively. Levin and Ehri (2009) investigated the role reading and writing personal names played in the development of preschool children's early reading strategies. They speculated that children's exposure to their own names would lead to incidental learning of letter names and sounds and that this knowledge would be evident in the initial strategies children used to read. They asked 4- and 5-year old native Hebrew speakers to read their own and classmates' names in and out context (on their lockers in the classroom and printed on cards). Over 70 % of the children reported using more than one strategy and their strategies varied in sophistication. They relied on contextual information (location of child's locker), visual similarity to another name or other visually distinctive features, as well as alphabetic knowledge to read names. Children with high, moderate, and low letter knowledge used an alphabetic strategy 47%, 18%, and 5% of the time, respectively. Use of less sophisticated strategies (e.g., contextual clues) declined and use of alphabetic strategies increased through improved letter knowledge and experience with print.

Results from training studies indicate preschool children can benefit from instruction in the alphabetic principle and will develop word identification strategies consistent with the type of instruction they receive (Levin, Shatil-Carmon, & Asif-Rave, 2006). Share and Gur (1999) observed a variety of strategies employed by 4- and 5-year-olds enrolled in a Hebrew preschool. They asked the children to read the names of their

classmates appearing in context on the children's lockers and printed in Hebrew on cards, as well as novel names. They conducted training sessions to determine whether instruction would contribute to the development of more sophisticated word identification strategies. Children participated in ten 30-minute sessions and were provided instruction in alphabetic skills, print concepts, or a combination of alphabetic and print awareness skills. Strategy change was analyzed for each group. In the alphabetic skills group, seven of the ten children demonstrated advanced strategy use characterized by an alphabetic-based strategy following instruction, while only two children in the print concepts group changed strategies. Five children in the combined group utilized more advanced strategies. An analysis of reading related skills measured after instruction indicated that gains in alphabetic skills, specifically segmentation, letter names, and matching letters to names were significantly related to strategy development, while gains in print concepts were not.

Researchers also have found that preschool intervention programs that included explicit tuition in segmenting and blending phonemes and alphabetic knowledge were especially effective with children considered at-risk for reading failure (McGeown, Johnston, & Medford, 2012). Two interventions targeting phoneme segmentation and blending with Head Start children resulted in gains in phoneme segmentation, blending and word reading (Yeh, 2003; Yeh & Cornell, 2008). Hatcher, Hulme, and Snowling (2004) also found that teaching phonological awareness skills and reading as early as preschool improved reading outcomes for at-risk children two years later.

DHH Children's Word Reading Strategies

The extent to which the reading strategies of DHH children resemble those of hearing children has long been controversial. Some researchers have claimed that DHH readers use only visual, orthographic, and semantic strategies for reading (Allen, et al., 2009, Chamberlain & Mayberry, 2008; Miller, 2006, 2009; Miller & Clark, 2011) and do not utilize phonological processes to identify words. Others have suggested that DHH children are sensitive to the spoken phonological structure in words and, therefore, may be using alphabetic and phonological strategies to read (Musselman, 2000; Perfetti & Sendak, 2000). According to the latter perspective, word reading development follows a trajectory qualitatively similar to that of hearing children (Wang, Trezek, Luckner, & Paul, 2008). Correlational and predictive studies of children's reading achievement and reading-related skills indicate letter-sound knowledge and phonological processes are evident in some DHH children's reading development, although these DHH readers may rely on different pathways from hearing children to form phonological representations (Harris & Moreno, 2006; Kyle & Harris, 2011). These pathways include speech reading and instructional methods, such as Cued Speech and Visual Phonics, to visually represent and disambiguate the phonology of spoken language (Miller & Clark, 2011; Kyle & Harris, 2011).

The extent to which theories of word identification and strategy development for hearing children are applicable to DHH children may depend on the quality of their phonological representations which are influenced by their access to spoken language (Lederberg, Schick, & Spencer, in press). While historically only a small proportion of DHH children had sufficient functional hearing to access spoken language through

auditory pathways, recent advances in technology and early identification through Universal Newborn Screening have resulted in a new generation of DHH children who have improved speech perception and production (Geers, Tobey, Moog, & Brenner, 2008). These new technologies include digital hearing aids for those with mild to moderately severe losses and the use of cochlear implants for those with severe to profound losses. For example, Easterbrooks et al. (2008) discovered over 70% of young (3 to 6 years of age) DHH children possessed at least some ability to perceive spoken language. For these DHH children with functional hearing who are developing spoken language to some extent, reading processes are more likely to follow a developmental pattern similar to hearing children and may include an early reliance on phonological recoding as a strategy for word identification. Indeed, researchers have found that for children with cochlear implants, phonological processing skills are important to early reading development (Geers et al., 2008; Spencer & Tomblin, 2009).

There is some evidence to suggest that DHH children with functional hearing utilize phonological strategies during word identification tasks. Watson (2002) used an analysis of word reading and spelling errors to infer the reading strategies of ten 7-year-olds who had received cochlear implants prior to age five. Seven of the children were achieving expected reading levels for their age group. Oral reading errors from running records indicated most of the children were using a phonological recoding strategy for reading, while spelling records provided evidence for both phonological recoding and visual recall strategies for writing words.

