Understanding Integration in Emergent Reading

by

Bronwen Jane Davis

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ABSTRACT

UNDERSTANDING INTEGRATION IN EMERGENT READING

Bronwen Jane Davis
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Advisor:
Dr. Mary Ann Evans

A predictable alphabet book was proposed as a natural way to observe emergent readers' attempts to integrate their developing literacy skills and knowledge base, despite not yet having achieved conventional levels of reading. Study 1 examined how accuracy in identifying words in an alphabet book in kindergarten related with emergent skills measured in kindergarten and with subsequent reading ability. One hundred and three children completed tests of phonemic awareness, letter knowledge, vocabulary, and rapid naming in kindergarten and were audiotaped reading an alphabet book with their parent. Reading ability was assessed one year later. Correlations were consistent with previous research identifying phonemic awareness, letter knowledge, vocabulary and rapid naming as significant correlates of emergent reading. Alphabet book accuracy correlated with subsequent reading, and the relative indirect effects of kindergarten phonemic awareness and letter sound knowledge on Grade 1 reading through kindergarten alphabet book reading were significant. Findings supported the conceptualization of how well a child identifies words in an alphabet book as a representation of early skill integration. Study 2 built upon these findings by examining self-reported reading strategies. Siegler's (1996) overlapping waves model was used as a framework, which emphasizes variability, adaptive choice, and gradual change in children's problem solving. Ninety-one kindergarteners completed tests of phonemic awareness, letter knowledge, and vocabulary, and read an experimentally designed alphabet book having pages of varying difficulty with a researcher twice over several months. Findings supported the three main features of the overlapping waves model. Children reported a variety of strategies across the book and on individual pages within it. They worked most quickly on the easiest pages, reported more strategies on the most difficult pages, and chose adaptively among their strategy repertoire. The number of strategies reported and the number of accurately labeled pages increased over time. The relative indirect effects of phonemic awareness and letter sound knowledge on alphabet book accuracy through the use of graphophonemic strategies were significant. Findings support the application of the overlapping waves model to the domain of reading. Overall, these studies highlight the potential for using typical literacy activities to deepen our understanding of the process of learning to read.

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Chapter 1

General Introduction

When a skilled reader encounters printed text, it most often feels as though the words are read completely automatically. The process of reading even a single word is far more effortful for the beginning, or emerging, reader. Though this contrast may lead the mature reader to perceive literacy as a skill that an individual either does or does not possess, researchers have moved away from such a dichotomous perspective. Instead, the field of emergent literacy conceptualizes the acquisition of literacy as a developmental continuum, beginning long before a child enters formal schooling (Whitehurst & Lonigan, 1998). An emergent literacy perspective emphasizes no clear boundary between pre-reading and reading, and assumes that reading, writing, and oral language develop from an early age both concurrently and interdependently.

The field of emergent literacy has consistently identified several foundational skills as important in the development of conventional forms of reading, including (not exclusively) the recognition of letters, the awareness of phonemes, the translation of printed letters to corresponding sounds, and the understanding of relevant word meanings (e.g., Adams, 1990, Bus & van IJzendoorn, 1999; Castles & Coltheart, 2004; Foulin, 2005; National Institute of Child Health and Human Development [NICHHD], 2000; Scarborough, 2001). Adams (1990) asserts that in the process of reading, "all of its component knowledge and skills must work together within a single integrated and interdependent system." (p. 423). This claim, however, refers to the process for skilled readers, and does not represent the reading process for emergent readers who do not initially have all of these skills and knowledge integrated. Van Kleeck (1998) describes some of the challenges for the emergent reader:

> That is, to become readers, children must integrate their letter knowledge with the crowning achievement of phonological awareness – phonemic awareness.
> Further, if they are to realize that the sequence of sounds represented by a string

> of letters corresponds to a spoken word, they must also integrate their knowledge of vocabulary. (p. 46).

The aim of this dissertation is to better understand how emergent readers begin to integrate and apply their foundational skills and knowledge. Integration will be used throughout this dissertation as a conceptual framework to refer to the application of multiple individual skills and knowledge in tandem in a child's efforts to identify words, as described by van Kleeck (1998). To ground this dissertation within the field of emergent literacy, it will begin with a review of the most commonly reported foundational skills and knowledge in learning to read. Within this section, efforts will be made to define each distinct skill, and to discuss how they may relate to each other and to reading ability. Next, a description of theories of reading development will be provided. The final section of the general introduction will propose an alphabet book as a way to observe children integrating and applying their developing skills and knowledge, before having achieved more conventional, or more tightly integrated, reading.

This dissertation consists of two separate studies, which together, aim to provide some understanding of how emergent readers begin to integrate and apply their developing skills and knowledge when attempting to identify words. The primary purpose of Study 1 was to provide justification for further examination of how young children engage in the task of labeling pages in an alphabet book. To do so, Study 1 examined how kindergarten children's ability to label pages in an alphabet book related to their developing literacy skills and knowledge base, and to subsequent reading ability. In Study 2, kindergarten children's attempts to identify pages in an alphabet book were observed overtime. In combination with a theory of cognitive development (i.e., Siegler's overlapping waves model, 1996), children's performance and self-reports were used as a way to build understanding of how these emergent readers integrate their developing skills and knowledge to progress into reading. The overall findings from both studies are summarized in a final conclusion, which provides one explanation for how young children integrate their various skills and knowledge in early reading attempts. Furthermore, it is suggested that young children's self-reports about how they engage in a typical literacy activity can be used to add to our understanding of the process of reading development. Finally, due to varying uses of the terms, it is important to specify what is meant by 'literacy' and by 'reading'. Similar to Whitehurst and Lonigan (1998), the term 'literacy' will not be used to refer to interactions with other symbols (e.g., interpreting maps, understanding numerals), which are sometimes implied by the term. While research has certainly also accumulated on literacy in non-alphabetic texts (e.g., Kao, Leong, & Gao, 2002; Tan & Perfetti, 1998; Taylor & Taylor, 1995), the samples used in the studies of this dissertation are English speakers, and the primary research that is summarized here will focus therefore on the knowledge of reading an alphabetic text. Considering the ultimate purpose of reading, truly successful reading requires both the ability to translate written text into oral language (i.e., decoding) and to understand the meaning of the decoded words (i.e., comprehension; Gough & Tunmer, 1986). This dissertation focuses primarily on children's early applications of foundational literacy skills to decode written English text, thus 'reading' is used to refer solely to word recognition, or the ability to decode words. When understanding is also implied, the term reading comprehension will be used.

