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A MICROGENETIC APPROACH TO EXAMINING SET FOR VARIABILITY: AN EXPLORATION OF EARLY READING DEVELOPMENT

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Abstract

Learning sight words is a process that involves forming connections between letters and their sounds in order to connect spellings of words with their pronunciations as well as their meanings. During the development of sight word reading, children will sound out (phonologically recode) words that they do not yet know by sight (Share, 1995). Because English lacks transparency, sounding out according to grapheme-phoneme correspondences often only results in an approximation to the target word. The process by which a child must match a word they have recoded phonologically with a word that exists in their vocabulary has been referred to as *set for variability*. Recently, two studies have examined the role that *set for variability* plays in the development of children's reading abilities. Tunmer and Chapman (2012) found using a novel task involving recognizing words from slightly mispronounced words that phonemic awareness and vocabulary made independent contributions to the variance in performance on their task. Using a similar task, Elbro, de Jong, Houter, and Nielsen (2012) found *set for variability* performance to make a contribution to word recognition skills for both regular and irregular words despite using a more regular orthography (Dutch). Together, the findings suggest that *set for variability* is a universal process involved in learning to read.

The current study seeks to gain a better understanding of the role that *set for variability* plays in the development of sight word reading. By combining quantitative data from traditional measures of reading skills with qualitative data from recording weekly reading sessions we expect to be able to better understand the way in which a child's *set for variability* develops and the role it plays in the development of reading words by sight. We compare emergent readers in different phases of their sight word reading development in their ability to identify the target words in a mispronunciation task. Participants' abilities in a number of reading measures are also analyzed in relation to the errors made on weekly reading sessions that were audio recorded and later phonetically transcribed in order to identify how *set for variability* skills develop in relation to some of the better-understood aspects of reading development. Implications for future *set for variability* research and educational impacts are discussed.

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A Microgenetic Approach to Examining Set for Variability: An Exploration of Early Reading Development

Accessing words from memory, or sight word reading, is a significant milestone in reading development. The ability to read words by sight allows readers to focus more attention on aspects of reading that are related to comprehension. Learning sight words is a process that involves forming connections between graphemes and phonemes (letters and sounds) in order to connect spellings of words with their pronunciations as well as their meanings. This is referred to as phonological recoding and plays a key role in learning new words (Wagner & Torgesen, 1987). The process of learning words by sight relies heavily on phonemic awareness (Lieberman, Shankweiler, Fischer, & Carter, 1974), as well as alphabetic knowledge; however, these are not the only variables related to word reading. Other sources of variability for word reading that have been suggested include orthographic processing and *set for variability*, the ability to determine the correct pronunciation of approximations to spoken words. Examining the process by which children match what they have sounded out with words that exist in their vocabulary can also further our understanding of the role vocabulary plays in learning to read and could benefit in terms of reading instruction in the early years. The current study will examine the role of *set for variability* in early reading development in kindergarten children. This concept will be elaborated further in the review of the literature.

First, key theories of word reading development will be reviewed. This will be followed by a detailed examination of the concept of *set for variability* and its relation to vocabulary. A thorough discussion of phonological awareness and emergent literacy will follow relating to the development of word reading skills. Finally, I will discuss the microgenetic perspective that inspired the current study to employ a mixed-method approach.

Sight Word Reading

In order to understand early reading development, key theories of reading acquisition will be examined. Ehri (1995) identifies four phases of development in regards to word reading: a) pre-alphabetic, b) partial alphabetic, c) full alphabetic, d) consolidated alphabetic. Each phase is related to the level of phonemic awareness as well as alphabetic knowledge. Ehri emphasized the use of the term “phases” in order to distinguish from “stages”, pointing out the overlap that occurs between phases during development. Each phase is simply a characterization of the most predominant strategy used in decoding and acknowledges that young readers use a variety of strategies even to read the same word at two separate instances.

Phase 1 – pre-alphabetic. The first phase identified by Ehri (1995) is the pre-alphabetic phase. At this point children know very little about the alphabetic system and therefore fail to make connections between letters and their sounds. If words are read at all in this phase it is done by recognizing select visual features of words such as knowing that the word is ‘look’ by thinking of the “oo” as eyes (Gough, Juel, & Griffin, 1992).

Phase 2- partial alphabetic. Progression to the next phase, known as the partial alphabetic phase, occurs when children learn the names or sounds of letters and use them to remember how to read words. In this phase, however, children only form connections between some of the letters and sounds in a word, most commonly the first and last letters in a word (Savage, Stuart, & Hill, 2001). At this point children are limited to forming only partial connections since they are unable to segment a word’s pronunciation into all of its segments. Children in this phase do not yet possess full knowledge of the alphabet, especially vowels, and therefore struggle with unfamiliar words.

Phase 3 – full alphabetic. When children can learn sight words by forming complete connections between all of the letters and sounds in words they are considered to be in the full alphabetic phase. At this point readers are able to decode unfamiliar words much more efficiently and can remember the correct spellings of words much better than in the partial alphabetic phase. In this phase children are also less likely to confuse words that are similar due to their increased ability to segment all parts of words.

Phase 4 – consolidated alphabetic. Lastly, the consolidated phase occurs when readers retain increasingly more sight words into their memory. As they become more familiar with frequently used letter patterns they are able to consolidate grapheme-phoneme connections into larger units. This is similar to Seymour's (1990) foundation of literacy framework in which he highlights orthographic development as occurring through dual modes being logographic or alphabetic. He also states that reading acquisition, as it parallels linguistic awareness, moves from small units (phonemes), to larger units (rimes, syllables, and morphemes) (Seymour, 1997). The current study mainly examined reading acquisition in children who are in either the partial or full alphabetic phases.

Set for Variability

During the development of sight word reading, children in the partial, full, and consolidated alphabetic phases utilize a process referred to as phonological recoding when they encounter words they do not yet know by sight (Share, 1995). During this process the child will sound out the word using grapheme-phoneme correspondences. Because English lacks transparency, sounding out according to grapheme-phoneme correspondences often only results in an approximation to the target word. Therefore, it becomes clear that a child must do more than recode an unknown word according to its sounds if he is to read it successfully. Although a good deal is known about the process of phonologically recoding unknown words, little is known about the precise mechanism by which children match the recoded attempt to the actual word especially given the fact that many recodings do not match the target word.

Recently, researchers have focused their attention on the possible role that vocabulary knowledge may play in the development of word recognition skills and have suggested that a child must match their phonological recoding with words that are already known to them in the oral domain (Nation & Cocksey, 2009; Ouellette, 2006; Ricketts, Nation, & Bishop, 2007). This recognition component of phonological recoding has long been acknowledged and discussed (Gibson, 1965; Gibson & Levin, 1975; Venezky, 1999) but research on this component has been rather scarce. Recent work surrounding this word recognition component has used the term *'set for variability'*. Although Venezky coined the term in 1999, no research has tested the construct until recently. This research acknowledges that vocabulary contributes to the development of word recognition skills since the young reader must match their phonological recodings to words in their oral vocabulary.

Tunmer and Chapman (2012) studied 152 new school entrants through a three-year longitudinal study in New Zealand to assess whether vocabulary influences word recognition skills indirectly through set for variability. The mean age of participants at school entry was 5 years 1 month ranging from 4 years 11 months to 5 years 3 months. Set for variability was measured using an adapted version of a task used by Tunmer and Chapman (1998) in which children must determine the correct pronunciation of mispronounced spoken words. The list of 40 words consisted of regularized pronunciations of irregularly spelled words (e.g., *lizard* pronounced "lie-zard"), the incorrect pronunciation of words containing polyphonic spelling patterns (e.g., *treasure* pronounced as "tree-zer"), and approximations to correct pronunciations based on the application of context-free spelling rules (e.g., *shoe* pronounced like “show”) (Tunmer & Chapman, 2012). A preliminary analysis identified the ability to identify mispronounced words, in contrast to the use of context, as the key in the correlation between the set for variability task and word recognition. This was established through a preliminary analysis that tested participants in both isolation and hearing those same mispronunciations in a sentence. It was found that hearing the words in context did not make an independent contribution to the relation between *set for variability* and exception word reading. Through hierarchical regression analyses and path analyses the researchers found that vocabulary and phonemic awareness made independent contributions to the variance in *set for variability* performance. The results also showed that year one vocabulary directly influenced year three reading comprehension and indirectly influenced year three decoding skill and word recognition through year one *set for variability*.

At the same time as Tunmer and Chapman (2012) conducted their study, (Elbro, de Jong, Houter, & Nielsen, 2012) found similar results with a pair of studies. The first study set out to determine whether word recognition from spelling pronunciation makes an independent contribution to word recognition in more regular orthographies and whether word recognition from spelling pronunciation is important for both regular and irregular word reading. Seventy-four first grade students (mean age 7 years 3 months) from the Netherlands were tested on a number of reading-related measures as well as a word recognition from spelling pronunciation task. In the word recognition from spelling pronunciation task, which measured *set for variability*, children listened to 24 regularized pronunciations of irregular words and were asked to produce the correctly pronounced word. For example, ‘plastic’ was given a regularized pronunciation with a standard Dutch (α) rather than the irregular pronunciation (æ) seen in

English. It was found that both phonological awareness and word recognition from spelling pronunciation made significant and unique contributions to the prediction of regular and irregular word reading accuracy. For word reading fluency, phonological awareness remained a predictor while word recognition from spelling pronunciation did not make a significant contribution.

In the second study by Elbro and colleagues (2012), a longitudinal design was employed with 187 Danish children, with the purpose of not only replicating results with a deeper orthography but also examining the early foundations of word recognition from spelling pronunciation. Results were similar to those of the first study. Unique contributions were made by word recognition from spelling pronunciation in both studies. A unique contribution was made by word recognition from mispronunciation for both regular and irregular words. The Danish language study also showed that some of the variation in first grade word recognition from spelling pronunciations could be predicted by word recognition from slightly mispronounced words at the end of preschool. Elbro et al. (2012) suggested that an underlying predictor of later word reading may be recognition from any type of deviant pronunciation and not just from orthographically motivated pronunciations. The overall findings suggest that *set for variability* plays a larger role than originally proposed in that it contributes to regular word reading even in a shallow orthography such as Dutch. The results from the mispronunciation task also broadens the potential role that *set for variability* plays.

Phonological Awareness

In order to fully understand a child's development of decoding skills one must understand the concept of phonological awareness and the concepts and terms that fall under this category. Phonological awareness refers to an individual's level of awareness of the sound structure of spoken words. Phonological awareness plays an important role in the ability to phonologically recode an unknown word. By understanding a word's sound structure, one can sound out a word that they do not yet know by sight. The importance of phonological awareness has long been established in the reading literature and it has been identified as the strongest predictor of reading achievement in the early years (Bus & IJizendoorn, 1999). Well before children develop an explicit understanding of the phonological structure of words, they develop an implicit knowledge of the sound structure allowing them to master the spoken form of their language both as a speaker and a listener. This implicit knowledge allows for self-correction of speech errors. It also allows children to distinguish whether variations of words are acceptable or not, and allows them to make judgements as to whether a word is part of their native language or not (Yavas, 1998).