Nielsen and Luetke-Stahlman (2002) observed strategies consistent with Ehri's phase theory in a case study of one girl who received a cochlear implant near the end of

preschool. Reading instruction was guided by Ehri's phases of word reading and initially focused on segmenting and blending individual phonemes and later on using orthographic features of words as strategies. During first grade, partial alphabetic strategies (initial consonant and picture cue, guessing based on initial letter) with no segmentation beyond the first the letter of the word gradually transitioned into alphabetic strategies which included sounding out and blending all of the letters in the words along with use of other phonological skills, such as rhyming words to match known words, chunking larger parts of words, and attention to orthographic patterns to read by analogy. Although the girl developed more advanced strategies, she continued to use phonological recoding, though less often, during the six years researchers documented her reading development.

Although advances in technology have led to improved reading skills for some children (Archbold, et al., 2008), reading remains challenging for many DHH children. In fact, the reading abilities of this new generation of DHH children may resemble those of hearing children who are at risk for reading failure at the start of school due to underdeveloped vocabularies, limited alphabetic knowledge, and poor phonological skills (Lederberg, et al., in press). Early intervention targeting the development of these skills, based on theories of word learning developed for hearing children, may be beneficial. Guided by the evidence for effective instruction for hearing children, *Foundations for Literacy* (Lederberg, Miller, Easterbrooks, Bergeron, & Connor, 2009) was developed to explicitly teach alphabetic knowledge, phonological awareness, vocabulary, and literate language in a preschool setting while adapting instructional strategies to meet the unique needs of DHH children. Evidence from single-case design studies indicate this approach

was effective in developing letter-sound correspondence and phonological awareness skills (Beal-Alvarez, Lederberg & Easterbrooks, 2011; Bergeron, Lederberg, Easterbrooks, Miller & Connor, 2009; Miller, Lederberg, Easterbrooks, in press). However, the extent to which this improvement in alphabetic and phonological knowledge is evident in their reading strategies remains a question. If DHH children do develop better phonological representations as a result of improved technologies allowing them to develop spoken language and use audition to represent the phonological structure of words, then phonological recoding should be apparent in the strategies they use to read words, especially in the context of explicit instruction designed to develop alphabetic knowledge, phonemic awareness, and segmentation and blending.

The goal of the present study was to examine the development of word identification strategies across the school year for DHH children who have functional hearing. Specifically, I addressed two research questions. First, which word identification strategies do DHH preschoolers use in the context of an intervention designed to explicitly teach the alphabetic principle and phonological recoding? Based on Siegler's overlapping waves model of strategy development, I hypothesized that these children will use multiple strategies throughout the school year when reading words. Similar to the strategies employed by young hearing children, it is anticipated that DHH children will use a variety of strategies including no attempt at all, partial alphabetic (sounding out some phonemes), alphabetic (attending to all phonemes to produce a word), and retrieving from memory (Farrington-Flint, et al., 2008; Levin & Ehri, 2009; Share & Gur, 1999). Second, how will the type, execution, and accuracy of word identification strategies DHH children use change over time? I hypothesized that DHH

preschoolers will follow a similar developmental pattern as described for hearing children (Ehri, 2000; Share, 1995; Siegler, 1988, 1996). Over the course of the school year, effective use of retrieval and alphabetic strategies will increase as use of partial alphabetic strategies and no attempts will decrease. Improved execution of alphabetic strategies over the course of the year will lead to improved accuracy (i.e., phonological recoding will result in reading the correct word).

I examined the reading strategy development for 15 DHH children in the context of instruction using *Foundations for Literacy*. Daily lessons were videotaped and reading strategies were coded from this archival video. Strategy classifications were based on children's overt behaviors during instructional episodes from September through May of the school year.

Method

Participants

Participants were 15 children (4 girls, 11 boys) between the ages of 42 and 68 months (M = 53.93 months; SD = 6.74) at time of initial testing who participated in the third and fourth years of the *Foundations* intervention. Children met the following criteria: (a) an unaided hearing loss of 50dB or greater in their better ear or a cochlear implant (CI), (b) an age of 42 to 71 months at the beginning of the school year, (c) the ability to identify spoken words on a speech perception task (Early Speech Perception Test, Moog & Geers, 1990), and (d) an absence of additional severe disabilities (e.g., intellectual disability, cerebral palsy, autism). Ten children were enrolled in oral-only classes and five children attended classes utilizing a combination of sign and spoken English (both simultaneous communication of spoken and signed English and/or

American Sign Language) for communication. Six of the children had a moderate to severe hearing loss and used digital hearing aids (M = 66.14 dB BE-PTA (Better Ear-Pure Tone Average) SD = 12.95; range = 55 – 83). The nine children with a severe to profound hearing loss used at least one CI (7 children used two). Mean age at identification was 9 months (range = birth – 25 mos.). Hearing aid users received their first hearing aids between 8 and 26 months (M = 18.33 mos.) and CI users were first implanted between 14 and 51 months (M = 31.56 months). Eight children were identified by their parents as White, six as Black, and one as Hispanic. Twelve children were enrolled in preschool classes and three children attended kindergarten classes in their respective schools.