Foundational Skills

For children learning to read text written in an alphabetic system, such as English, it is widely accepted that they must gain insight into the alphabetic principle (e.g., Adams, 1990; Byrne, 1998, Foorman et al., 2003). That is, children must discover and learn to apply the knowledge that phonemes (the smallest sound units of spoken words) are represented by graphemes (printed letters). However, making such connections is challenging due to the seamless nature of syllables in oral language, which lacks breaks in speech delineating individual phonemes. Awareness of sound units in spoken language (i.e., phonemic awareness; NICHHD, 2000) appears to develop in a particular, but overlapping sequence, moving from word-level skills, to syllable-level skills, to onset/rime-level skills, to phoneme-level skills (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003). Some research also suggests that phonemic sensitivity then progresses from the beginning, to the end, and then to the middle of words (Treiman, 1994, Treiman & Zukowski, 1996).

Phonemic sensitivity is important in early reading development as it allows the emergent reader to segment oral language into units that map onto written graphemes, and to blend individual phonemes into complete words. In fact, a core phonological deficit appears present in nearly all readers with poor decoding skill (Stanovich, 1988; Stanovich & Sigel, 1994). Furthermore, children's level of phonemic awareness as measured before formal schooling has consistently been identified as one of the best predictors of subsequent reading achievement (e.g., Share, Jorm, Maclean, Matthews, 1984; Storch & Whitehurst, 2002; Wagner et al., 1997). A recent meta-analysis yielded a moderate average correlation of .40 between phonemic awareness measured in or before kindergarten and subsequent decoding ability and demonstrated that it remained a significant predictor of decoding (as well as of spelling and reading comprehension) after controlling for age, socioeconomic status, letter knowledge, oral language, IQ, and prior decoding ability (Eunice Kennedy Shriver National Institute of Child Health and Human Development [EKS-NICHHD], NIH, & DHHS. 2008). Melby-Lervåg, Lyster, and Hulme (2012) described similar correlational findings in their more recent meta-analysis, and additionally demonstrated that children with dyslexia show a large deficit in phonemic awareness compared to same-aged typically developing peers (average effect size, $d = -1.37$). Some researchers contend that the relationship is reciprocal, such that learning to read (preliminary levels such as letter naming in particular) also facilitates the growth of phonemic awareness (Mann & Wimmer, 2002; Perfetti, Beck, Bell, & Hughes, 1987; Wagner, Torgesen, Rashotte, 1994; Wagner et al., 1997). Morris and colleagues (Morris, Bloodgood, Lomax, & Perney, 2003) suggest a developmental model in which basic phonemic sensitivity (i.e., to beginning consonant sounds) precedes a concept of word in text (i.e., facility in distinguishing words in text measured through finger pointing), which is then followed by more mature levels of phonemic segmentation. Promising are intervention studies, which have demonstrated that teaching phonemic awareness is effective in increasing children's abilities to manipulate phonemes and that these increases are maintained post-interventions and translate into better subsequent reading achievement (e.g., Bus & van IJzendoorn, 1999; NICHHD, 2000). Noteworthy, however, is that interventions appear most effective when phonemic training is accompanied by instruction in letter-sound correspondences (Byrne & Fielding-Barnsley, 1989; NICHHD, 2000).

To map oral phonemes onto written graphemes, emergent readers must also have knowledge of letters. In the National Early Literacy Panel's (EKS-NICHHD et al., 2008) meta-analysis, alphabet knowledge (i.e., knowing the sounds letters represent and/or their associated names) measured in or before kindergarten correlated strongly with later decoding ability (r = .50), and remained a significant predictor of decoding, spelling, and reading comprehension after controlling for age, socioeconomic status, oral language, phonemic awareness, and IQ. Knowing the sound a letter or a group of letters represents is fundamental in applying the alphabetic principle to decode an unknown word, and letter sound knowledge has been shown to be a powerful predictor of reading achievement (e.g., Lomax & McGee, 1987; McBride-Chang, 1999; Storch & Whitehurst, 2002). As previously indicated, instruction in letter-sound associations is a critical component in phonemic awareness training in order for the gains to generalize to reading activities (NICHHD, 2000).

Though some studies failed to demonstrate gains from training children on letter names (e.g., Jenkins, Bausell, & Jenkins, 1972; Muehl, 1962; Samuels, 1972), a substantial body of research has identified letter name knowledge as a strong predictor of learning to read (e.g., McBride-Chang, 1999; Scarborough, 1998; Share et al., 1984; Storch & Whitehurst, 2002). Noteworthy is the consistently strong correlation found between letter name and letter sound knowledge (i.e., .70 to .80; e.g., Evans, Bell, Shaw, Moretti, & Page, 2006; Kim, Petscher, Foorman, & Zhou, 2010; Worden & Boettcher, 1990). Children more readily learn letter-sound associations for letters that they can name compared to those that they cannot (Ehri, 1993; Treiman, Tincoff, Rodriguez, Mouzaki, & Francis, 1998) and letter name knowledge has been shown to predict letter sound knowledge earlier in development than does the reverse (McBride-Chang, 1999). At the most basic level, a child who knows the name of a printed letter may better understand instructional attempts about that letter made by parents and preschool teachers. Walsh, Price, and Gillingham (1998) additionally suggest that knowing letter names makes them identifiable and familiar, which allows them to be processed more efficiently when reading. Other research indicates that children more readily demonstrate knowledge of letter sounds for letters whose names contain the associated sound (e.g., *b, t, v*) than for those whose names do not (e.g., *w, h, y*), suggesting that letter names provide insights to children into the sounds that they represent (Evans et al., 2006, McBride-Chang, 1999, Piasta & Wagner, 2010; Treiman et al., 1998).