Phonological awareness is important in early literacy development because it enables children to make connections between words in the spoken form with words in their written form. Phonological awareness is a skill that has multiple levels. Just like words can be broken down into their syllabic structure, onset-rime, and phoneme structure; phonological awareness can be described in terms of syllable awareness, onset-rime awareness, and phonemic awareness (Gillon, 2004). There are a number of ways to evaluate phonological awareness at each of its levels. At the syllable level, phonological awareness refers to an awareness that words can be divided into syllables. Asking a child how many syllables (or parts) are in a word is one such way of measuring phonological awareness at this level (Dodd, Holm, Oerlemans, & McCormick, 1996). Onset-rime awareness refers to an awareness that words and syllables can be divided within syllables. This is most often measured through rhyming tasks since rhyming requires an understanding that words can share a common ending. One such measure asks children to judge if two such words rhyme, for example, "do these words rhyme: shell bell?" (Dodd et al. 1996).

At the individual sound level is phonemic awareness. Phonemes are the smallest unit of sound that influence the meaning of a word. Phonemes are abstract in the sense that when listening to spoken words, the listener does not hear separated phonemes, instead, phonemes are blended into syllables within the sound stream. Individuals must learn to perceive phonemes in speech in order to learn to read (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). There are a total of 41 phonemes in the standard spoken English language with 25 of them being consonants (Gillion, 2004). Phonemic awareness is necessary in order to understand that words are comprised of individual sounds and ultimately the most crucial level of phonological awareness when it comes to phonologically decoding words. One such task used to measure phonemic awareness is a blending task that asks "what word do these sounds make?" (Wagner, Torgesen, & Rashotte, 1999). Phonological awareness is an important factor when looking at any emergent reading skill and *set for variability* is no different. Results from both *set for variability* studies discussed show a significant relationship between phonological awareness and the ability to reach target words from mispronunciations (Tunmer & Chapman, 2012; Elbro et al., 2012).

Emergent Literacy

The current study is based on an emergent literacy perspective. Emergent literacy is a perspective on literacy development that views reading acquisition as taking place on a continuum beginning early in a child's life as opposed to the conventional literacy perspective, sometimes termed the 'reading readiness approach,' which states that reading occurs at the beginning of school instruction. Proponents of an emergent literacy approach oppose the idea that there is a demarcation between reading and pre-reading arguing that literacy related behaviours occurring in preschool are legitimate and important aspects of early literacy. The second distinction that is made based on the emergent literacy framework is the concept that reading, writing, and oral language develop concurrently and interdependently. Traditional views hold that reading is acquired before writing and emphasize the importance of specific instruction. While the term ‘emergent literacy’ dates back to work done by Clay (1966); Teale and Sulzby’s (1986) book *Emergent Literacy: Writing and Reading* is considered to be the first formal introduction to the term and is said to have prompted the field of inquiry.

Two lines of research methodologies have been used to provide information on the different components of emergent literacy. One line focuses on the relationship between emergent literacy and the acquisition of conventional literacy mainly through quantitative studies. The other perspective, which tends to utilize qualitative studies, examines the development of behaviours of pre-school children in response to literacy tasks and materials (Whitehurst & Lonigan, 1998). Whitehurst and Lonigan (1998) identified several components of emergent literacy that have emerged from the two perspectives in a thorough review. The components most directly related to reading acquisition are reviewed briefly below.

Language. While several aspects of language skills are important to literacy development as a whole, it is vocabulary that is initially important. When children attempt to sound out words according to their letters they must rely on their vocabularies to match their phonological recodings to words that they know. A number of longitudinal studies have found a relationship between oral language proficiency and later reading skill. This holds true not only in typically developing readers but also in children with reading-delays and/or language-delays (Bishop & Adams, 1990; Butler, Marsh, Sheppard, & Sheppard, 1985; Pikulski & Tobin, 1989; Scarborough, 1989; Share, Jorm, MacLean, & Matthews, 1984). Decontextualized language skills have been shown to be related to conventional literacy skills such as decoding, print production, and understanding story narratives (Dickinson & Snow, 1987).

Conventions of print. Children are capable of understanding the conventions of books before they are able to read (Clay, 1979a). For the English language these conventions include left to right, and top to bottom direction of print, the difference between covers and the pages of books, the difference between pictures and text, and the meaning of different punctuation. Knowledge of such conventions is helpful to the process of learning to read (Clay, 1979b; Tunmer, Herriman, & Nesdale, 1998). Using Clay's (1979b) *Concepts about Print Test,* Tunmer, Herriman, and Nesdale (1998) found that scores on the test at beginning of Grade 1 predict reading comprehension and decoding achievement at the end of Grade 2, even after controlling for vocabulary and metalinguistic awareness.

Knowledge of letters. In alphabetic language systems such as English, decoding print requires the translation of units of print to units of sound. This starts with knowing the names of letters. Knowing the names of letters facilitates the knowledge of letter-sounds by beginning readers (Bond, & Dykstra, 1967; Chall, 1967; Mason, 1980). In these instances, relating sounds to letter names is helped by the fact that letter names provide clues to their sounds. Knowledge of letter names is crucial for the beginning reader who is learning to decode words. Stevenson and Newman (1986) found alphabetic knowledge at the time of entry into school to be one of the strongest predictors of short- and long-term literacy success. A number of studies have indicated that letter knowledge significantly influences the acquisition of some phonological sensitivity skills (Bowey, 1994; Johnston, Anderson & Holligan, 1996; Stahl & Murray, 1994).

Phoneme-grapheme correspondence. Understanding the link between phonemes and the letters of the alphabet is the bridge between emergent literacy and the successful decoding of real words. Phoneme-grapheme knowledge consists of knowing the sounds of individual letters as well as the combinations of letters and the sounds that they make. This has been assessed by asking children what sounds different letters make as well having children phonologically recode pseudowords requiring them to blend individual phonemes together. It has been found that children who are better at phonologically recoding words tend to score higher on tests of reading achievement (Gough & Walsh, 1991; Hoover & Gough, 1990; Jorm, Share, MacLean, & Matthews, 1984; Juel, 1988; Tunmer et al., 1998).

Emergent reading. Reading environmental print such as McDonald's signs or Pepsi bottles and pretending to read (by looking at pictures in a book) are examples of emergent reading behaviours (Teale & Sulzby, 1986). Some have suggested that the ability to read environmental print is a demonstration of children's ability to derive meaning from text through the use of context (Goodman, 1986). Studies have failed to demonstrate a direct causal link between the ability to read environmental print and later decoding skills (Gough, 1993; Masonheimer, Drum, & Ehri, 1984; Stahl & Murray, 1993). This has led researchers to look at the concept of intentionality by asking children questions such as, "What is the print on this page for?" (Purcell-Gates, 1996; Purcell-Gates & Dahl, 1991). Purcell-Gates (1996) found that children's intentionality was related to children's concepts of print, understanding of the alphabetic principle, and concepts of writing.

Several qualitative studies have looked at the behaviours of preschool-aged children in situations in which reading is required in an attempt to reveal the knowledge and beliefs children have about reading. One such study by Ferreiro and Teberosky (1982) found what seemed to be an orderly progression in children's understanding of print. They reported that four-year old children from their sample recognized the difference between 'just letters' and 'something to read'. The same study (Ferreiro & Teberosky, 1982) also characterized children as passing through stages where they believe that print is a non-linguistic representation (ie. a picture), to believing that print codes parts of the linguistic stream, to understanding there is a one-to-one correspondence between the print and the language.

Cognitive factors. A number of cognitive factors play a role in the acquisition of literacy skills. A relationship has been found between phonological memory and rate of vocabulary acquisition (Gathercole, WIllis, Emslie, & Baddeley, 1992) as well as reading acquisition (Gathercole, Willis, & Baddeley, 1991; Rohl & Pratt, 1995; Wagner, Torgesen, & Rashotte, 1994). Rapid naming performance (i.e., naming arrays of digits and letters as quickly as possible) may discriminate poor readers from good readers independently of phonological sensitivity (McBride-Chang & Manis, 1996)

Whitehurst and Lonigan (1998) proposed a broad division between the components of both emergent and conventional literacy. The proposed model consists of two interdependent sets of skills and processes. They distinguish between inside-out and outside-in skills and make the analogy to the distinction between decoding and comprehension made by Gough (1991). Outside-in components represent the context in which children are trying to read or write and include such components as conventions of print. Conversely, inside-out refers to children's knowledge of the rules for translating the particular writing they are trying to read into sounds or the sounds into print when they are writing. These two broad sets of skills and processes are considered equally important to reading and work side by side in readers who are reading well. The concept of *set for variability* can be used to link these two types of skills.

Microgenetic Perspective

The qualitative portion of the current study's research design is inspired by the microgenetic perspective. Similar to the way that Ehri (1995) characterized word reading development as proceeding in phases rather than stages, Siegler (1996) has highlighted a more general need to rethink the way people perceive development. In his classic paper *Emerging Mind*s, Siegler speaks of the gap between the way classic theories of development describe growth as taking place in stages and the way his own children (and all other children for that matter) actually develop. He argues that despite accounts of children's age and thinking as proceeding in a one-to-one relation there is a lot more variability in children's concepts, theories, and reasoning than developmental theories typically take into account. An example of this is that a child may solve an addition problem by retrieving the answer from memory but then solve the same problem at a different time by counting fingers (Siegler, 1996). He points out that there is adaptive choice involved in what strategy to use at any given point even if the decision is not a conscious one. Additionally, Siegler (1996) argues that in contrast to the premises of most theories of cognitive development, change is actually constant and not intermittent, as it is often described as in stage theories where change is believed to occur between relatively constant stages occurring only between stages of relative consistency. While describing developmental differences in terms of stages may provide for a nice picture to present to psychology students; Siegler (1996) cautions that this type of thinking is dangerous because it avoids asking what may be the most important question of all for developmental psychologists: how does change occur?

Siegler (1996) called his model of development the 'overlapping waves model,' arguing that cognitive development can best be characterized by a pattern of overlapping waves that represent developmental trajectories of adaptive strategy use. This model was first applied to a variety of algorithmic domains such that as long as the strategies were executed correctly, the correct answer would be obtained. Rittle-Johnson and Siegler (1999) first applied this model to a non-algorithmic domain with a study looking at spelling development. In this case, non-algorithmic refers to strategy use that even when applied correctly may not yield the correct answer. In spelling, for example, one may apply all of the orthographic regularities in English and still spell many words incorrectly (Venezky, 1970). In their study of spelling development, Rittle-Johnson and Siegler (1999) used observations and verbal retrospective reports to support the applicability of the overlapping waves model in the development of spelling. Their study found that spelling development has all three key functions of the overlapping waves model in that there is variability, constant change, and adaptive choice involved. These findings are significant because they lend support for applying the overlapping waves model to a variety of other non-algorithmic domains. Sharp, Sinatra, and Reynolds (2008) extended the research by Rittle-Johnson and Siegler (1999) by employing a microgenetic, mixed-design approach to look at spelling development. The study examined the relationship between the development of strategy use and the spelling errors that children made using error feature analysis. The use of a microgenetic approach allows for a fine-grained analysis making up for the lack of observational density that so often is a product of traditional developmental research methods.