Individual assessments of vocabulary and emergent literacy skills were administered during the fall of each intervention year. Receptive vocabulary was measured through the Peabody Picture Vocabulary Test – Fourth Edition (PPVT-IV: Dunn & Dunn, 2007). Children were provided with an array of four pictures and asked to choose the picture that best represented a word presented in the child's preferred language. Expressive vocabulary was assessed through the Early One Word Picture Vocabulary Test (EOWPVT: Brownell, 2000). Children were asked to name illustrations depicting objects, actions or concepts. Directions for both vocabulary measures were given in spoken English or Simultaneous Communication (signed and spoken English), depending on the child's school communication environment. Children responded in their preferred language. Phonological awareness was measured by the Test of Preschool Emergent Literacy (TOPEL) (Lonigan, Wagner, & Torgesen, 2007). Subtest 3, Phonological Awareness, measured elision and blending at the word, syllable, and

phoneme levels. Standard scores for all three tests were derived based on scoring guidelines for hearing children. For all three, means are 100 and standard deviations are 15. Alphabetic knowledge was assessed through a letter-sound identification task developed by study personnel. Children were asked to say the sound associated with 18 consonants, 5 vowels, and 3 digraphs. One consonant was presented for practice with feedback. While the directions for the TOPEL and letter-sound identification were delivered in the child's school language, only spoken responses were recorded and scored. Vocabulary and emergent literacy skills of participants are summarized in Table 1.

Intervention

Children were instructed in pull-out groups of 1 – 3 children by research teachers 4 days per week, 1 hour per day, throughout the school year (September/October – May) using *Foundations for Literacy* (Lederberg, Miller, Easterbrooks, Bergeron, & Connor, 2009). *Foundations for Literacy* consists of 25 instructional units that contain four lessons each and five review weeks. Table 2 contains the number of participants, total hours of instruction, and number of instructional units of the curriculum completed for each instructional group. Teachers progressed at their own pace, with review weeks inserted when they deemed necessary. Therefore, while the instructional hours remained approximately the same over the school year for instructional groups, the number of curriculum units varied (See Table 2.)

Table 1

Means and Standard Deviations for Children's Vocabulary and Emergent Literacy Skills

Measure	Mean	Std. Deviation	Range
EOWPVT	78.57	12.12	55-94
PPVT	81.80	13.81	57-106
TOPEL	81.00	17.62	34-101
Letter Sound Identification	3.20	4.34	0-17

Notes. Letter sound – raw score possible 31. EOWPVT, PPVT, TOPEL: Mean =100, SD = 15. EOWPVT – n=14; one student too low for standard score. EOWPVT = Early One-Word Picture Vocabulary Test, PPVT = Peabody Picture Vocabulary Test, TOPEL = Test of Preschool Emergent Literacy.

Table 2

Characteristics of Instructional Groups

Instructional Group	Intervention Year	No. of Participants	Instructional Hours	Curriculum Units Completed
1 SC	Year 3	3	105	24
2 OC	Year 3	3	95	24
3 SC	Year 4	2	91	21
4 OC	Year 4	3	105	21
5 OC	Year 4	3	104	21
6 OC	Year 4	1	104	21

SC = Simultaneous Communication; OC = Oral Communication

Each instructional unit was organized around a story used to teach grapheme-phoneme correspondences. See Appendix A for examples of instructional materials. The following components are relevant to word reading.

Grapheme Phoneme Correspondence. Stories using recurring characters introduced a specific phoneme and a semantic association for that phoneme. For example, the following story was used to teach the GPC for long *O*:

> *Kate was outside helping Miss Giggle in the garden. They were planting flowers. Kate saw something flying around her. Miss Giggle said, "Kate, a bee is trying to land on your bow." "Oh!, oh!" screamed Kate as she tried to shoo the bee away. "Oh, oh, oh!"Later, inside Miss Giggle told Kate that her mouth looked like an 'o' when she cried, "Oh!" "That is the sound the letter O makes," said Miss Giggle. She wrote the letter 'o' on a card and stuck it on the box.*

Throughout the week, children built a meaningful association for the phoneme /o/ by repeatedly telling the story, as well as acting it out. In the context of the story, the phoneme was paired with the grapheme. Children were given extensive practice with GPC through flash cards and fluency charts, as well as reading words containing the taught phonemes and graphemes.

Concept cards. The semantic association strategy included picture cards called concept cards that were used as mnemonic cues for the phoneme. For example, the phoneme /o/ was represented by a depiction of the story character saying *"oh"* while a bee flew around her bow. The concept cards were used to introduce the phoneme, then as a bridge between phoneme and grapheme. Concept cards were used throughout the year during independent and group reading activities and games. See Appendix A.

Word reading instruction. Decodable words, or key words, were introduced as soon as children learned two phonemes. (See Appendix B for a list of words from the *Foundations for Literacy* curriculum.) The pronunciation and meaning of each key word

were taught and practiced during language activities before words were used in reading activities. Children were taught to sound and blend the individual phonemes using concept cards before encountering the words in print. An altered orthography was used to represent silent letters in multiple spellings. After specific words were explicitly taught by the teacher through modeling and practiced in groups, children had the opportunity to read key words represented by both graphemes and concept cards in individual and group games and activities. In addition, eleven high frequency words (sight words) were taught through a visual-recognition, whole-word retrieval strategy. Activities included reading key words and high frequency words in isolation and in meaningful sentences, as well as reading simple stories containing key words, high frequency words and rebus pictures.