In addition to the high degree of association with each other, letter name and letter sound knowledge are also tightly related to the development of phonemic awareness. Specifically, much research has demonstrated positive associations between children's letter name knowledge and their abilities to detect and manipulate phonemes (e.g., Bowey, 1994; Johnston, Anderson, & Holligan, 1996; Kim et al., 2010; Stahl & Murray, 1994). In longitudinal studies, individual differences in children's levels of letter knowledge in kindergarten and in Grade 1 significantly correlated with subsequent phonological sensitivity assessed one and two years later (Wagner et al., 1994; 1997). Because training phonemic awareness has little to no effect on learning of letter names (Lundberg, Frost, & Peterson, 1988) and because many children learn some letter names before being able to demonstrate substantial awareness of phonemes, it is suggested that learning the names of letters may help children gain insights into the concept that syllables and words are composed of phonemes (Johnston et al., 1996; Treiman, 2005). From a slightly different perspective, but also demonstrating the interconnectedness of these three variables, Kim and colleagues (2010) found that phonological awareness had a larger effect on letter sound knowledge when children knew the letter names than when they did not. Share (2004) additionally demonstrated that after controlling for receptive vocabulary, phonological awareness correlated with learning letter-sound correspondences when the letter names contained that sound. Other research has noted, more specifically, that children appear better able to name sounds for letters whose names contain their associated sound at the beginning rather than end of the name (i.e., *b, p, d* vs. *f, m, r*; Evans et al., 2006; Kim et al., 2010; McBride-Chang, 1999, Treiman, 1994). McBride-Chang (1999) suggests that children may be predisposed to most closely attend to initial sounds, in line with some findings from phonological tasks on which children are first able to identify and manipulate initial word sounds than those found at the middle or end of words (Treiman, 1994, Treiman & Zukowski, 1996). However, Evans and colleagues (2006) note that these position effects have not been observed in other languages. Instead, they suggest that the phenomenon of English speaking children learning letter sounds for letters whose name contains the sound at its beginning stems from experiences of English-speaking North American culture, which often focus on teaching phonemes via initial positions (e.g., in a typical alphabet book). Piasta and Wagner (2010) add insight into the interconnections between letter name, letter sound, and phonemic awareness. They note that it is only children with higher levels of phonological sensitivity who are able to use that awareness to learn the sounds from letter names that contain their associated sound in the initial position. Those with lower levels of phonological sensitivity are not able to do so, and do not appear able to use letter names to learn their sounds regardless of the sound's position in the name. However, when children are provided with explicit instruction combining letter names and sounds, the limitations of phonological abilities and position effects of sounds appear overridden, such that children are able to learn letter sounds from both letters containing the sound in the beginning or end their names, regardless of their phonological abilities.

A variety of early oral language factors, such as expressive and receptive vocabulary, understanding the rules of grammar and sentence structure (syntactic awareness), and listening comprehension, have also been identified as contributing to a child's literacy development. Though several aspects of language relate consistently to the development of reading comprehension (EKS-NICHHD et al., 2008, Sénéchal, Ouellette, & Rodney, 2006; Storch & Whitehurst, 2002), research has also looked to their relation with early word recognition and decoding skills, considering that the purpose of text is always to communicate meaning (Whitehurst and Lonigan, 1998). The National Early Literacy Panel's meta-analysis (EKS-NICHHD et al., 2008) revealed that composite measures assessing multiple aspects of oral language and those measuring more complex oral language skills (e.g., grammar and listening comprehension) were moderately to strongly related to subsequent decoding, while measures of vocabulary yielded relatively weak relationships. After controlling for alphabet knowledge and phonemic awareness, however, oral language factors did not always remain significant predictors of subsequent decoding (EKS-NICHHD et al., 2008).

Nevertheless, vocabulary and other aspects of oral language do not appear completely unimportant in the development of reading. Research has consistently demonstrated that preschoolers with identified language impairments are at high risk for developing reading disabilities (Scarborough, 2001). In addition, vocabulary knowledge has been shown to relate concurrently and longitudinally to early measures of phonological sensitivity (e.g., Bowey, 1994; Burgess & Lonigan, 1998; Lonigan, Burgess, & Anthony, 2000; Wagner et al., 1997). Through structural modeling techniques, Storch and Whitehurst (2002) demonstrated a path from preschool and kindergarten oral language factors to concurrent code-related skills (e.g., phonemic awareness and alphabet knowledge), and then a path from the code related skills to subsequent word reading in Grade 1. The lexical restructuring model (Metsala & Walley, 1998) proposes that growing vocabularies in early and middle childhood lead to more fine-tuned lexical representations of words, which utilize the word parts rather than their wholes. Thus, a developing vocabulary that gradually segments words into smaller parts in memory may allow for increased phonemic sensitivity (Lonigan, 2006). In fact, providing a vocabulary intervention has been shown to significantly improve preschoolers' vocabulary and phonemic awareness, while providing a phonemic awareness intervention improved only its target, and not children's vocabulary skills (Lonigan, 2006). In line with the lexical restructuring model (Metsala & Walley, 1998), interventions in facets of oral comprehension other than vocabulary (e.g., basic skills training in monitoring comprehension and making inferences) seem not to extend benefits to gains in phonemic awareness (Bianco et al., 2010). Thus, though the relation between early oral language and subsequent decoding skills is only, at best, inconsistently found, oral language appears closely linked to the development of other known foundational literacy skills. As such, oral language factors cannot be overlooked when considering emergent literacy.