Given the successful application of the overlapping waves model to a non-algorithmic domain like spelling it seems reasonable to consider such a model for the development of reading skills. In fact, Ehri's (1995) work on the development of word reading has many similarities to Siegler's (1996) overlapping waves approach. Ehri describes phases of development over stages acknowledging the existence of adaptive choice and constant change in the development of decoding skills.

The microgenetic method of studying cognitive development is key to applying the overlapping waves model to word reading development. Three properties define the microgenetic approach to studying how change occurs: a) observations must span the entire period of change, b) the density of observations is high relative to rate of change, c) and observed behaviour must be subjected to intensive trial-by-trial analysis, with the goal of inferring the processes that give rise to both quantitative and qualitative aspects of change (Siegler & Crowley, 1991). The rationale for such an approach is that traditional cross sectional and longitudinal designs only provide before and after snapshots but tells us very little about the processes that produced a given change. Siegler and Crowley (1991) illustrate this point with the example of studying a tornado. A longitudinal design would provide a before and after shot of the tornado; while a microgenetic approach would provide a video or several pictures of the tornado as it occurs.

While the microgenetic method places more demands on time and resources its potential for rich data is high. The idea and rationale for microgenetic methods dates back almost 100 years to Heinz Werner (1925) and Lev Vygotsky (1978). Werner performed what he called genetic experiments which were aimed at depicting the unfolding of successive representations that made up psychological events (Werner, 1925). Werner described how repeated presentation of highly similar tones led to an increased perceptual differentiation of tonal space. While his work focused on change over a single stimulus he made the point that such an approach could be applied to processes that continued over hours, days, or even weeks (Werner, 1948). Vygotsky (1978) approved of Werner's arguments favoring genetic experiments, and argued in a general sense for more studies of concepts and skills in the process of change.

Environmental Factors and Literacy Development

Environmental factors have long been identified as strong determinants of child development across domains. Literacy development is no different. Several components of emergent and conventional literacy have been shown to be related to environmental factors.

Several studies have demonstrated significant correlations between home literacy environment and preschool children's language abilities (for a review see Bus, Van Ijzendoorn, & Pellegrini, 1995). A number of other components of emergent literacy have been associated with home literacy environment as well. For example, shared book reading has been found to be an extremely rich source of learning for young children. Ninio and Bruner (1978) found that the most frequent context for maternal labelling of objects was during shared reading. Shared reading and print exposure foster vocabulary development in preschool children (Cornell, Senechal, & Broda, 1988; Elley, 1989; Jenkins, Stein, & Wysocki, 1984; Senechal, 2006). One of the factors repeatedly found to play a role in the home literacy environment is socioeconomic status (SES). SES is one of the strongest predictors of performance differences in children at the beginning of grade one (Alexander & Entwisle, 1988). These differences are not only in reading achievement as whole but in a number of the emergent literacy components outlined above.

With such significant correlations between SES and performance on a number of components of emergent literacy it seems quite clear that there are factors related to SES that directly influence children's literacy development. Identifying commonalities within groups and differences between groups will provide useful insight into factors that are important in the development of different components of emergent literacy skills and should work to improve future intervention research. The importance of identifying the breakdowns in development is highlighted in light of work that demonstrates just how stable performance differences remain throughout one's educational journey (Baydar, Brooks-Gunn, & Furstenberg, 1993; Stevenson & Newman, 1986; Tramontana, Hooper, & Selzer, 1988). Stanovich (1986) further points out the importance of better understanding the developmental processes of different components of emergent literacy skills. He does so by demonstrating that while deficits in reading skills are relatively specific at first, the specificity breaks down as the strength of the reciprocal relationship between reading abilities and other areas of education increases with age and grade level (also, see Mol & Bus, 2011).

Current Study

Learning to read words by sight is a major milestone for young learners. The process involves a variety of linguistic skills and requires children to gain an understanding of several literacy concepts. The emerging reader must first understand that letters are a system of symbols and that they represent sounds that together form words. In a language that has a deep orthography like English, simply sounding out the letters of a word will not normally provide the target word. Emerging readers must match the sounds with words that exist in their oral vocabulary. This process has long been identified as a requirement for successful word reading but is not yet well understood. In this framework, children are said to possess a *set for variability* whereby they try to match the sounds to a word with the understanding that if the sounds do not match a word they know, they must alter the sounds until a sensible match can be found. Examination of this process should lead to a better understanding of the role that vocabulary plays in young readers' development and could prove useful in guiding future reading instruction. This concept has only recently been explored in the literature by having children listen to words that are mispronounced in a variety of ways and testing their ability to match those words with a target word. Tunmer and Chapman (2012) found in their study that vocabulary and phonemic awareness were both important factors in children's performance on a *set for variability* task. Around the same time as this study, Elbro et al. (2012) published results from a similar study. They found that both phonological awareness and word recognition from spelling pronunciation made significant and unique contributions to the prediction of regular and irregular word reading accuracy.

The present study aimed to further understand the role of *set for variability* in beginning reading by employing a mixed-method approach. By combining quantitative scores from traditional measures of reading skills with qualitative error data of errors from weekly recordings of reading sessions, we attempted to better understand the way in which a child's *set for variability* develops. Better understanding the concept of *set for* variability will assist in shaping current teaching practices since there remains debate over the most effective ways to teach emergent readers. Errors were analyzed for patterns between performance on reading related measures and decoding attempts of unknown words. The approach is inspired by microgenetic studies that look beyond the data that longitudinal studies provide in order to understand the development of complex skills that occurs in a relatively short amount of time. The study seeks to understand how emerging readers become able to match their phonological recodings to target words. Therefore the study will focus on the following three research questions and their respective hypotheses:

1) Does the measure of *set for variability* employed in this study successfully differentiate between levels of reading abilities in the current sample? It was hypothesized that the measure of *set for variability* would be related to other measures of emergent literacy skills such as vocabulary and word reading. This would help to validate the use of the *set for variability* task and provide evidence that it is measuring the construct at hand.

2) Is there a specific phase in word reading development that emerging readers begin to show *set for variability* skills? It was hypothesized that *set for variability* continues to develop throughout a young reader's early school years just as we know that emergent readers' skills

develop even before formal reading instruction. It was expected that children who appeared to be in the partial alphabetic stage would already possess the ability to match some mispronounced words with their target words in their mental lexicon.

3a) Do those who perform well on the measure of *set for variability* make a higher proportion of errors that are real words since they have a better understanding that they must match their recoding with a real word? It was hypothesized that those who scored higher on the *set for variability* task will have a higher proportion of errors that are real words since they have a better understanding of how to reach the target word that they have phonologically recoded. This would provide evidence for an awareness of the task involved in reading which has not necessarily been identified in the literature but could be reasonably expected given children's general awareness of the reading process as whole. It was also hypothesized that those who performed well on the *set for variability* task would show more use of this strategy over time and therefore the proportion of real word errors would increase more than their weaker counterparts.

3b) Do those who perform well on the *set for variability* task make a higher proportion of their errors on vowel sounds demonstrating the use of a strategy? It was hypothesized that those who scored higher on the *set for variability* task would make a higher proportion of their errors on vowel sounds since vowels have more variance in the sounds that they make. In line with Venezky (1999), a child who fails to match their phonological recoding to a word that they know will then have to modify their recoding. Given the inconsistency of letter-sound correspondences for vowel sounds in English they would serve best to try changing the sound of the vowel. Again, assuming an awareness of the task is present, it stands to reason that a child who performs well on a mispronunciation task would make a higher proportion of errors on vowel sounds. Therefore, it was hypothesized that those who are strong on the *set for variability* task will also tend to make more vowel errors over time than those who were weaker at the task.

Method

Participants and Design

The participants were selected from a larger group of students who participated in a pretest (N=36). A total of 20 junior and senior kindergarten children from three public schools in the Waterloo Region District School Board (Ontario, Canada) were included in the final analyses. Gender was split evenly with the mean age at time of pretest being 66.4 months (*SD* = 3.03 months). There was no significant mean age difference between boys and girls. Six participating classroom teachers distributed invitation letters to the parents of their junior and senior kindergarten students but withheld invitations from those who were considered by their teacher to be drastically behind their peers in their reading abilities. While precise demographic information was not possible, schools were approached based on their ability to provide a diverse sample. There were several poor readers as well as several strong readers from each school so there did not appear to be a bias in who signed up to participate in the study although that is a possibility.

While a larger sample size would have been ideal, 20 was seen as an appropriate minimum given the practical limitations faced in terms of time, resources, and the political climate at the time. Many schools were hesitant to participate due to a work-to-rule in which teachers were participating. The 20 participants were selected on the basis that they did not yet appear to be in the consolidated alphabetic phase of reading but were far enough along in their literacy development that they could phonologically recode unknown words as outlined in the section to follow. Of the participants tested, five were excluded because they were deemed too far advanced in their literacy development (consolidated phase) and eleven were considered to be not yet capable of phonologically recoding.

Three criteria were used in selecting participants for final analyses. 1) At pretest the participants scored at least 49/52 on a test of letter names and sounds since knowledge of letter names and sounds is required in order to be considered as being in the partial alphabetic stage. 2) The participants were also required to read at least one word on the second page of the Word ID subtest such as *is* or *you* from the Woodcock Reading Mastery Test-Revised (Woodcock, 1998). 3) The participants who met the pretest requirements were required to attend a minimum of 6 reading sessions to be included in the sample. This final requirement did not have to be used as an exclusionary criterion for any of the participants.

Procedure

A demographic questionnaire was sent home with students but the response rate was too low to include descriptives on first language, parent educational achievement, etc. The study received ethical approval from both the Research Ethics Board at Wilfrid Laurier University and the Research Committee at the Waterloo Region District School Board. Consent was obtained from the principals of each school as well as from the parents of the children. Assent was obtained from each participant prior to pretest. Participants were rewarded with small prizes at pretest and post-test such as decorative pencils and erasers or bouncy balls. Participants were given stickers at the end of each reading session and collected these stickers on a page that they had decorated.