Coding Scheme and Coding Procedures

All instructional groups were videotaped on almost all instructional days. The first four units did not include reading activities and some of the lessons were not recorded. As a result, we coded between 78-99 hours of video per group. The video was digitized and imported into Interact v9.4 for coding. Coding occurred in three passes. The following three coding schemes were used sequentially:

Activity Codes. On the first pass, two graduate research assistants (GRA) assigned activity codes to each instructional session on the initial pass using a mutually exclusive and exhaustive coding scheme, which included marking reading activities. For this study, only reading activities were coded. A reading activity was defined as any activity that involved children, individually or in groups, reading words of two or more phonemes represented by graphemes or concept cards. Reliability for activity coding was calculated using Cohen's kappa. To determine reliability, a second coder randomly

selected 1 of the 4 lessons from a unit (approximately 25% of total lessons) to code and compare. Average kappa across all years and groups was .79 with a range of .67 to 1.00.

Context. On the second pass, a GRA coded all reading activities for context. Reading activities occurred within two contexts: isolated word reading or meaningful, connected text. During the third pass, context coding was confirmed by the first author. Agreement was 100%.

Child independent reading events. On the third pass, the first author identified independent reading events where the teacher did not model a particular reading strategy explicitly. Reading activities that included reading by more than one student at one time or where teachers explicitly taught a strategy were not coded. The dimensions coded are described below and on Table 3.

Type of Prompt. The initial request from the teacher to the child to read a word was coded into two categories. A General Prompt was defined as a request to read without modeling or cueing a particular strategy (i.e., *"what word"* or *"your turn")*, while Teacher Cue represented a request to read which directed the child to apply a particular strategy (i.e., "*say the sounds"* or "*tell me the sounds then read the word")*. Independent reading events where the teacher provided a complete model were not coded because these events were not considered to be independent of the teacher.

***Reading Stimulus*.** Coders divided words into three categories: graphemes, concept cards, or not visible.

Table 3

Coded Dimensions of Strategy Use

Dimension	Category	Definition	Examples
Prompt	General	Presentation of word or sentence and request to read	*"Your turn,"* "*What word"*
	Teacher Cue	Request to read preceded by strategy suggestion	*"Say the sounds then tell me the word"*
Strategy	No Attempt	Child makes no attempt to produce sounds or word in response to prompt or requests assistance by asking for help or looking at the teacher	Child looks at word then at teacher who responds with assistance in reading word; child says *"I don't know"* and teacher responds with assistance
	Segment Only	Child produces some or all phonemes without producing word	Child reads *pie* as /*p*/ or /p//i/
	Segment + Blend Word	Child says some or all phonemes and blends into word	*Boat*. Child says /b//o//t/ then *boat* or *bug;* Child says phoneme /m/ then states the word *me* or *my*
	Retrieve Word	Child states an answer without overt strategy use	Child says *boat* or *bug* when presented with *boat*
	Other	Child names letters, a picture, or response is unintelligible	
Result	Correct	Stated word is correct	
	Incorrect	Stated word is incorrect	

Reading Strategy. Strategy identified the child's behavior following the prompt to read a word. Children's reading strategies were divided into five categories. The first four categories represented a developmental progression: (a) No Attempt (child refuses and does not attempt to produce a word or requests assistance by asking for help or looking at the teacher); (b) Segment Only (child produces some or all of the phonemes in the word without producing a word); (c) Segment and Blend Word (child sounds out some or all phonemes and produces word); (d) Retrieve Word (child states a word without overt

strategy use); and (e) Other (child names letters, names a picture, or response is unintelligible).

Result. Result was coded as Correct (stated answer is correct) or Incorrect (no answer or stated answer is incorrect) and if incorrect, the actual word produced was recorded.

The author coded 100% of independent word reading activities. Another graduate student randomly selected 25% of the reading activities and independently coded for reliability. Cohen's kappa for the dimensions included in this paper was .93 for prompt, .91 for strategy, and .93 for result.

Coding procedure.

Once an individual reading activity was identified, the following coding sequence was initiated. First, the individual child identification number was entered in the sequence followed by the actual word the child was asked to read. Next, the word stimuli were identified as graphemes, concept cards, or not visible. Reading strategies were determined by observing the overt behavior of the child while reading words and categorized according to the coding scheme. Finally, the result (correct or incorrect) and the actual word produced for incorrect responses were recorded. Word type, whether decodable or high frequency, was determined from the transcript. Only decodable words were included in the present analyses.

Results

Description of Reading Activities

The number of reading activities, the amount of time spent in reading activities, and the percentage of all instructional activity coded as reading events varied by

intervention year and instructional group. The mean number of reading activities was 57 (range 38-81). The children spent an average of 6.17 hours (range 3.16-9.66) in explicit word reading activities during the year accounting for 10.77 (range 7.11-17.95) percent of the total instructional time.

Although the types of reading activities remained relatively consistent across years and instructional groups, the frequency with which words were presented and the number of different words that the children read varied throughout the year. The school year was divided into three time periods with approximately 30 lessons per time period. New words were introduced during each time period corresponding with the introduction of new phonemes. Inclusion of previously taught words into lessons was not systematically integrated into the curriculum but was left to the individual teacher. Appendix B lists the different words observed for all groups.

Reading activities were analyzed for the number of independent opportunities to read (defined as the total number of times a word was presented for an individual child to read), the number of times each word was presented, the number of different words, and the percentage of new words introduced during each time period. Any word preceded by either a General Prompt or a Teacher Cue was considered an independent word reading event. The means for the characteristics of independent word reading events are presented in Table 4.

Not surprisingly, the children had more than three times as many opportunities to read during Times 2 and 3 than during Time1. However, while the average number of different words presented increased each time period, the number of opportunities to read an individual word decreased.