Other general cognitive factors have been implicated in the development of reading, including rapid automatized naming (RAN), which refers to the ability to quickly name individual items in an array (i.e. letters, digits, colours, or objects; for review see Kirby, Georgiou, Martinussen, & Parrila, 2010). Wolf and Bowers (1999) identified three subgroups of poor readers; those with phonological processing deficits, those with RAN deficits, and those with both deficits. They suggest the third 'double-deficit' group is associated with more severe reading difficulties. However, RAN has sometimes been considered as no more than a phonological processing task, which no longer predicts reading once phonological skills are controlled for (Wagner et al., 1994). Yet other researchers have demonstrated that poor readers are slower to name continuous lists of numbers, letters, colours, and objects and that RAN does account for unique variance in word reading even after controlling for phonological awareness (e.g. Ackerman & Dykman, 1993; Lovett, 1987; McBride-Chang & Manis, 1996). Wagner and colleagues (1997) found that RAN was a significant and independent predictor of early word reading (i.e., in kindergarten and Grade 1), but that its influence decreased over development (i.e., no longer predictive of word reading in a period of Grade 2 through 4), while phonological processing remained a significant predictor over time. Parrila and colleagues (Parrila, Kirby, & McQuarrie, 2004) did not discover this same diminishing effect, instead finding significant relations between kindergarten RAN and word reading in Grades 1 through 3, both when other phonological skills were controlled for and when the autoregressor of prior reading was included. It is possible that naming speed assessed using colours or at an earlier point in development (as done by Parilla et al.) shares less variance with other literacy skills than rapid letter or digit naming measured later in development (as done by Wagner et al.), and as such, only the former remains a unique predictor of word reading after other known emergent skills are controlled for (Parilla et al., 2004). Some researchers have suggested that rapid naming exerts more influence on the accuracy and speed of word reading than phonemic awareness does in languages that have more consistent orthographies than English (e.g., Dutch; Verhagen, Aarnoutse, & van Leeuwe, 2008). Other research has attempted to better understand the link between RAN and literacy by examining specific components of RAN. Georgiou and colleagues (Georgiou, Parrila, & Kirby, 2006; Georgiou, Parrila, Kirby, & Stephenson, 2008) found that pause time between items on both colour and letter naming measures was highly correlated with reading accuracy and fluency while articulation time of the items was only weakly correlated with reading outcomes. Similar to Wagner et al., (1997), pause time in RAN tasks appeared limited in its influence on reading outcomes, and lost significance in its concurrent relations with reading outcomes by Grade 3 (Georgiou et al., 2008). Slower RAN has been particularly, and more consistently, implicated in poorer reading fluency (e.g., Lervåg & Hulme, 2009; Wolf et al., 2002). Though there may be building evidence that RAN plays a predictive role in reading acquisition, an understanding of the processes through which it may influence reading is not yet clear. Some researchers are beginning to test more specific theories. For example, Lervåg and Hulme (2009) suggest that performance on naming tasks reflects the integrity of neural circuits involved in object identification and naming, which children draw upon to build a system of visual word recognition. Research in this area remains needed.

Other factors still have been implicated in early literacy development. Another cognitive variable, for example, is phonological memory. The ability to recall orally presented phonological information such as pseudo-words, has been related both to vocabulary and to reading acquisition (Gathercole, Willis, Emslie, & Baddeley, 1992; Wagner et al., 1994). Phonological memory may allow children to better establish long-term memory representations of words linked with their meanings. As an attitudinal factor, some research has identified print motivation, a child's interest in reading activities, as influencing early literacy development. A child who is interested in literacy is more likely to engage in early reading interactions, notice print in the environment, and ask more questions about its meaning (Whitehurst & Lonigan, 1998). Print motivation has been associated with early literacy skills and later reading achievement (Payne, Whitehurst, & Angell, 1994). More specifically, preschooler's self-reported interest in reading has been shown to relate to their letter name and letter sound knowledge (but not phonemic awareness; Frijters, Barron, & Brunello, 2000). The degree to which early interest in reading affects reading acquisition is not quite clear, and may in part be due to different findings when parent versus child reports are used (e.g., Crain-Thoresen & Dale, 1992 vs. Frijters et al., 2000). In older children, however, internal motivation to read has been shown to be associated with positive reading outcomes for reading-disabled fourth-graders completing an intervention program, even with phonological skills controlled (McTaggart, 2009).

In sum, a variety of literacy, language and attitudinal factors appear involved in the process of learning to read. This conclusion is inferred through conceptualizations of the components of reading, statistical correlations, and changes in reading ability after training children in individual skills. How emergent readers begin to integrate these individual skills and knowledge base during early attempts to identify words, however, is less well understood, but is considered in the following section with theories of early reading development.

Theories of Reading Development

Stage theories. Stage theories generally reflect observations that emergent readers tend to pass through a series of phases characterized by prominent use of particular strategies (e.g., Ehri, 1995, Frith, 1985; Marsh, Friedman, Welch, & Desberg, 1981). Ehri (1995) proposed that children first read words through visual attributes (i.e. *pre-alphabetic phase* or *visual cue reading*). In this phase, children note and associate particular visual features of letters or of context with word pronunciations or meanings, and store these connections in memory. Support for the existence of this stage has been drawn from findings that young children more easily learn lists of dissimilar words rather than lists of similar words, because the former offers more distinctive visual cues (Otto & Pizzilo, 1970-71). Similarly, children learn lists containing words of various lengths more easily than they do lists of same-length words (Lipscomb & Gough, 1990). Children also attend to visual cues outside of the print itself to distinguish words, such as accompanying pictures or designs. Gough and Juel (1991) demonstrated that in a sample of 4- and 5-year-old children, all of them learned a word on a flashcard that was accompanied by a thumbprint more quickly than words without a salient visual cue. Very few of the children could correctly identify the word when the thumbprint was removed, but many identified the associated word when shown only the thumbprint.

Ehri's *pre-alphabetic phase* is comparable to initial stages of word reading proposed by other theorists and researchers; Gough's (1996) *selective association phase,* Frith's (1985) and Seymour and MacGregor's (1984) *logographic stage*, Marsh and colleagues' (1981) *linguistic guessing* and *discrimination net guessing stages,* and Share and Gur's (1999) *contextual dependency* and *visuographic stages*. Though making slightly different emphases which are generally reflected in their label, these initial stages are all marked by the tendency for children to learn words by making connections with visual or contextual features. More generally, this initial stage represents how a child can remember a printed word without alphabet knowledge or substantial phonemic sensitivity. In many ways, this initial stage seems relatively distinct from conventional reading. It is conceivable that a child could be successful in this stage due to visual skills and cognitive ability, but struggle when required to apply more foundational literacy skills, such as phonemic awareness. Some researchers have questioned whether the *pre-alphabetic phase* is a required stage in reading development at all, or whether children can successfully learn to read by beginning at later stages (Stuart & Coltheart, 1988, Bowman & Treiman, 2008).