Participants completed a pretest at which time their suitability for the study was determined. The pretest included measures of general cognitive abilities as well as reading related measures. Participants then completed weekly reading sessions during which they read from two books. Participating children read *Bob Books* which are phonetically controlled adding just a few new sounds per book. The other book that they read was *Dick and Jane and Friends,* which includes short stories. Early stories are written in a pattern book format while later stories include many high frequency sight words. These types of books were selected to encourage decoding as well as partial decoding and the use of strategies related to set for variability. Participants started their first session by reading from the easiest books in the series and research assistants determined a level that was not frustrating but also included some words that the children did not know by sight. Participants were only prompted if they failed to make attempts on unknown words by themselves. Research assistants prompted in the following order: “You can do it. Just give it a try,” “What could we do if we come across a word that we don’t know?” and finally, “Why don’t we try to sound it out.” Eight weeks later, after completing the weekly reading sessions participants completed a posttest with the same measures as the pretest.

Weekly reading sessions typically took place in a resource room in which one or two research assistants sat with an individual and had them read while being recorded. The same research assistants read with the children at each school in order to establish a rapport with the participants. In the case that a student was away on the day of reading sessions, the research assistants would return to read with the student in the next day or two (where possible). In such cases, the reading sessions would sometimes take place in pods or even in the halls. Audio recordings were done on a Sony IC recorder device (ICD-PX333) using the built in mono microphone and uploaded to a computer before being phonetically transcribed.

Weekly reading sessions were phonetically transcribed by a senior undergraduate student trained in the use of the International Phonetic Alphabet, and subsequently coded. Coding focused on two forms of errors. Proportions were calculated because the participants did not read the same pages of the books and therefore could not be compared directly. First, errors were coded for whether or not the attempt was a real word. A proportion was calculated for the number of errors made that were real words. Since the stories contained a number of different names, attempts made that used a name from the stories or a commonly known name were be coded as real words. The reasoning for this is that the study was looking for children to match their phonological recodings with words in their lexicon so for them to guess a name when sounding out letters they are giving a valid attempt. Next, the transcriptions were coded for the proportion of errors made on the vowel sound for the target word. If more than more than one sound differed from the target word each sound was coded making it possible, for example, to have two consonant errors for a three letter word or to have both a consonant and a vowel error.

Measures

Participants were measured on a battery of standard reading related measures. Tests of word and pseudoword reading as well as vocabulary are considered to be related to *set for variability* performance. Measures of phonological awareness and phonological processing are useful for classifying emergent readers in terms of their development. Each of the standardized tests are considered to be valid and reliable tests are have been used throughout related literacy research. The mispronunciation task is an experimental task that has been found to effectively measure the construct that is *set for variability,* while the letter names and sounds task is a simple experimental task that is helpful in the screening of participants. Each task was selected for its ability to measure what was intended without being highly demanding for the participants in terms of how long it took to complete the tasks. Participants were given breaks as required while completing the testing and completed the tasks in two separate sessions during the same day or on consecutive days in order to effectively measure their abilities on the specific tasks and not their ability to sustain focus.

Reading accuracy. Subtests of the Woodcock Reading Mastery Test-Revised (WRMT-R) were used to assess reading accuracy (Woodcock, 1987). Word and pseudoword reading accuracy were measured by asking participants to read words and pseudowords (i.e., cat, ift) in a non-timed task. Tasks are presented to students in a booklet with several words in isolation. Participants are asked to read the words the best they can and to take their time doing so. For pseudowords, participants were told that these were not actually English words but that they could sound the spellings out. Reported reliabilities are .96 for Word Identification and .95 for the Word Attack (Woodcock, 1987).

Phonological processing. Two sub-tests of the Comprehensive Test of Phonological Processing (CTOPP) were used to measure this aspect of phonological awareness (Wagner, Torgesen, & Rashotte, 1999). The Rapid Digit Naming sub-test measures the speed and accuracy of participants reading an array of numbers in random order. Similarly, the Rapid Letter Naming sub-test measures the speed and accuracy in reading an array of letters in random order. Participants are given a practice page to test their understanding of the tasks. They were then timed for how long it took them to read 36 letters or numbers. Participants were given two versions of the numbers and two versions of the letters task. Their time for each version of the task was added to the other giving them a total time for the digits task and a total time for the letters task. Students with more than 4 errors were not given a time for that task as per the instructions of the task. The reported reliabilities for the Rapid Digit Naming task for five and six year olds respectively are .89 and .75. The reported reliabilities for the Rapid Letter Naming task for five and six year olds respectively are .89 and .82.

Phonological awareness. Two subtests from the CTOPP battery of tests were used to measure phonological awareness. The Elision is a word segmenting exercise that requires children to repeat a word omitting a particular word or sound (i.e., say “popcorn” without saying “corn”, or say “fixed” without the “/k/”). The task begins with several practice items where feedback is given to the participants. Feedback was also given to participants on the first two scored items as per the instructions of the task. The task was stopped after three consecutive incorrect responses or after completing the list. The reported reliabilities for five and six year olds respectively are .90 and .92.

The blending words subtest requires children to listen to individual phonemes and to blend them to make a target word. (ie. “What word do these sounds make? M..OO..N) (Wagner, Torgesen, & Rashotte 1999). This task was presented to students on an mp3 playing device using the recorded stimuli provided with the CTOPP battery of tests. Students were allowed to listen again to any recording if they were unable to hear it due to uncontrollable noise in the school environment. The reported reliabilities for five and six year olds on the blending words task are .88 and .89.

Vocabulary. Receptive vocabulary was measured using the Peabody Picture Vocabulary Test Third Revision (PPVT-III). Participants are given a word and asked to identify which picture best represents that word. Participants were asked to make their best guess if they did not know the answer. The task was continued until a participant made eight or more errors on the same easel. Reported reliabilities for children at age six are .95 (Dunn & Dunn, 1997).

Each of the measures described above are standardized tests and are widely accepted as valid and reliable measures of reading related cognitive abilities. Additionally, two experimental tasks were used.

Letter names and sounds. Participants were given flash cards containing five random letters (six on one card). Participants are asked to identify both the names of the letters as well as the sound that they make when in isolation. Participants are given each letter once totaling a possible score of 52.

Set for variability – mispronunciation task. Children's ability to identify the correct pronunciation of mispronounced words was measured using a task adapted from Tunmer and Chapman (1998). The words used in the tasks consist of regularized pronunciations of irregularly spelled words, the incorrect pronunciation of words containing polyphonic spelling patterns, and approximations to correct pronunciations based on the application of context-free spelling rules. Participants were told that they would be listening to a recording of a little girl who is trying to read words but not quite pronouncing them. Participants were asked if they could tell what word she was trying to read. When participants gave two answers for one item they were instructed to choose only one word and asked if they would like the task to be explained again. Words were presented in isolation only based on the earlier findings by Tunmer and Chapman (2012) that suggested that it was the ability to identify mispronunciations rather than contextual information that was responsible for the high correlations they found between performance on this task and decoding skills and word recognition.

Results

A number of factors from the pretest/post-test measures were assessed using bivariate correlations. Reading related measures known to be associated with each other were analyzed in order to ensure the sample was appropriate. The total score on the *set for variability* task as well as the scores on each of the subtests were compared with related measures to assess whether the mispronunciation task was an appropriate measure for the sample used in this study. In addition, an independent samples *t*-test was used to compare those participants included in the study with those who failed to meet the inclusion criteria. This was used as a way of ensuring that the inclusion criteria used effectively differentiated the participants.

Next, participants were coded for the alphabetic phase they were likely in at pretest. Participants were classified based on their performance on the blending words subtest of the CTOPP (Wagner, Torgesen, & Rashotte, 1999). This subtest asks children to listen to letter sounds presented in isolation and to blend them in order to reach a target word. The idea of coding this subtest for alphabetic phase is that the subtest has clear demarcations between how complex the task of blending a word is. All participants were able to get at least one correct answer on the task and therefore none were considered to be in the pre-alphabetic phase. Participants were classified based on their ceiling score on the task. Those who achieved a ceiling of 8 or less were coded as being in the partial alphabetic phase because these stimuli only required participants to blend two segments together to reach the target word, specifically the onset-rime. Those who achieved a ceiling of 9 or higher but less than 14 were considered to be in the full alphabetic phase because this portion of the task required them to blend each individual letter sound in order to recognize the target word at hand. Those who scored higher than 14 correct were considered to be in the consolidated alphabetic phase since they were able to blend larger words that contained more complex units of sound.

Most participants either fell in the partial or full alphabetic phase and therefore these two phases were considered. A one-tailed independent samples *t*-test was used to compare *set for variability* scores between those considered to be in the partial alphabetic phase versus those in the full alphabetic phase. Therefore, the following analyses were conducted with 36 or 20 participants as stated in each section.

The errors made were analyzed in a number of ways. Bivariate correlational analyses were used to assess any associations between the proportions of errors of each type with performance on the measure of *set for variability.* Participants were also divided using a median split according to their performance on the set for variability mispronunciation tasks. Poor performers were compared with strong performers using an independent samples *t*-test to assess if there was a significant difference in the proportion of errors made using real words as well as the proportion of errors that were made on vowels as opposed to consonants.

Overview

All quantitative data analyses were conducted using IBM SPSS Statistics Version 21.0 (IBM Corp., 2012). Analyses of the pretest data were carried out on all 36 participants that completed testing. Quantitative analyses were carried out on the 20 participants that met the initial inclusion criteria and completed all of the testing. From those 20 participants two did not receive a score on the RAN letters task as they made too many mistakes to receive a score (as per scoring instructions). Of those who did not meet inclusion criteria but whose pretest data was analysed, one participant did not receive a score for the RAN letters task while another individual did not receive a score on the RAN digits task. The results of the analyses should be interpreted with caution due to the small sample size. However, distributions of the scores on the various parametric tests conformed closely enough to the normal distribution to make analyses worthwhile. The one exception was the distribution of Word ID scores that had a slight positive skew when analyzing the complete pretest dataset.

Research Question 1: Relationship Between *Set for Variability* and Other Measures of Emergent Literacy

The first research question asked whether scores on the *set for variability* task were related to other measures of emergent literacy that have been shown to be related in the past. This would help to validate the measure in the current sample since the age and school year is different for the current sample than it was when used in previous studies. The relationship between key measures at pretest was examined for the full sample (n = 36).

A bivariate series of correlational analyses was used to test the validity of the *set for variability* task employed in this study as well as the appropriateness of the entire pretest sample (n=36). Significant positive correlations were found between the total score on the *set for variability task* and measures of vocabulary, phonological awareness, number of letter sounds known and pseudoword reading as well as a marginally significant correlation with word reading (see Table 4). As expected, measures of vocabulary, pseudoword reading, and phonological awareness were all found to be significantly correlated. Word reading was significantly and positively correlated to phonological awareness, letter names, and letter sounds but no evidence was found for a relationship between word reading and vocabulary. As an additional check, an independent samples *t*-tes*t* was run between the 20 participants included in the study after pretest and the 13 participants who were considered to be too weak. The included participants scored significantly higher on all measures apart from the first subtest of the *set for variability* task than did those excluded from the study for being too weak (see Table 6).