Table 4

Characteristics of Independent Word Reading Events

	Time 1	Time 2	Time 3
Opportunities	41.17	120.83	142.67
Opportunities per word	6.30	4.67	3.37
Number of different words	6.5	26.0	41.0
Percentage new words	100	74	57

Note: Averages for groups across both years (N = 6).

Variability and Choice of Reading Strategy

First, I investigated the variability of children's strategy choices and whether children changed their strategies over the course of the year while reading decodable words. Only word reading opportunities preceded by a general prompt from the teacher were used for this analysis to study strategies that were independent of teacher direction. As displayed in Figure 1, all the children used multiple strategies throughout the school year. None of the children used a single strategy at any time point and the majority of the children used either three or four strategies. Individual variability in strategy choice increased as more children used at least four strategies by Time 3. All of the children added segment only, segment and blend, and retrieval to their strategy repertoire by the end of the year.

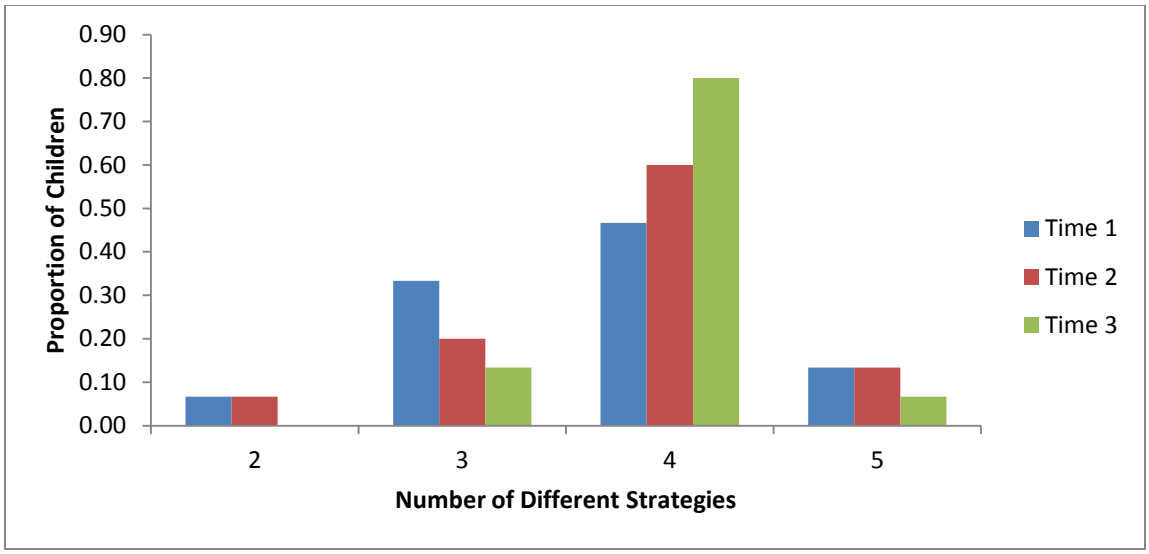

Figure 1. Proportion of children who used multiple strategies during each time period.

As displayed in Figure 2, the kinds of strategies children used changed over the school year. A repeated measures ANOVA was conducted to examine the effect of time on children's strategy choice at the three time periods. There was a statistically significant main effect for strategy, F (3, 42) = 6.87, p = .001, η_p^2 = .329, and a significant time by strategy interaction, F (6, 84) = 5.48, p = .0001, η_p^2 = .281. Follow-up paired t-tests indicated that use of Segmenting Only decreased from Time 1 (M = .41, SD = .19) to Time 2 (M = .33, SD = .14), t(14) = 2.46, p = .02 while Segment and Blend use increased from Time 1 (M = .22, SD = .14) to Time 2 (M = .41, SD = .21), t(14) = -5.35, p = .0001. Retrieval use increased from Time 2 (M = .15, SD = .12) to Time 3 (M= .28, SD = .24), t(14) = -2.31, p = .027. Children's use of a phonological strategy improved over time from predominantly segmenting sounds only during the beginning of the instructional year to segmenting and blending sounds to produce a word by the middle of the year. Retrieval use also increased from the middle of the year to the end of the year.