Regardless of its validity as a stage of reading, word learning through visual cues is not efficient nor does it help when encountering new words (Gough, 1996). In his two-stage model, Gough (1996) proposes that children must move into a stage in which they are learning and applying the alphabetic principle and drawing on phonemic awareness to decipher orthography. Ehri (1995) breaks this up further, and proposes three subsequent stages based on the application of the alphabetic principal. Other stage theories also include phases that reflect use of the alphabetic principle (Frith, 1985; Seymour & MacGregor, 1984; Marsh et al. 1981), but generally do not distinguish specific aspects of the progression as does Ehri's (1995) framework.

Ehri's (1995) second stage, the *partial alphabetic phase* (or *phonetic cue reading*) represents a phase when attempts to read are guided by early levels of letter knowledge and phonemic awareness. In this stage, emergent readers recognize some words through reliance on several known letter-sound correspondences and developing phonemic sensitivity, that is, segmentation of initial and final sounds of words.

Support for the existence and distinction of the pre-alphabetic and the partial alphabetic phases comes partly from Ehri and Wilce's (1985) findings that kindergarteners who could read a few words more easily learnt words with simplified phonetic spellings rather than visually distinctive spellings, while the reverse was true for kindergarteners who were not yet able to read words. Ehri and Wilce (1985) conclude that children transition from employing visual cue strategies to phonetic strategies as they move into reading. Similarly, Rack and colleagues (Rack, Hulme, Snowling, & Wright, 1994) found that beginning readers were better able to learn a list of words with invented spellings that were more closely related phonetically (i.e., articulated similarly) to their true spellings. For example, children were better able to learn the invented spelling for *table* when it was spelled as *dbl* rather than *kbl*, due to the more closely related sounds represented by the letters *d* and *t* than by *k* and *t*. Stuart and colleagues (Stuart, 1990; Stuart & Coltheart, 1988; Stuart, Masterson & Dixon, 2000) also demonstrate support for *phonetic cue reading*, but instead argue that if children possess a sufficient level of phonemic awareness, they skip the *pre-alphabetic phase* and immediately take advantage of their phonemic sensitivity. In one study, a small sample (n = 8) of non-reading 4-year-old children were told a label that corresponded with a picture and asked to chose that label from a selection of printed words (Stuart, 1990). Only children who were able to segment initial word phonemes performed above chance on the experimental task, suggesting that they were able to use their phonological skills despite their young age and inability to recognize a single word when tested. Similarly, Bowman and Treiman (2002; 2008) demonstrated that 4-year-old children who could not yet read any frequent, simple words were better able to learn phonetically shortened words (e.g., AP for ape) rather than arbitrarily shortened words (e.g., OM for ape). Thus, children appear to make use of their very beginning letter knowledge to read and to spell words.

Ehri and Roberts (2006) purport that *phonetic cue reading* differs from true decoding because many letter-sound associations are overlooked; instead, it is more a form of guessing based on partial information. It is specifically the very beginning, and sometimes ends of words, as well as relevant letter name and sound knowledge, which are speculated to make up this partial information (Ehri, 1995). The partial alphabetic phase, therefore, represents the first signs of integrating several foundational skills.

Ehri (1995) proposes that children eventually move into a *full alphabetic phase* in which they read through forming complete connections between letters in words and phonemes, and finally, into a *consolidated alphabetic phase* in which they are able to recognize larger units of letter patterns across different words. It is the phases preceding the full and consolidated alphabetic phases that are of particular interest for the present research.

Non-stage theories. A growing body of research aims to understand reading through non-stage based theories. Raynor and colleagues (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001) suggest however, that non-stage theories of reading development are not completely incompatible with stage theories, though they do involve slightly different emphasis and conceptualization. For example, the latter three stages in Ehri's (1995) model could be conceptualized as increased sensitivity and facility with phonemic awareness and alphabetic knowledge, and thus, increased proficiency in reading. Though not described in detail here, non-stage theories emphasize this incremental nature of reading development and focus on explaining the changes observed in reading by underlying mechanisms (e.g., Perfetti, 1992; Seidenberg, 2005).

In sum, both stage and non-stage theories of reading acquisition recognize the central role of the increasing development and application of foundational language and literacy skills, including alphabetic knowledge and phonemic sensitivity. Though these theories imply an integration of foundational skills, the experimental evidence used in their support focuses primarily on the application of developing phonemic sensitivity. We know, however, that other language and literacy skills predict subsequent reading (e.g., Adams, 1990; NICHHD, 2000; Scarborough, 2001) and that interventions used to produce gains in reading require more than phonemic awareness training (NICHHD, 2000). Thus, it appears that reading theories imply a gradual integration process, predictive studies highlight several foundational skills, and intervention studies support the need for several component skills, but understanding of the integration process remains unclear. Specific questions raised by the review thus far include whether or not a very preliminary integration process (i.e., as suggested in Ehri's second stage) can be observed and assessed in a natural reading activity, and if so, whether this predicts later reading.

Early Integration in Reading Development

Given that conventional reading is typically conceptualized to reflect tightly integrated literacy skills, any earlier measure of reading, therefore, could be considered a measure of integration at that level. Indeed, the National Early Literacy Panel's meta-analysis (EKS-NICHHD et al., 2008) identified that the strongest early single correlates (i.e., measured in kindergarten or before) with later reading were measures of decoding (real and non-words) and spelling (real and invented). What is unclear, however, is the developmental time point in the integration process reflected by these early measures, which are primarily standardized tests of isolated word reading (EKS-NICHHD et al., 2008). That is, though assessed when children are relatively young, the measures used could be reflecting somewhat sophisticated integration, more similar to conventional reading (or to the *full alphabetic phase;* Ehri, 1995) than to preliminary integration (or to the *partial alphabetic phase*; Ehri 1995).