Research Question 2: At What Point in Development do *Set for Variability* Skills Begin to Emerge?

The second research question asked if *set for variability* skills appear to emerge during the early part of reading instruction or if they tend to develop prior to reading instruction as many other emergent literacy skills tend to do. This was tested by comparing those considered to be in the partial alphabetic phase with those considered to be in the full alphabetic phase.

A one-tailed independent samples *t*-test, $t(31) = 1.987$, $p = .028$, confirmed a significant difference in scores on the pretest measure of *set for variability* between those considered to be in the partial alphabetic phase (n=18) as opposed to those in the full alphabetic phase (n=15). Despite this difference it is clear that those children in the partial alphabetic phase are capable of matching some mispronunciations on the task with the target words as evident by a mean score of 5.22 (n=18). Means and standard deviations shown in Table 2 show that even those children who failed to meet inclusion criteria who would have generally been considered to be in the pre-alphabetic phase of word reading were able to match some mispronunciations with the target words. In fact, every participant except for two, was able to get at least three correct target words on the task. While a significant difference in performance on the *set for variability* task was found between those children considered to be in the partial alphabetic phase compared with those children considered to be in the full alphabetic phase, all participants in this study were able to get at least one correct answer.

Research Question 3a: Does *Set for Variability Performance* Predict a Higher Proportion of Errors That Are Real Words?

The third question looked at the types of errors that participants made during their weekly reading sessions. These hypotheses test if scores on the *set for variability* task are related to actual reading behaviour in this group of children learning to decode words. In other words we asked if children who initially performed well on the *set for variability* task made different types of errors that would indicate they had a stronger understanding of the strategy they are apparently using to decode words.

First, we examined the use of real words. If children have an awareness of why they are sounding out words then it stands to reason that their attempts result in real words from their vocabulary more often as opposed to making up words that sound like the recoded version. To test this hypothesis, all of the errors made during the weekly reading sessions were coded for whether they were real words or not. A value was calculated for each participant for the proportion of errors each individual made that were real words. As can be seen from the results shown in Table 7, there was no evidence for a relationship between the proportion of errors using real words and initial scores on the *set for variability* measure both for the subsets as well as the total score. Using a median split as an indicator of high versus low performance on the *set for variability* measure an independent samples t-test was used to compare participants' proportions of real word errors. The independent samples t-test $t(18) = -.586$, $p = .565$, failed to demonstrate a significant difference between the two groups in the proportion of errors they made that were real words. The low group (n=9) had a mean proportion of real words of .78 (SD = .08) while the high group (n=11) had a mean proportion of .80 (SD = .10). Finally, a slope was calculated based on the proportion of real word errors made each week. No evidence was found for a relationship between the real word reading slope and performance on the *set for variability* task at pretest ($n = 20$, r = -.81, $p = .709$).

Next, we asked if those children with strong *set for variability* skills made more errors on the vowel parts of the words. The weekly reading sessions were coded in terms of whether errors were made on vowels as compared to consonants. No evidence was found for a correlation between the proportion of errors made on vowels and any of the subtests or the total score on the *set for variability* measure (see Table 7). Similarly, an independent samples t-test $t(18) = -.273$, $p = .788$, failed to demonstrate a significant difference between the high and low groups from the *set for variability* task on the types of errors made. The low group (n = 9) had a mean proportion of errors that were vowels of .49 (SD = .12) while the high group (n = 11) had mean proportion of .51 (SD = .13). While no difference was found in the types of errors made based on performance on the *set for variability* measure, it is interesting to note that the mean proportion of errors that were real words was .79 (SD = .09) and the mean proportion of errors made on the vowel sounds in words was .50 (SD = .12) despite the fact the proportion of vowel phonemes to consonant phonemes in the English language is .39. Lastly, the slope of the proportion of vowel errors over each week was compared with performance on the *set for variability* task. No significant evidence was found for a correlation between the slope of the proportion of vowel errors and performance the measure of *set for variability* (n = 20, r = -.17, p = .471).

In examining the proportion of real word errors as well as the proportion of vowel errors with performance on the *set for variability* task we found no evidence of a significant relationship nor did we find evidence when using the slopes that represent errors over each week. Using a median split, to separate participants between high and low performers on *the set for variability* task we failed to find evidence for differences both in the proportion of errors that were real words as well as in the proportion of errors made on the vowel sounds of words.

Discussion

The aim of the current study was to gain a better understanding of the role that *set for variability* plays in the process of learning to read by asking when such skills begin to emerge as well as by examining the differences in the types of errors children make depending on how far along they are in their development of *set for variability* skills. Nonetheless, because the sample size after pretest was reduced to 20 participants, results must be interpreted with caution. Since the distributions from the various parametric tests conformed closely enough to a normal distribution analyses were still considered to be worthwhile. The one exception to this was that results on the word reading task appeared to have a slight positive skew. Since the sample size was somewhat low, some analyses using the pretest data were carried out using all of the 36 participants that completed the pretest. These analyses were only carried out where it was deemed appropriate to do so.

Since the sample in the current study differed from those in the Elbro, de Jong, Houter, and Nielsen (2012) and Tunmer and Chapman (2012) studies both in age and years of formal schooling, it was first important to test whether the use of the mispronunciation task (Tunmer & Chapman, 2012) was an appropriate measure for the current sample. To examine the appropriateness of the measure, we examined the relationship between pretest scores on the *set for variability* task and those on other reading related measures that have been found to relate in previous studies (Elbro et al., 2012; Tunmer & Chapman, 2012). The correlations between related measures were smaller in the current study than those of the previous studies, however, they were still statistically significant. Since the sample size in the current study was much smaller, these findings suggest that the use of the mispronunciation task (Tunmer & Chapman, 2012) is appropriate and that it was a valid measurement of the *set for variability* construct at hand.

Correlations were found between *set for variability* (total score and subtests) and vocabulary, phonological awareness, knowledge of letter sounds, and pseudoword reading as well as a marginally significant correlation with word reading. A stronger relationship between word reading and *set for variability* was expected but the marginal significance level could be a result of the small sample size since the distribution of scores on this measure were slightly skewed. As expected, measures of vocabulary, pseudoword reading, and phonological awareness were all found to be significantly related to each other providing evidence that the sample was generally representative of emerging readers at large. Word reading was found to be significantly correlated with phonological awareness, letter names, and letter sounds but no evidence was found for a relationship between word reading and vocabulary. Since word reading is generally known to be related to vocabulary and was found to be in the study by Tunmer and Chapman (2012), this result again raises some reason for caution in interpreting word reading scores in this sample. Finally, an independent samples *t*-test between the 20 participants that met inclusion criteria and the 13 participants that scored too low for the study confirmed a significant difference between the groups on all measures in the study other than the first subtest of *set for variability* providing support for appropriateness of the inclusion criteria used and its ability to differentiate between participants.

The second research question asked if *set for variability* skills appear to emerge during early reading instruction or whether they develop much sooner as do many other reading skills associated with emergent literacy. While the study by Tunmer and Chapman (2012) had a sample that began at an average age of 5 years 1 month (ranging from 4 years, 11 months to 5 years 3 months), it was not until the participants were an average age of 5 years 9 months that they were tested on the *set for variability* task. The current study had an average age of 5 years 6 months and had participants as young as 4 years 7 months at time of testing. All participants were able to identify at least one target word from the mispronunciation task and all but two got at least 3 correct. This finding provides evidence to suggest that *set for variability* is a process developing much the same way as other emergent reading tasks that are better understood and that begin to develop prior to formal reading instruction. Therefore, the ability to perform the set for variability task appears to develop gradually. By classifying participants based on their performance on the blending words task those children deemed to be in the partial alphabetic phase were compared with those children considered to be in the full alphabetic phase. While there were significant differences in performance between the two groups, both had some success in identifying the target words from the mispronunciations. It appeared that participants were able to do as well as their vocabulary allowed them to do which is in line with what Venezky (1999) highlighted in his work.

The third research question asked about the type of errors being made. Specifically we examined if performance on the *set for variability* measure was related to the type of errors generally committed by participants during their weekly reading sessions. The question was broken into two related questions. The first asks if those strong *set for variability* skills are related to making more errors using real words whereas the second asks if *set for variability skills* are related to a higher proportion of errors made on vowel sounds. The two questions aim to provide evidence for the existence of an awareness in the strategy that is phonological recoding. If children who do better on the mispronunciation task have a better awareness of why they are phonologically recoding words that they do not know how to read than it stands to reason that a) they will make a higher proportion of errors that are real words since they understand the point is to match the mispronunciation with a real word and b) they will make a higher proportion of errors on the vowel sounds, since as Venezky (1999) pointed out, vowels have more variance and therefore are more likely the source of error when a target word is not reached.

An analysis of the proportion of real word errors found no evidence for a correlation between proportion of errors that were real words and performance on the measure of *set for* *variability*. Slope was also calculated by taking the proportion of real word errors made each week but we failed to find evidence for a correlation between the slope and *set for variability*. Additionally, a median split was used to classify participants as either low or high in *set for variability*. An independent samples t-test failed to demonstrate a significant difference between the two groups. The lack of significant findings may suggest that awareness is not an important factor in ones' ability to perform such a task. More likely, however, is the possibility that the sample had generally reached a ceiling, meaning that all of the participants were aware that they needed to use a real word. This is considered likely given that the sample as a whole had a proportion of real word errors close to .8.

Similarly, the proportion of errors made on vowel sounds was analyzed, again we found no evidence for a correlation between the proportion of errors made on vowels and performance on the measure of *set for variability*. An analysis of the slope of vowel errors also failed to find any significant correlation with performance in *set for variability*. The same median split was used as was used for real word errors. An independent samples t-test failed to show a significant difference between low and high performers. While no difference was found between participants from the two groups it is interesting to note that the proportion of errors made on vowel sounds was .5 (SD = .12) despite the fact that the proportion of vowel sounds to consonant sounds in the English language is .39.

Together, the results from the analyses of the proportion of errors that were real words as well as the proportion of errors that were vowel sounds give some indication that perhaps emergent readers already have an implicit awareness of why they sound out words and that this awareness may develop at some point before formal schooling begins. Because classroom literacy instruction was not observed, it is not possible to rule it out as an explanatory variable.

One other consideration to be made is the idea of awareness versus sensitivity. Anthony and Lonigan (2002) make this distinction in regards to phonological awareness. They maintain that the ability to consciously reflect on phonemes, or phonemic awareness, is a metalinguistic ability distinct from general metacognitive control processes that would allow children to be sensitive to phonemes without necessarily being aware of what's happening. It is possible that children complete *set for variability* tasks without consciously reflecting on the process.

Limitations and Suggestions for Future Research

There are some limitations to this study that need to be recognized. The limitations lead to some suggestions for future research examining the role of *set for variability.* While some of the limitations are related to the availability of resources, some simply arose as the study unfolded and the research team was able to observe what went well and what could be changed. Because of the previously mentioned difficulties in recruiting schools, pilot data could not be collected.