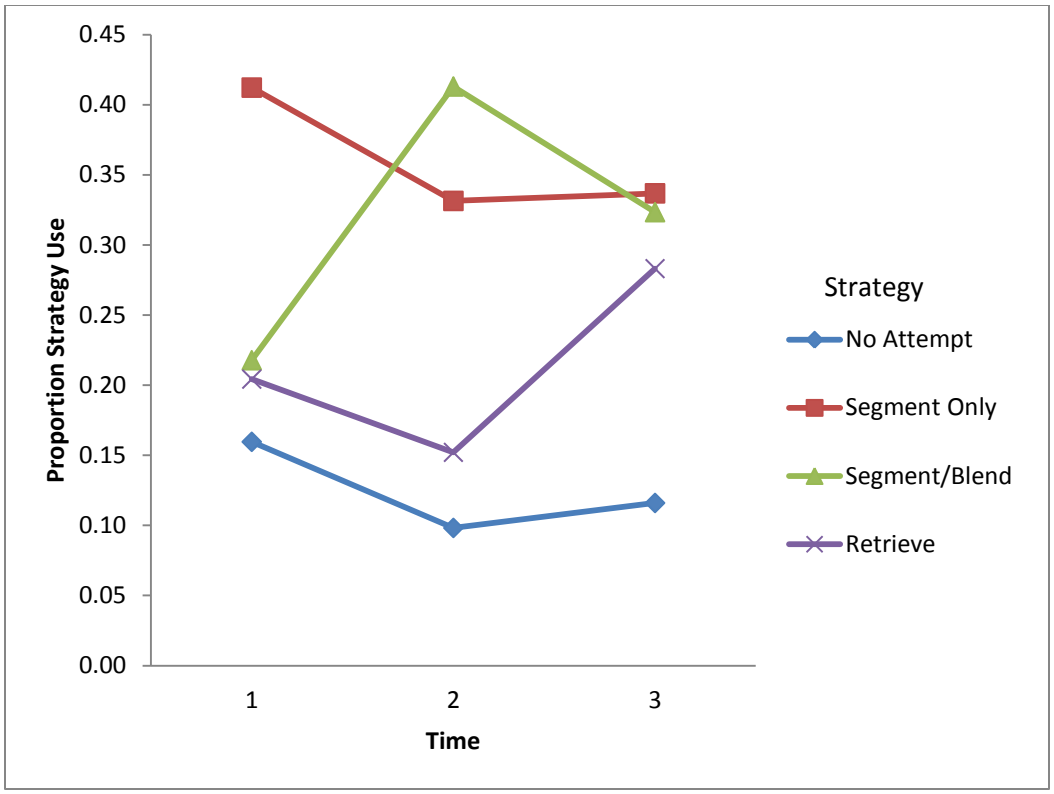

Figure 2. Proportion strategy use at each time period for four strategies.

Accuracy of Reading Strategies

I next examined the accuracy of children's reading as well as whether or not that accuracy improved during the year. In contrast to the previous analysis, because strategy choice was not an issue, this analysis included all word reading opportunities (general prompt and teacher cues).

Word reading accuracy was defined as the number of words correctly identified. Accuracy was measured by the number of words read correctly as a proportion of total reading opportunities. I analyzed word reading accuracy for retrieval vs. phonological strategy (segmenting only combined with segmenting and blending) using a 2 (type of strategy) x 3 (time) ANOVA. There was a main effect for strategy, F (1, 14) = 34.68, p =

.001, $\eta_p^2 = .712$. Children were significantly more accurate when they used retrieval than when they used a phonological strategy. There was no main effect for time, or interaction between time and strategy. Summed across all strategies, children's word reading accuracy was relatively stable across the year. Children correctly identified 41%, 40%, and 42% of the words presented at Times 1, 2, and 3, respectively.

While more than half the words the children attempted were not read accurately, they were very accurate at decoding phonemes when using a phonological strategy. Phoneme accuracy was defined as the number of phonemes correctly identified as a percentage of the total number of phonemes attempted. Overall, 87% of the total phonemes were accurately decoded. As displayed in Table 5, children were highly accurate when identifying the initial, medial, and final phonemes in two- and three-phoneme words. However, once four-phoneme words were introduced during Time 3, accuracy for the final phoneme in four-phoneme words averaged less than 50%.

Table 5

Phonemes correctly identified as a percentage of total phonemes attempted

	Time 1	Time 2	Time 3
1st Phoneme	94%	86%	91%
2nd Phoneme	88%	89%	88%
3rd Phoneme	100%	84%	81%
4th Phoneme			48%

A 2 (strategy) x 3(time) repeated measures ANOVA was conducted to examine the number of different words read correctly at each time period. Mauchley's test indicated that the assumption of sphericity was violated for time (x_2 (2) = 13.34, p = .001, therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity (ε_{time} = .609; $\varepsilon_{time_strategy}$ = .741). Results revealed statistically significant main effects for time, F (1.2, 17.05) = 11.66, p = .002, η_p^2 = .454, strategy, F (1, 14) = 11.21, p = .005, η_p^2 = .445 and a time by strategy interaction, F = (1.48, 20.74), = 5.50, p = .019, η_p^2 = .282. The number of different words read correctly increased over the course of the year. Execution of phonological strategies improved over the course of the year from an average of three different words correct at the beginning of the year to an average of 12 different words correct by the end of the year.