Invented spelling, however, may better reflect more preliminary integration attempts than do standardized decoding measures or conventional spelling tests. Tasks of invented spelling measure a child's ability to apply phoneme-grapheme relations to write words, despite not yet knowing correct orthographic rules (e.g., "RM" for arm; Read, 1971). Treiman and colleagues (Treiman, 1994; Treiman, Tincoff & Richmond-Welty, 1997) have demonstrated that children use letter names in their inventive spellings to translate the phonemes they hear in spoken words into written language, suggesting that invented spelling may reflect some integration of alphabetic knowledge and phonemic sensitivity. On average, measures of invented spelling in kindergarten or earlier correlate strongly with subsequent decoding (r = .58; EKS-NICHHD et al., 2008).

Can similar integrative processes be observed when emergent readers encounter text in a typical reading experience, such as a child's picture book? Illustrations have become increasingly salient and dominant in children's books over recent decades (Brookshire, Scharff, & Moses, 2002; Willows, 1978), but simply labeling pictures is not sufficient to be considered reading. In investigations of how 2- to 5-year-old children attempt to independently 'read' storybooks, Sulzby (1985) found that young children begin by creating stories based primarily on the illustrations. Other research has highlighted that young children spend very little time looking at the accompanying text both when being read to (Evans & Saint-Aubin, 2005; Roy-

Charland, Saint-Aubin, & Evans, 2007) or when looking at books independently that are above their reading level (Evans, Saint-Aubin & Landry, 2009). Sulzby (1985), however, suggests that children gradually move into 'reading' attempts that are increasingly governed by the print rather than by the illustrations. How this transition occurs is not clear. In an eye-tracking study of 5-year-old children reading an alphabet book, Evans and colleagues (2009) found that children's letter knowledge predicted how quickly they looked towards the page's target letter and how long they spent looking at the letters and words. Higher levels of letter knowledge were associated with shorter latency to look at the target letter and with more time looking at the print. Thus, children may move into Sulzby's (1985) print-governed stage of storybook reading only after they have developed more conventional levels of word reading skills. This has not yet been systematically examined.

Alphabet books are a form of predictable picture books, offering a unique experience in which children are provided with illustration, letter name, and letter sound cues (Smolkin, Yaden, Brown, & Hofius, 1992). In a previous study, we examined 5-year-old children who were not yet able to read as they looked through an alphabet book with their parent, controlling for expressive vocabulary in correlational analyses (Davis, Evans, & Reynolds, 2010). Consistent with Ehri's (1995) proposed *phonetic cue phase,* children in this study appeared to rely on their phonemic awareness and letter-knowledge to complete the "*letter* is for *object*" phrases. Thus, emergent readers were not solely guided by the accompanying illustrations. More specifically, better ability to identify initial phonemes related to more accurate attempts to label intended objects throughout the book. Furthermore, children's levels of awareness of initial phonemes, letter name knowledge, and letter sound knowledge inversely related to the number of miscues made in which the child provided an alternate, incorrect label for the target object (e.g., *R is for bunny* rather than *rabbit*). Inferred from the correlations and error analyses, it appears as though children with lower levels of phonemic awareness and letter-knowledge relied more heavily, or even exclusively, on the visual cues of the illustration, thus sometimes making labeling errors. Children who had developed more phonemic awareness and had gained greater levels of letter-knowledge were better able to choose an appropriate word (i.e., one beginning with the intended letter and phoneme), despite not yet being able to read at conventional levels. Thus, these children appear able to integrate their emerging letter knowledge with their developing phonemic awareness, as well as with their interpretation of an illustration and vocabulary base.

In sum, a conventional alphabet book with salient print as well as illustration, letter name, and letter sound cues may provide the emergent reader an opportunity to integrate several foundational language and literacy skills in a relatively typical reading activity. To support the conceptualization of this pseudo-reading activity as an early integration of emergent skills in the process of reading development, longitudinal relations with more advanced integration (i.e. subsequent decoding) are required. This is the aim of the first study.

Chapter 2

Study 1

Building on our previous work, we examined kindergarten children working through an alphabet book with their parent. In contrast to the strict word reading cutoff used by Davis et al. (2010), the entire sample of kindergarteners was used to ensure adequate variability among all skills examined, with the assumption that most of the sample have not achieved conventional levels of reading. Concurrent correlates of emergent skills were examined, including those not included in our previous study (i.e., vocabulary and rapid naming), as well as subsequent reading. It was speculated that emergent skills, including phonemic awareness, letter-knowledge, vocabulary and rapid naming would all correlate with alphabet book reading. To determine whether alphabet book reading may represent an early integration of emergent skills in the process in reading development, the number of accurately labeled alphabet book pages was examined longitudinally as a predictor of Grade 1 reading – measured both by a standardized individual word reading list and a non-standardized measure of shared book reading with a parent. Based on theories of reading development and several significant correlations with emergent literacy skills (Davis et al., 2010), it was hypothesized that the degree to which emergent readers are able to 'read' an alphabet book would significantly predict Grade 1 reading.

Theories of reading development (e.g., Ehri, 1995) highlight the need for emergent skills to become more tightly integrated to lead to more conventional levels of word reading. To provide further support for this conceptualization, alphabet book reading – representing an early integration of emergent skills – was examined within a model including both emergent skills and subsequent reading. Emergent skills were examined simultaneously in order to investigate the relative indirect effects. It was expected that the relative relations between the skills and knowledge measured in kindergarten and reading measured in Grade 1 would be mediated[1] by alphabet book reading, as indicated by significant indirect effects. However, it was anticipated that when controlling for more robust predictors of reading (i.e., phonemic awareness and letter

[1] What has historically been referred to as *partial* mediation is expected, however this term has fallen out of favour recently for several reasons, including the rarity of complete mediation in psychology, the lack of numerical bases, and the imprecision in the term (c.f., Preacher & Kelley, 2011).

sound knowledge), shared variance would result in several kindergarten predictors lacking the ability to predict unique variance in alphabet book reading and Grade 1 reading. Shared variance could in itself be a sign of initial skill integration, and one skill's inability to predict unique variance in reading above and beyond other emergent skills or knowledge does not necessarily indicate that the skill is not involved in the process of reading development. However, it was decided that including only the emergent variables with the ability to predict significant unique variance in reading would allow for the most concrete conclusions that distinct skills are applied in tandem. Therefore, only the emergent skills and knowledge that predicted significant unique variance in Grade 1 reading based on initial regression analyses were included in the mediation testing and as such, no specific predictions were made regarding individual predictors.