One observed limitation was that some participants found the mispronunciation task difficult to hear. This was sometimes due to the testing environment which could not always be controlled for environmental noise. Participants were listening to the recording from iPhone speakers. Perhaps future studies could utilize headsets to ensure maximum attention and reduce variance due to mishearing the recording. While previous studies using this type of task presented the mispronunciations aloud, it is still believed that if implemented effectively a recording is a benefit because it can ensure consistency in the testing procedure. In order to make this consistent, the task should be recorded in a studio equipped with professional recording equipment which would likely eliminate a significant amount of error.

An obvious limitation to the study was the small sample size. Part of the difficulty recruiting schools to participate was likely due to political tensions that existed at the time and the reluctance of teachers and principals to participate in research due to those conditions. What complicated this was that when schools were willing to participate there was a limit as to how many could do so at one time due to the time consuming nature of the weekly reading sessions and the ensuing phonetic transcriptions and coding that went along with them. Future studies of this nature would benefit by streamlining the reading sessions by possibly creating passages that are controlled in their length and the number of target words to later be coded (rather than coding all words). It would also be beneficial to have all participants read the exact same scripts each week in order to compare them more effectively. The current study had researchers choose different readings based on the child's ability to read. While this was done in order to see all participants make some mistakes it proved to be costly in terms of analysing errors, leaving the study to only look at the proportion of errors made rather than looking at more comparable figures between participants.

Another limitation of this study was the lack of demographic information collected. While a demographic questionnaire was distributed, there was simply not enough of a response to use the information that was collected. Demographic information is important when considering emergent literacy and therefore a strong effort should be made to ensure the return of such questionnaires (Alexander & Entwisle, 1988). Future studies should make it a priority to implement strategies that will ensure the return of most, if not all, of the demographic questionnaires. Strategies may include incentives for the successful completion and return of the questionnaires, distributing the questionnaires attached to the consent forms, or possibly implementing an online form that participants would have as an option to fill out should they choose to do so. It would be important to include the option for them to use the paper version and not rely solely on an electronic questionnaire as there are still several people that either prefer this method or do not have consistent online access.

In relation to the microgenetic perspective, this study was limited because it did not span the entire developmental process being examined. It was difficult to predict at what point it would be useful to begin reading sessions with the children in order to watch them match phonological recodings with their vocabulary. It appears that it would be necessary to begin at some point in preschool or at least at the very beginning of formal education and to follow those students over the entire first year of schooling in order to gain a complete sense of the process at hand.

Future research on the topic of *set for variability* may include an even younger population than this study did, in order to gain insight into the age in which *set for variability* skills begin to emerge. Such a task would need to be adapted to include the appropriate vocabulary words for such an age group. One thing that could be considered is to look at the types of errors made on the *set for variability* task itself. Studying children's perceptions that the mispronunciations represent real words or not could give some insight into the development of such skills and the way in which children are implementing related strategies.

Practical Implications

This study, especially the findings that even the youngest participants could complete some *set for variability* items, not only has implications for future research but has practical implications in terms of the way emergent readers are taught. While it appears that young readers may have an implicit awareness of the task at hand when sounding out a word there is still a significant portion of the time where they apply a non-word to their recoding. It would seem likely that emerging readers would still benefit from explicit instructions that they should only apply words that they know to be real when trying to reach a target word. Adults could be taught to model this process by sounding out words during shared reading time. Adults could make comments such as, "what is a word that I know that sounds like that?" Adults could also do the recoding portion of the task for the child and have the child try to come up with the target word.

Results from this study reinforce the notion that *set for variability* is an independent construct that plays a role in the development of word reading. Results indicate that *set for variability* skills likely develop prior to formal schooling much like other emergent literacy skills. This study provides support to phonics based curricula, as it further indicates children's ability to match phonological recoding with words in their vocabulary.

Conclusions

The current study further supports the notion that the process of sounding out words is in fact a two-step process. In contrast to previous research, children younger than those in previous studies of this nature participated in this study. Importantly, it was found that children who had not yet reached their fifth birthday could determine some target words on a mispronunciation task. Their performance on this task appeared to be related to the strength of their vocabulary. Despite a lack of evidence that participants' scores on the mispronunciation task were related to strategy use, it appears that the participants generally attempted to use real words when decoding as evidenced by the errors that they made. It may be worthwhile to look at younger populations to determine if children use real words as soon as they are capable of performing such a task or if this is a learned behaviour over time. A useful next step would be to employ a similar study that begins immediately at the start of formal schooling and follows students over the entire school year. Such a study would also serve well to analyse the types of errors made on the *set for variability* task itself.

References

Alexander, K. L., & Entwisle, D. R. (1988). Achievement in the first 2 years of school: Patterns and processes. *Monographs of the Society for Research in Child Development, 53*(2), 157.

Anthony, J. L., & Lonigan, C. J. (2004). The nature of phonological awareness: Converging evidence from four studies of preschool and early grade school children. *Journal of Educational Psychology,* 96(1), 43-55. doi:http://dx.doi.org/10.1037/0022-0663.96.1.43

Baydar, N., Brooks-Gunn, J., & Furstenberg, F.F. (1993). Early warning signs of functional illiteracy: Predictors in childhood and adolescence. *Child Development, 64*(3), 815-829. doi:10.1111/j.1467-8624.1993.tb02945.x

Bishop, D. V. M., & Adams, C. (1990). A prospective study of the relationship between Specific language impairment, phonological disorders and reading retardation. *Journal of Child Psychology and Psychiatry, 31,* 1027–1050. doi:10.1111/j.1469-7610.1990.tb00844.x

Bond, G. L., & Dykstra, R. (1967). The cooperative research program in first-grade reading instruction. *Reading Research Quarterly, 2,* 5-142.

Bowey, J.A. (1994). Phonological sensitivity in novice readers and nonreaders. *Journal of Experimental Child Psychology, 58,* 135-159.

Bus, A. G., & van Ijzendoorn, M. H. (1999). Phonological awareness and early reading: A meta-analysis of experimental training studies. *Journal of Educational Psychology, 91*(3), 403-414. doi:10.1037/0022-0663.91.3.403

Bus, A.G., Van Ijzendoorn, M.H., & Pellegrini, A.D. (1995). Joint book reading makes for success in learning to read: A meta-analysis on intergenerational transmission of literacy. *Review of Educational Research, 65*(5), 1-21.

Butler, S.R., Marsh, H.W., Sheppard, M.J., Sheppard, J.L. (1995). Seven-year longitudinal study of the early prediction of reading achievement. *Journal of Educational Psychology, 77*(3), 349-361. doi: 10.1037/0022-0663.77.3.349

Chall, J.S. (1967). *Learning to read: The great debate.* New York: McGraw-Hill.

Clay, M. M. (1966). Emergent reading behavior. Unpublished doctoral dissertation, University of Auckland, New Zealand.

Clay, M.M. (1979a). *Reading: The patterning of complex behavior.* Auckland: Heinemann.

Clay, M.M. (1979b). *The early detection of reading difficulties.* Portsmouth, NH: Heinemann.

Cornell, E.H., Sénéchal, M., & Broda, L.S. (1988). Recall of picture books by 3-year-old children: Testing and repetition effects in joint reading activities. *Journal of Educational Psychology, 80*(4), 537-542.

Dickinson, D.K., & Snow, C.E. (1987). Interrelationships among pre-reading and oral language skills in kindergartners from two social classes. *Early Childhood Research Quarterly, 2,* 1-25.

Dodd, B., Holm, A., Oerlemans, M., & McCormick, M. (1996). *Queensland University Inventory of Literacy.* University of Queensland, Australia: Department of Speech Pathology and Audiology.

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

Elbro, C., de Jong, P. F., Houter, D., & Nielsen, A. (2012). From spelling pronunciation to lexical access: A second step in word decoding? *Scientific Studies of Reading, 16*(4), 341-359. doi:10.1080/10888438.2011.568556

Elley, W. B. (1989). Vocabulary acquisition from listening to stories. *Reading Research Quarterly, 24*(2), 174-187.

Ehri, L. C. (1995), Phases of development in learning to read words by sight. *Journal of Research in Reading, 18,* 116–125. doi: 10.1111/j.1467-9817.1995.tb00077.x

Ferreiro, E. & Teberosky, A. (1982). *Literacy before schooling*. Heinemann Educational Books, Exeter, N.H.; London

Gathercole, S.E., Willis, C., & Baddeley, A.D. (1991). Dissociable influences of phonological memory and phonological memory deficits phonological awareness on reading and vocabulary development. *British Journal of Psychology, 82,* 387-406.

Gathercole, S.E., Willis, C., Emslie, H., & Baddeley, A.D. (1992). Phonological memory and vocabulary development during the early school years: A longitudinal study. *Developmental Psychology*, 28, 887-898.

Gibson, E.J. (1965). Learning to read. *Science, 148,* 1066-1072. doi:10.1126/science.148.3673.1066

Gibson, E.J., & Levin, H. (1975). The psychology of reading. Cambridge, MA: MIT Press.

Gillion, G. T. (2004). *Phonological awareness: From research to practice.* New York, NY. The Guilford Press.

Goodman, Y. (1986). Children coming to know literacy. In W. Teale and E. Sulzby (Eds.), *Emergent Literacy*. Norwood, N.J.: Ablex Publishing Company.

Gough, P. B. (1991*).* The complexity of reading. In R. R. Hoffman & D. S. Palermo (Eds.), *Cognition and the symbolic processes* (pp. 141-149). Hillsdale, NJ: Erlbaum.

Gough, P.B. (1993). The beginning of decoding. *Reading and Writing, 5,* 181-192.

Gough, P.B., Juel, C., & Roper-Schneider, D. (1983). A two-stage model of initial reading acquisition. In J.A. Niles and L.A. Harris, *Searches for meaning in reading/language processing and instruction*. Paper presented at the meeting of National Reading Conference, Rochester, NY.

Gough, P.B. & Walsh, M.A. (1991). Chinese, Phoenicians, and the orthographic Cipher of English. In S. Brady and D Shankweiler (Eds.), Phonological processes in literacy (pp. 199-209). Hillsdale, NJ: Lawrence Erlbaum Associates.

Hoover, W.A. & Gough, P.B. (1990). The simple view of reading. *Reading and Writing: An Interdisciplinary Journal, 2*, 127-160. doi:10.1007/BF00401799.

Jenkins, J., Stein, M., & Wysocki, K. (1984). Learning vocabulary through reading. *American Educational Research Journal, 21,* 767-787.