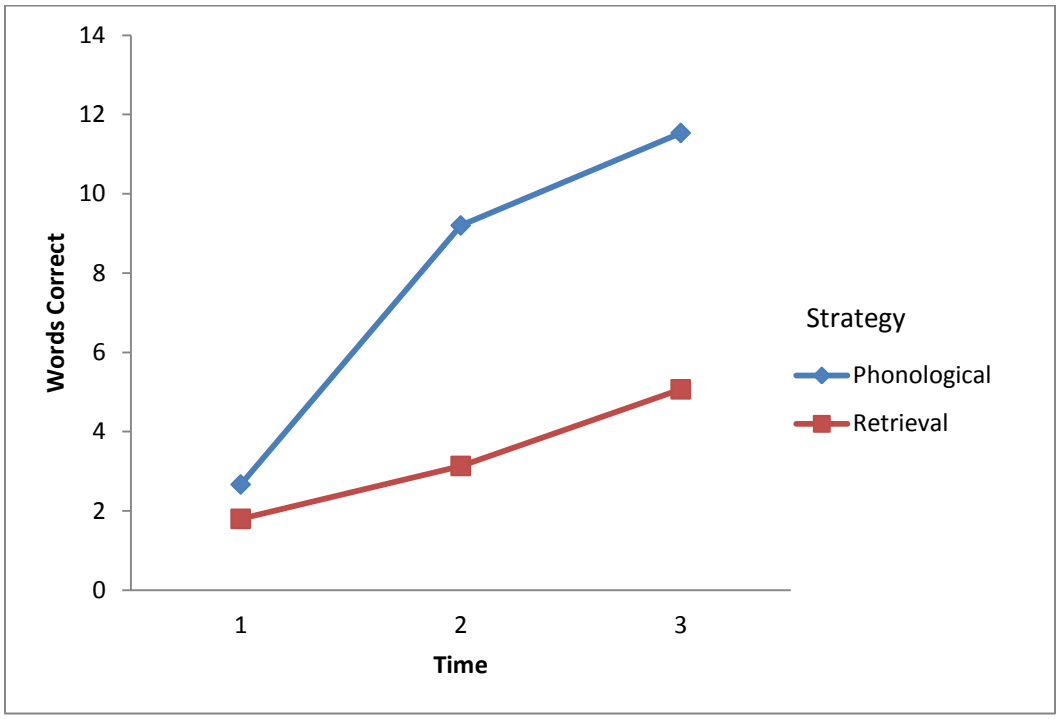

Figure 3. Number of different words correct when using a phonological strategy or retrieval.

Discussion

This investigation was the first longitudinal study to observe the development of preschoolers' early word-reading strategies within the context of explicit instruction during the school year. Word-reading activities were used to teach letter-sound correspondence, print awareness, and phonological awareness. Children were taught a phonological recoding strategy and were provided opportunities to practice this strategy from the very beginning of instruction, which offered an opportunity to observe their word reading development in a naturalistic setting. Over the course of the year, these DHH preschoolers learned to phonologically recode and retrieve decodable words in isolation and in connected text.

Consistent with Siegler's overlapping waves theory, the children used a variety of strategies to comply with the teachers' requests to read the words presented from the very beginning of instruction. The children primarily used the strategy they were taught, phonological recoding. They also retrieved from memory, used partial letter cues, and guessed words from context, consistent with observations of young children in naturalistic settings prior to formal instruction (Levin & Ehri, 2009; Share & Gur, 1999) as well as observations of slightly older children following formal reading instruction (Farrington-Flint, et al, 2008; Juel & Minden-Cupp, 2000).

Change was observed in strategy choice and execution as the year progressed. According to Siegler, strategy change occurs through increased use of more sophisticated strategies, decreased use of less sophisticated strategies, more efficient and effective use of backup strategies, and an increased reliance on retrieval from memory (Rittle-Johnson & Siegler, 1999; Siegler, 1996). Children initially segmented phonemes only, then segmented and blended phonemes into words. Over the course of this year-long

intervention, the children improved their ability to execute a segment and blend strategy and increased their use of retrieval by the end of the year.

Phonological strategy execution followed a developmental progression, similar to that described by Ehri's phase theory. Children used their alphabetic knowledge first to identify some or all of the individual phonemes, then segment and blend those phonemes into words. The children were efficient in acquiring grapheme-phoneme correspondences as evidenced by their early and accurate attempts to segment words into their constituent phonemes. Blending, on the other hand, proved to be a more difficult skill to acquire, although gradual improvement was observed over the year. Yeh (2003, 2008) reported similar results for a short-term intervention with preschool children enrolled in Head Start programs who learned segmentation but found blending words to be difficult. It may be that blending is simply hard for preschool children.

I expected that the children would choose to retrieve familiar words from memory more often than they used phonological recoding by the end of the year. This happened to some extent. However, increased retrieval use was not observed to the degree expected as only 25% of the words presented were retrieved by the end of the year. According to Share (1995, 2000), through phonological recoding of unknown words, children form and store orthographic representations of these words and gradually move from reliance on phonological recoding to retrieving from memory. One explanation is their age. Four-year-olds simply may be too young to form reliable orthographic representations for more than a limited number of very familiar words. On the other hand, it could be a function of the limited word reading practice provided in this curriculum. First-grade Dutch children who read target words either four or six times over two days recognized target words

versus homophonic foils more quickly than children who received zero or two exposures (Reitsma, 1983). Ehri and Saltmarsh (1995) found skilled beginning readers in first grade required an average of four trials to learn target words, while less-skilled first graders required an average of nine trials. The preschool children in the current study were not provided with consistent exposure to the same word. In fact, the average number of times a single word was presented for a member of a group to read individually declined over time for newly introduced words and few words were presented as many as nine times to a single child. This inconsistency may explain the children's continued reliance on phonological recoding throughout the year for familiar as well as unfamiliar words. Grapheme-phoneme correspondence, on the other hand, was practiced individually several times per week and previously taught correspondences were maintained throughout the year. Consistent exposure and weekly practice may explain the high degree of accuracy for indentifying the individual sounds in words from the very beginning of the year.

Accuracy improved over time when measured as the number of different words read correctly during each time period. The words increased in number and difficulty across the year. However, when measured as a percentage of word reading opportunities during each time period, accuracy was relatively stable across the year. From the beginning of the year, the children read approximately 40 percent of the words correctly and maintained this percentage as new words were introduced throughout the year. Although children used retrieval less often, they were very accurate when they did. It may be that the children used retrieval only for words that were well-practiced.