The hypotheses (for the correlational and mediation analyses) regarding Grade 1 reading refer to both performances on a standardized individual word reading list and a non-standardized measure of shared book reading. Employing a frequency count of words read independently during shared book reading was a novel measure of reading ability. Support for the hypotheses with this outcome aimed to provide evidence for the ecological validity of the findings.

Method

Participants. Participants were drawn from 152 families, recruited in junior kindergarten from four Southwestern Ontario boards of education, who were participating in a larger, three-year longitudinal study spanning junior kindergarten through to Grade 1. Of the initial sample, 49 families were excluded from the present study for the following reasons: (a) attrition or illness at the time of the kindergarten school and home visits or the Grade 1 school visit; (b) the alphabet book not being read or the parent reading the book for the child at the home visit; (c) incomplete kindergarten school data; and (d) audiotape problems. The final sample included 103 children (48 boys and 55 girls), 48 of whose data were presented in a previous study (see Davis et al., 2010). Independent samples *t*-tests revealed no significant differences between the final sample of children and those lost for the above reasons on any of the study variables.

During the home visits, most children read the story books with their mothers; only one child read with both parents in kindergarten, 6 children read with their fathers in kindergarten, and 7 children read with their fathers in Grade 1. English was reported as the primary language spoken in the home by all participants with approximately 8% of families reporting also speaking a second language at home. At the time of the first home visit, children ranged in age from 62 to 76 months (*M* = 68.60, *SD* = 3.34). The sample of children was primarily from middle- to upper middle-class homes with well-educated parents (see Davis et al., 2010 for further details).

Procedures and measures.

Phase 1: School visit. In the fall of the children's senior kindergarten year, a trained research assistant met with each child individually in a room separate from the classroom. The following measures were administered (as well as several others for the larger project which are not reported here). Published reliability statistics on each of the measures' norming samples are listed within these descriptions when appropriate. Internal consistency reliability coefficients from the current sample's performance on each measure are reported in Table 1.

The Word Identification subtest of The Woodcock Reading Mastery Test –Revised (WRMT-R-WI; Woodcock, 1998) was used as a standardized measure of word reading. The WRMT-R-WI requires a child to read aloud a list of progressively more difficult, isolated words. The WRMT-R-WI reports an overall internal consistency reliability coefficient of .98 for its norming-sample.

As a measure of expressive vocabulary, the Expressive One-Word Picture Vocabulary Test, Third Edition (EOWPVT; Brownell, 2000) was administered. The EOWPVT requires children to say one word to name presented pictures. The EOWPVT yielded a corrected test-retest reliability statistic of .89 for participants in its norming-sample aged four to seven.

Phonemic awareness was assessed with the Alliteration Awareness subtest of the Pre-Reading Inventory of Phonological Awareness (PIPA; Dodd, Crosbie, McIntosh, Teitzel, & Ozanne, 2003). In this task, the examiner reads aloud sets of four words to a child, and presents four corresponding colored images. Children are required to point to the picture of the word that does not begin with the same sound. On its norming-sample, the Alliteration Awareness subtest

Table 1

Descriptive Statistics and Intercorrelations among Kindergarten Literacy and Language Skills, Alphabet Book Accuracy, and Grade 1 Word Reading

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. Alliteration awareness								
2. Letter sound knowledge	.44**							
3. Letter name knowledge	.51**	.65**						
4. Rapid naming	-.39**	-.30**	-.46**					
5. Vocabulary	.43**	.42**	.31**	-.20*				
6. Alphabet book accuracy	.55**	.54**	.49**	-.37**	.38**			
7. Grade 1 word identification	.60**	.53**	.53**	-.41**	.27**	.64**		
8. Grade 1 shared book reading	.52**	.36**	.40**	-.32**	.19	.56**	.70**	
M	8.01	20.83	22.77	97.32	67.74	16.34	39.12	606.01
SD	3.13	6.10	3.85	37.37	10.74	3.49	14.16	348.73
Range	1-12	1-32	7-26	44-235	34-91	4-24	8-70	101-1708
Reliability [a]	.81	.91	.90					

Note. *N* = 103 except for statistics involving Grade 1 shared book reading where *N* = 93.

[a] Figures represent Cronbach's alpha coefficients of internal consistency for the sample. Blank cells occur when internal consistency coefficients are not applicable due to the nature of those tasks. Additional reliability statistics from published norming samples are provided in the text when applicable.

*p < *.05*. **p < *.01*.

yielded a test-retest coefficient of .83 and a split-half reliability coefficient (averaged across age groups) of .82.

Rapid automatized naming was assessed with the Rapid Color Naming subtest of the Comprehensive Test of Phonological Processing (Wagner, Torgesen, & Rashotte, 1999). Children first completed the practice trial to ensure he or she could name all the colours. Each child was then instructed to say the names of coloured squares presented on a card as quickly and as accurately as possible. Children's performance was timed on two separate trials of the task, each of which included 36 colours to be named. The time in seconds for each trial was summed to represent the overall naming score. Thus, lower scores reflect faster naming. On its norming-sample, the Rapid Color Naming subtest yielded an overall internal consistency reliability coefficient of .74 for 5-year-old children, and a test-retest reliability coefficient of .78 for children aged 5 to 7 years.