Johnston, R.S., Anderson, M. & Holligan, C. (1996). Knowledge of the alphabet and explicit awareness of phonemes in prereaders: The nature of the relationship. *Reading and Writing: An interdisciplinary Journal, 8,* 217-234. doi: 10.1007/BF00420276

Juel, C. (1988). Learning to read and write: A longitudinal study of 54 children from first through fourth grades. *Journal of Educational Psychology, 80(4),* 437-447. doi: 10.1037/0022-0663.80.4.437

Liberman, A.M., Cooper, F.S., Shankweiler, D.P., & Studdert-Kennedy, M. (1967). Perception of the speech code. *Psychological Review, 74*(6), 431-461. doi: 10.1037/h0020279

Liberman, I.Y., Shankweiler, D., Fischer, F.W. & Carter, B. (1974). Explicit syllable and phoneme segmentation in young children. *Journal of Experimental Child Psychology, 18,* 201-212.

Mason, J. (1980). When do children begin to read: An exploration of four year old children's letter and word reading competencies. *Reading Research Quarterly, 15,* 203-227.

Masonheimer, P.E., Drum, P.A., & Ehri, L.C. (1984). Does environmental print identification lead children into word reading? *Journal of Reading Behavior,16,* 257-271.

Mol, S. E., & Bus, A. G. (2011). To read or not to read: A meta-analysis of print exposure from infancy to early adulthood. *Psychological Bulletin, 137*(2), 267-296. doi:10.1037/a0021890

Nation, K., & Cocksey, J. (2009). The relationship between knowing a word and reading it aloud in children’s word reading development. *Journal of Experimental Child Psychology, 103,* 296–308.

Ninio, A., & Bruner, J. (1978). The achievement and antecedents of labeling. *Journal of Child Language, 5,* 1-15.

Ouellette, G. P. (2006). What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. *Journal of Educational Psychology, 98,* 554–566.

Pikulski, J.J. & Tobin, A.W. (1989). Factors associated with long-term reading achievement of early readers. In S. McCormick, J. Zutell, P. Scharer and P. O'Keefe (Eds.), Cognitive and social perspectives for literacy research and instruction. Chicago, National Reading Conference.

Purcell-Gates, V. (1996). Stories, coupons, and the "TV Guide": Relationships between home literacy experiences and emergent literacy knowledge. *Reading Research Quarterly, 31*(4)*,* 406-428.

Purcell-Gates, V., & Dahl, K. L. (1991). Low-SES children's success and failure at early literacy learning in skills-based classrooms. *Journal of Reading Behavior, 23*(1)*,* 1-34.

Ricketts, J., Nation, K., & Bishop, D. V. M. (2007). Vocabulary is important for some, but not all reading skills. *Scientific Studies of Reading, 11,* 235–257

Rittle-Johnson, B., & Siegler, R.S. (1999). Learning to spell: Variability, choice and change in children's strategy use. *Child Development, 70,* 332-348.

Rohl, M., & Pratt, C. (1995). Phonological awareness, verbal working memory and the acquisition of literacy. *Reading and Writing, 7,* 327–360.

Savage, R., Stuart, M. & Hill, V. (2001). The role of scaffolding errors in reading development: Evidence from a longitudinal and a correlational study. *British Journal of Educational Psychology, 71,* 1–13.

Scarborough, H.S. (1989). Prediction of reading dysfunction from familial and individual differences. *Journal of Educational Psychology, 81,* 101-108.

Share, D.L., (2008). Orthographic learning, phonological recoding, and self-teaching. *Advances in Child Development and Behavior, 36,* 31-82.

Share, D.L., Jorm, A.F., Maclean, R., & Matthews, R. (1984). Sources of Individual differences in reading acquisition. *Journal of Educational Psychology, 76(6),* 1309-1324.

Senechal, M. (2006). Testing the home literacy model: Parent involvement in Kindergarten is differentially related to grade 4 reading comprehension, fluency, spelling, and reading for pleasure. *Scientific Studies of Reading. 10(1),* 59-87.

Seymour, P. H. K. (1990). Developmental dyslexia. In M. W. Eysenck (Ed.), *Cognitive psychology: An international review* (pp. 135–196). Chichester: Wiley.

Seymour, P. H. K. (1997). Foundations of orthographic development. In C. Perfetti, L. Rieben, & M. Fayol (Eds), *Learning to spell* (pp. 319–337). Hillsdale, NJ: Erlbaum.

Siegler, R.S. (1996). *Emerging minds: The process of change in children's thinking.* New York: Oxford University Press.

Siegler, R.S., & Crowley, K. (1991). The microgenetic method: A direct means for studying cognitive development. *American Psychologist, 46,* 606-620.Stahl & Murray, 1993)

Stahl, S.A. & Murray, B.A. (1994). Defining phonological awareness and its relationship to early reading. *Journal of Educational Psychology, 86,* 221-234.

Stanovich, K.E. (1986). Matthew Effects in Reading: Some consequences of individual Differences in the acquisition of literacy. *Reading Research Quarterly, 21,* 360- 407.

Stevenson, H.W. & Newman, R.S. (1986). Long-term prediction of achievement and attitudes in mathematics and reading. *Child Development, 57,* 646-659.

Teale, W.H., & Sulzby, E. (1986). *Emergent literacy: Writing and reading.* Norwood, NJ: Ablex Publishing.

Tramontana, M. G., Hooper, S. R., & Selzer S. C. (1988). Research on the preschool prediction of later academic achievement: A review. *Developmental Review, 8*, 89–146 doi:10.1016/0273-2297(88)90001-9

Tunmer, W. E., & Chapman, J. W. (1998). Language prediction skill, phonological recoding ability, and beginning reading. *Reading and spelling: Development and disorders.* (pp. 33-67) Lawrence Erlbaum Associates Publishers, Mahwah, NJ.

Tunmer, W. E., & Chapman, J. W. (2012). Does set for variability mediate the influence of vocabulary knowledge on the development of word recognition skills? *Scientific Studies of Reading, 16*(2), 122-140. doi:10.1080/10888438.2010.542527

Tunmer, W.E., Herriman, M.L., & Nesdale, A.R. (1988). Metalinguistic abilities and beginning reading. *Reading Research Quarterly, 23,* 134-158.

Venezky, R. L. (1970). *The structure of English orthography.* The Hague: Mouton.

Venezky, R. L. (1999). *The American way of spelling. The structure and origins of American English orthography.* New York, NY: Guilford.

Vygotsky, L. S. (1978). Mind and society: The development of higher mental processes. Cambridge, MA: Harvard University Press.

Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin, 101*(2), 192-212. Doi:10.1037/0033-2909.101.2.192

Wagner, R.K., Torgesen, J.K., & Rashotte, C.A. (1994). Development of reading-related phonological processing abilities: New evidence of bidirectional causality from a latent variable longitudinal study. *Developmental Psychology, 30,* 73-87.

Wagner, R. K., Torgesen, J. K., & Rashotte, C. A. (1999). Comprehensive test of phonological processing. Austin, TX: PRO-ED.

Werner, H. (1925). Uber mikromelodik und microharmonik [Musical micromelodies and microscales]. *Zschr. Psychol, 98.*

Werner, H. (1948). *Comparative psychology of mental development. New* York, NY: International Universities Press.

Whitehurst, G. J., & Lonigan, C. J. (1998). Child development and emergent literacy. *Child Development, 69*(3), 848-872. doi:10.2307/1132208

Woodcock, R. W. (1998). Woodcock Reading Mastery Tests-Revised. Circle Pines, MN: AGS.

Yavas, M.S., (1998). *Phonology: Development and disorders.* San Diego, CA: Singular Publishing Group.

Table 1
Numbers of Participants Pretested at Each School and Participants Who Met Inclusion Criteria

Time and School	Total Number of Children Who Completed Pretest	Number of Children Who Met Inclusion Criteria	Number of Children Excluded for Scoring too Low	Number of Children Excluded for Scoring too High
Mar.-May 2013				
School A	15	8 (53%)	2 (13%)	5 (33%)
Oct. – Dec. 2013				
School B	14	10 (71%)	4 (29%)	0
Nov - Jan 2013				
School C	7	2 (29%)	5 (71%)	0

Note. The 20 children who met inclusion criteria were used in the qualitative analyses. As stated, some of the quantitative analyses include the initial 36 children who completed the pretest battery of tests.

Table 2

Means and Standard Deviations of Raw Scores at Pretest

Measure	Included			Too Low			All Participants		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
PPVT III-A	20	88.70	12.36	11	79.09	19.94	36	84.03	16.91
RAN-D	20	69.43	28.81	10	117.20	46.74	35	81.27	40.04
RAN-L	18	88.84	28.89	10	120.00	32.91	33	94.43	33.59
Elision	20	7.20	3.12	11	3.09	2.51	36	6.25	3.92
Blending	20	7.85	2.58	11	5.09	1.76	36	7.22	2.70
Word Attack	20	6.55	6.11	11	.73	1.10	36	5.81	6.52
Word ID	20	13.00	7.77	11	1.00	1.18	36	12.61	13.33
Letter Names	20	25.60	0.754	11	24.91	0.83	36	12.61	13.33
Letter Sounds	20	24.25	2.05	11	17.18	6.59	36	12.61	13.33
Set Var. S1	20	0.75	0.851	11	0.45	0.82	36	0.69	0.79
Set Var. S2	20	1.90	0.852	11	1.18	0.75	36	1.61	0.84
Set Var. S3	20	2.50	1.10	11	1.82	1.33	36	2.17	1.18
Set Var. S4	20	1.90	1.12	11	1.09	0.83	36	1.56	1.03
Set Var. Total	20	7.05	2.44	11	4.55	2.51	36	6.03	2.57

Note. PPVT III-A = Peabody Picture Vocabulary III - Test A; RAN Digit = Comprehensive Test of Phonological Processing- Rapid Digit Naming subtest; RAN Letter = Comprehensive Test of Phonological Processing- Rapid Letter Naming subtest; Elision = Comprehensive Test of Phonological Processing- Elision subtest; Blending = Comprehensive Test of Phonological Processing- Blending Words subtest; Word Attack = Woodcock Reading Mastery Test-Revised- Word Attack subtest; Word ID = Woodcock Reading Mastery Test-Revised- Word Identification subtest; Letter Names = Letter Naming task; Letter Sounds = Letter Sound task; Set Var. S1 = Set for Variability – Mispronunciation Task Subtest 1; Set Var. S2 = Set for Variability – Mispronunciation Task Subtest 2; Set Var. S3 = Set for Variability – Mispronunciation Task Subtest 3; Set Var. S4 = Set for Variability – Mispronunciation Task Subtest 4; Set Var. Total = Set for Variability – Mispronunciation Task Total Score