Though guided by the literature on what works for hearing children, the curriculum designers made accommodations to the order of sounds based on the assumption that long vowels would be easier for DHH children to hear. This modification necessitated the introduction of vowel digraphs and more advanced orthographic representations (i.e., final *e*) than is typically included in the beginning stages of most explicit, systematic phonics based reading programs and represented a significant departure from the typical CVC words that usually comprise children's first reading experiences. Despite the added difficulty, the children used their alphabetic knowledge to sound and blend these words. Accuracy increased in terms of the total number of different words they read correctly over the course of the year; although increased accuracy was not reflected in the proportion of words read correctly. Future research should investigate whether this population would benefit from starting with the typical sequence of letter-sound correspondences and systematic exposure to new and previously learned words.

Typically, observations of children's strategy use involve individually presenting a carefully controlled set of words while recording overt behaviors, latencies, and immediate, retrospective reports of strategy use. All children are presented the same words and the same number of opportunities to read the words during a single trial or multiple trials and change is observed over time on the same words. This procedure was not possible in an instructional setting and is a limitation of this study. Lack of control over opportunities afforded each child and inconsistency in the words presented make a fine-grained analysis of change problematic. However, this variability is indicative of the real world of instruction and provides some insight into the instructional experiences of

these children. Future research is needed to observe how the variable nature of reading opportunities in the classroom interacts with child characteristics to impact reading development. Additionally, research involving the development of reading in the DHH population has been limited by small numbers of participants. This study is no exception.

The reading strategies of DHH children who have functional hearing appear to resemble those of hearing children. This is an indication that their early reading acquisition may follow a similar developmental pathway. The current observations did not support the view that DHH children were more likely to develop visual, semantic, or orthographic strategies to read words (Allen, et al,. 2009; Miller, 2009). In fact, they were more likely to use a phonological strategy and attempted to segment and blend individual phonemes when given word reading tasks. This may have resulted from the emphasis on segmenting and blending phonemes during the instructional activities. Regardless of the reason, the children's strategies reflected use of their developing phonological processing abilities.

Preschool children are capable of learning to read simple words and will develop and use the strategies they are taught. In fact, the strategies used by the children in this study more closely resembled those of slightly older school children than the emergent literacy (Mayer, 2007) or pre-alphabetic strategies (Ehri, 2005) described in the literature for preschool children prior to school entry. The children rarely used letter names instead of letter sounds, guessed words based on partial letter cues, relied on the initial sound, or used context to identify the words presented.

The increased expectation for literacy achievement at school entry has created an urgent need for intervention for those children most at risk of reading difficulties prior to

kindergarten in order to close an achievement gap that exists prior to formal instruction in learning to read. Instruction in the alphabetic principle and phonological awareness using print appears to be a viable intervention for DHH preschool children who have functional hearing and are developing language through audition.

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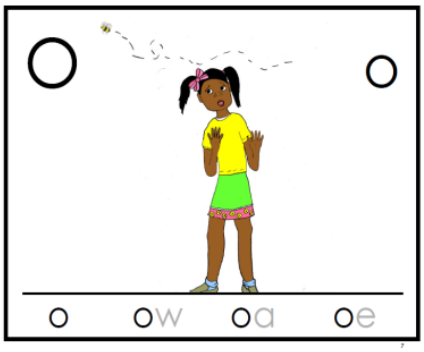
APPENDIXES

APPENDIX A

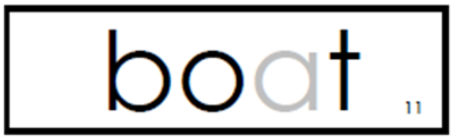
Foundations for Literacy Reading Materials

Large Concept Card

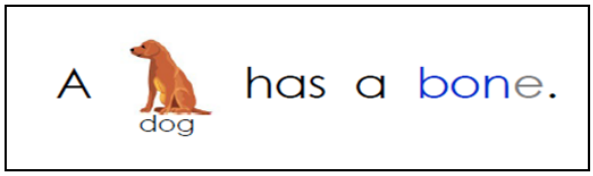


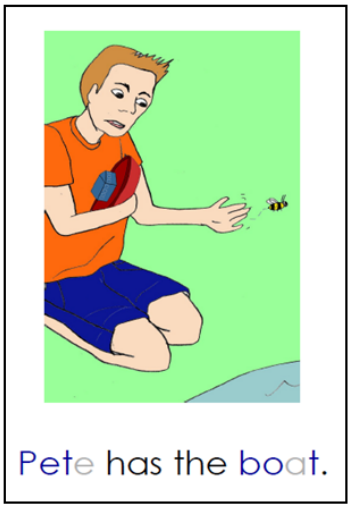
Key word represented by concept

Key word represented by graphemes.



Practice sentence with key words, high frequency, and rebus pictures.





Reading practice book.

APPENDIX B

Words Presented for Independent Reading

bake
bats
bean
beat
bee
beet
bike
bite
boat
bone
bow
cake
cat
cats
coat
coco
comb
eat
eats
face
feet
game
gate
go
goat
hay
high
ice
Kate
kite
knee
knock
lake
leaf
like
lime
make
me
mean
meat
mop
mow
my
name
night
nine
no
nose
not
note
on
pea
Pete
phone
pie
play
pot
sack
same
sat
say
seat
see
shake
she
sheep
shiny
show
sight
sky
smash
so
soap
sock
socks
take
tape
tea
team
teapot
tie
tight
time
toe
top
tops
tow
white
wipe