Table 3

Means and Standard Deviations of Raw Scores at Posttest

Measure	Low Set for Var.			High Set for Var.			All Participants		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
PPVT III-A	9	86.33	10.68	11	90.64	13.78	20	92.25	14.92
RAN-D	9	74.45	34.45	11	65.33	24.21	20	65.47	23.57
RAN-L	8	87.70	34.83	10	89.75	25.11	20	80.18	32.74
Elision	9	6.00	1.32	11	8.18	3.84	20	7.65	2.11
Blending	9	7.78	2.44	11	7.91	2.81	20	10.75	2.20
Word Attack	9	4.78	3.63	11	8.00	7.44	20	8.80	5.19
Word ID	9	14.22	7.87	11	12.00	7.91	20	22.30	9.76
Letter Names	9	25.67	0.71	11	25.55	0.82	20	25.80	0.41
Letter Sounds	9	23.67	2.40	11	24.73	1.68	20	25.10	1.07
Set Var. S1	9	0.33	0.71	11	1.09	0.83	20	1.20	1.11
Set Var. S2	9	1.78	1.09	11	2.00	0.63	20	2.10	1.17
Set Var. S3	9	2.00	0.87	11	2.91	1.14	20	2.95	1.10
Set Var. S4	9	1.00	0.71	11	2.64	0.81	20	2.10	1.02
Set Var. Total	9	5.11	1.17	11	8.64	2.01	20	8.35	3.05

Note. PPVT III-A = Peabody Picture Vocabulary III - Test A; RAN Digit = Comprehensive Test of Phonological Processing- Rapid Digit Naming subtest; RAN Letter = Comprehensive Test of Phonological Processing- Rapid Letter Naming subtest; Elision = Comprehensive Test of Phonological Processing- Elision subtest; Blending = Comprehensive Test of Phonological Processing- Blending Words subtest; Word Attack = Woodcock Reading Mastery Test-Revised- Word Attack subtest; Word ID = Woodcock Reading Mastery Test-Revised- Word Identification subtest; Letter Names = Letter Naming task; Letter Sounds = Letter Sound task; Set Var. S1 = Set for Variability – Mispronunciation Task Subtest 1; Set Var. S2 = Set for Variability – Mispronunciation Task Subtest 2; Set Var. S3 = Set for Variability – Mispronunciation Task Subtest 3; Set Var. S4 = Set for Variability – Mispronunciation Task Subtest 4; Set Var. Total = Set for Variability – Mispronunciation Task Total Score

Table 4

Correlations Between Measures at Pretest (N=36)

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PPVT III	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RAND	.13 .	-	-	-	-	-	-	-	-	-	-	-	-	-
RANL	.07	.80***	-	-	-	-	-	-	-	-	-	-	-	-
Elision	.39**	-.40*	-.34*	-	-	-	-	-	-	-	-	-	-	-
Blend	.24	-.30*	-.41 **	.52***	-	-	-	-	-	-	-	-	-	-
Word Attack	.27	-.44**	-.50**	.75***	.71***	-	-	-	-	-	-	-	-	-
Word ID	.089	-.45**	-.57***	.55***	.54***	.75***	-	-	-	-	-	-	-	-
Letter Names	-.21	-.38*	-.35*	.31*	.53***	.41**	.48**	-	-	-	-	-	-	-

	.107	.013	.025	.035	<.001	.007	.001							
Letter Sounds	.24	-.37*	-.35	.45**	.54***	.48**	.44**	.37*	-	-	-	-	-	-
SFV 1	-.03	-.09	-.10	.29*	.32**	.42**	.20	.22	.25	-	-	-	-	-
SFV 2	.338*	-.07	.04	.23	.10	.10	.07	.14	.49**	.19	-	-	-	-
SFV 3	.22	.12	.23	.04	.13	.03	-.06	.10	.20	.21	.27	-	-	-
SFV 4	.31*	-.15	-.12	.35*	.35*	.32*	.02	.14	.48**	.29*	.33*	.46**	-	-
SFV Total	.33*	-.05	.04	.32*	.33*	.31*	.06	.21	.52**	.46	.52**	.80***	.81***	-

Note. *p < .05 (1-tailed), **p < .01 (1-tailed), ***p < .001 (1-tailed). PPVT III = Peabody Picture Vocabulary III - Test A; RAND = Comprehensive Test of Phonological Processing- Rapid Digit Naming subtest; RANL = Comprehensive Test of Phonological Processing- Rapid Letter Naming subtest; Elision = Comprehensive Test of Phonological Processing- Elision subtest; Blend = Comprehensive Test of Phonological Processing- Blending Words subtest; Word Attack = Woodcock Reading Mastery Test-Revised- Word Attack subtest; Word ID = Woodcock Reading Mastery Test-Revised- Word Identification subtest; Letter Names = Letter Naming task; Letter Sounds = Letter Sound task; SFV 1 = Set for Variability – Mispronunciation Task Subtest 1; SFV 2 = Set for Variability – Mispronunciation Task Subtest 2; SFV 3 = Set for Variability – Mispronunciation Task Subtest 3; SFV 4 = Set for

Variability – Mispronunciation Task Subtest 4; SFV Total = Set for Variability – Mispronunciation Task Total Score

Table 5

Correlations Between Measures at Posttest (N=20)

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PPVT III	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RAND	-.36	-	-	-	-	-	-	-	-	-	-	-	-	-
RANL	-.32	.83***	-	-	-	-	-	-	-	-	-	-	-	-
Elision	.47*	-.20	-.08	-	-	-	-	-	-	-	-	-	-	-
Blend	.42*	-.12	0.12	.41*	-	-	-	-	-	-	-	-	-	-
Word Attack	.64**	-.49**	-.45*	.65***	.49*	-	-	-	-	-	-	-	-	-
Word ID	.58**	-.49*	-.38*	.42*	.29	.73**	-	-	-	-	-	-	-	-
Letter Names	.15 .	-.08	-.10	.28	.12	.40*	.50*	-	-	-	-	-	-	-

Letter Sounds	.00	.07	-.04	.13	.30	.38*	.03	-.07	-	-	-	-	-	-
SFV 1	-.22	.22	-.07	.15	.20	-.05	-.15	-.02	.34	-	-	-	-	-
SFV 2	.31	-.01	.07	.59**	.36	.45*	.18	.26	.25	-.31	-	-	-	-
SFV 3	.35	.13	.10	.47	.56**	.30	-.13	-.14	.14	.14	.42* .	-	-	-
SFV 4	-.09	-.09	-.16	.14	.46*	.21	-.09	.18	.04	.26	.17	.46**	-	-
SFV Total	.14	-.07	-.02	.50*	.56*	.33	-.06	.10	.28	.62**	.70***	.76***	.70***	-

Note. **p* < .05 (1-tailed), ***p* < .01 (1-tailed), ****p* < .001 (1-tailed). PPVT III = Peabody Picture Vocabulary III - Test A; RAND = Comprehensive Test of Phonological Processing- Rapid Digit Naming subtest; RANL = Comprehensive Test of Phonological Processing- Rapid Letter Naming subtest; Elision = Comprehensive Test of Phonological Processing- Elision subtest; Blend = Comprehensive Test of Phonological Processing- Blending Words subtest; Word Attack = Woodcock Reading Mastery Test-Revised- Word Attack subtest; Word ID = Woodcock Reading Mastery Test-Revised- Word Identification subtest; Letter Names = Letter Naming task; Letter Sounds = Letter Sound task; SFV 1 = Set for Variability – Mispronunciation Task Subtest 1; SFV 2 = Set for Variability – Mispronunciation Task Subtest 2; SFV 3 = Set for Variability – Mispronunciation Task Subtest 3; SFV 4 = Set for

Variability – Mispronunciation Task Subtest 4; SFV Total = Set for Variability – Mispronunciation Task Total Score

Table 6

Comparison of Those Included in Study vs. Those Who Scored Too Low at Pretest

Measure	Levene's Test for Equality of Variances			*t*-test for Equality of Means				
	Equal Variances Assumed	*F*	*p*	*t*	*df*	*p* (1-tailed)	Mean difference	Std. Error Difference
PPVT III-A	Y	2.57	.120	1.66	29	.054	9.61	5.78
Elision	Y	<0.01	.967	3.74	29	<.001***	4.11	1.10
Blending	Y	1.46	.237	3.15	29	.002**	2.76	0.88
Word Attack	N	7.65	.010	4.14	21.2	<.001***	5.82	1.41
Word ID	N	37.17	<.001	6.77	20.6	<.001***	12.00	1.78
Set Var. S1	Y	0.01	.218	0.94	29	.179	0.30	0.32
Set Var. S2	Y	0.03	.870	2.34	29	.135	0.72	0.31
Set Var. S3	Y	0.07	.793	1.53	29	.068	0.68	0.44
Set Var. S4	Y	1.54	.225	2.10	29	.023*	0.81	0.39
Set Var. Total	Y	<0.01	.998	2.71	29	.006**	2.51	0.92

Note. *$p < .05$ (1-tailed), **$p < .01$ (1-tailed), ***$p < .001$ (1-tailed). PPVT III-A = Peabody Picture Vocabulary III - Test A;; Elision = Comprehensive Test of Phonological Processing- Elision subtest; Blending = Comprehensive Test of Phonological Processing- Blending Words subtest; Word Attack = Woodcock Reading Mastery Test-Revised-Word Attack subtest; Word ID = Woodcock Reading Mastery Test-Revised- Word Identification subtest; Set Var. S1 = Set for Variability – Mispronunciation Task Subtest 1; Set Var. S2 = Set for Variability – Mispronunciation Task Subtest 2; Set Var. S3 = Set for Variability – Mispronunciation Task Subtest 3; Set Var. S4 = Set for Variability – Mispronunciation Task Subtest 4; Set Var. Total = Set for Variability – Mispronunciation Task Total Score. Equal variances assumes – Y = yes; N = no

Table 7

Correlations Between Measures of Set for Variability and Proportion of Real Word and Vowel Errors (N=20)

Measure	1	2	3	4	5	6	7
1.Real Word	-	-	-	-	-	-	-
r							
p							
Vowel		-	-	-	-	-	-
r	.06						
p	.401						
Set S1			-	-	-	-	-
r	.22	.-.09					
p	.172	.352					
Set S2				-	-	-	-
r	-.11	-.23	-.25				
p	.316	.169	.140				
Set S3					-	-	-
r	-.35	.06	-.08	.39*			
p	.063	.404	.362	.043			
Set S4						-	-
r	.12	-.23	.42*	.10	.34		
p	.308	.162	.035	.338	.070		
Set Total							-
r	-.07	-.19	.41*	.48*	.72***	.79***	
p	.390	.210	.035	.015	<.001	<.001	

Note. *p < .05 (1-tailed), **p < .01 (1-tailed), ***p < .001. 1. Real Word = Proportion of errors made that were real words; 2. Vowel = Proportion of errors made on vowel sounds; 3. Set S1 = Set for Variability – Mispronunciation Task Subtest 1; 4. Set S2 = Set for Variability – Mispronunciation Task Subtest 2; 5. Set Var. S3 = Set for Variability – Mispronunciation Task Subtest 3; 6. Set S4 = Set for Variability – Mispronunciation Task Subtest 4; 7. Set Var. Total = Set for Variability – Mispronunciation Task Total Score