Letter knowledge was assessed with two tasks. As a measure of letter sound knowledge, The Letter Sound Knowledge subtest of the PIPA (Dodd et al., 2003) was administered. Children are presented with pages containing lowercase letters alone and in combinations and are asked to say what sound each makes. The test yielded a test-retest reliability coefficient of .97 on the PIPA's (Dodd et al., 2003) norming-sample, and an average (across ages) split-half reliability coefficient of .96. Letter name knowledge was assessed by asking children to say the name of all 26 letters, presented on white page in random order. Letters were written in black font and in lowercase form.

Phase 1: Home visit. One to three months after the school visit, an observer visited the child's home and asked the participating parent and child to set up where they would normally engage in shared book reading. Parents and children were presented with an alphabet book as well as a selection of short and simple narrative storybooks for use in the larger longitudinal project. The dyads were requested to read as they normally would and were permitted to choose the order in which they read the presented books (see Davis et al., 2010 for further details on the reading sessions). The observer audiotaped the book readings and recorded any non-verbal behaviour (e.g., pointing to pictures, letters, or words). Parents were asked to rate on a five-point scale how typical the reading session was for their child; approximately 92% reported that the session was *Somewhat*, *Quite a bit*, or *Very Typical*, while approximately 8% reported that it was *Not at All* or *A Little Typical.* Parents also completed a questionnaire to assess demographic and home literacy practices. In total, sessions generally lasted less than an hour. Upon completion, families were presented with a gift certificate to a bookstore as a thank-you.

The alphabet book used in this study was *ABC: A Child's First Alphabet Book* (Jay, 2003). The book follows the conventional pattern "*letter* is for *object*" (letter and object appearing in bold). The page depicting the letter *X* does not follow this pattern and was therefore excluded from all analyses. Each target object in print is illustrated in a scene with several other objects, many also beginning with the target letter (e.g., the illustration for "*A* is for apple" consists of a scene with an apple, airplane, ant, and artist; see Davis, et al., 2010 for further details).

The alphabet book reading sessions were transcribed verbatim using the Child Language Data Exchange System's CLAN format (MacWhinney, 2000). Transcripts were coded for how the child labeled each target item (i.e., the illustrated item presented in the print). Alphabet book accuracy reflects the number of correctly labeled pages by each child, and is equivalent to the correct labeling attempts coded by Davis et al., 2010.

Approximately 11% of the transcripts (i.e., 11) were coded by a second judge to assess the reliability of the coding scheme. As reported by Davis et al. (2010), good reliability was found with a Cohen's Kappa coefficient of .99 for correctly labeled attempts.

Phase 2: School visit: In the winter of the children's Grade 1 year, a trained research assistant met individually with each child, in a room separate from the classroom, and administered the WRMT-R-WI (Woodcock, 1998) again as a measure of word decoding (as well as several other measures not used in this study thus not reported here).

***Phase 2: Home visit*:** Also in the winter of the children's Grade 1 year, a researcher visited the child's home and observed a shared-book reading session between the child and a parent, following the same overall protocol as described in Phase 1. The dyads were presented with a selection of storybooks to read together. Similar to Phase 1, 93% of parents reported that the reading session was *Somewhat*, *Quite a bit*, or *Very Typical*, while 7% reported that it was

Not at All or *A Little Typical.* The reading sessions were transcribed verbatim using the CHILDES CLAN format (CHILDES; MacWhinney, 2000). The number of words read correctly by the child during shared book reading was calculated as a second outcome measure of first-grade reading ability.

Results

Children's kindergarten word identification scores (M = 9.03, SD = 12.62) were positively skewed with 50% of children able to accurately identify four or fewer words. Thus, though children ranged in their reading abilities in kindergarten, many remained below conventional levels of reading.

Table 1 presents the descriptive statistics and intercorrelations among the kindergarten emerging literacy and language skills, alphabet book accuracy, and the two Grade 1 reading variables. Letter sound knowledge, letter name knowledge, and rapid naming deviated from normal distributions due to skewness. When correlations were conducted with transformed variables correcting for skew, all significant correlations remained unchanged with the exception of the correlation between transformed rapid naming and expressive vocabulary, which fell below significance, $r(101) = -.18$, $p = 0.07$. Thus, the original correlations are presented for ease of interpretation as well as for consistency with the following mediation analyses which used bootstrapping techniques which account for skewed variables (Preacher & Hayes, 2004).

Similar to the partial sample reported by Davis et al. (2010), significant positive correlations were found between alphabet book accuracy and alliteration awareness, letter sound knowledge, and letter name knowledge. In addition, alphabet book accuracy correlated significantly and positively with expressive vocabulary and negatively with rapid naming speed. As predicted, all measured kindergarten language and literacy skills and alphabet book accuracy associated significantly with Grade 1 reading ability, both when measured by performance on the standardized reading task and when measured by number of words read during shared book reading. Thus, children with higher levels of phonemic awareness, letter knowledge, and vocabulary, and faster rapid naming speeds, labeled more alphabet book pages correctly in kindergarten, and were able to read more words in Grade 1.

Mediation analyses. Thus far, the results showed that the five emergent skills and knowledge variables measured in kindergarten related both to how well children were able to label pages in an alphabet book in kindergarten and to reading in Grade 1. Also, alphabet book accuracy in kindergarten positively related to subsequent Grade 1 reading. The goal of this study was to examine alphabet book reading – representing an early integration of emergent skills – within the process of reading development. Therefore, the emergent skills and knowledge variables, alphabet book accuracy, and Grade 1 reading were examined within one model. Alphabet book accuracy was treated as a mediation variable in two single mediation models with multiple predictors of Grade 1 reading. The first mediation analysis used Grade 1 word identification as the outcome, and the second employed Grade 1 shared book reading as the outcome.

Prior to performing the tests of mediation, three separate multiple regression analyses were conducted with the five kindergarten skill and knowledge variables entered as predictors of three outcomes: alphabet book accuracy, Grade 1 word identification, and Grade 1 shared book reading. As shown in Table 2, letter name knowledge, rapid naming, and vocabulary were not significant unique predictors of alphabet book accuracy, word identification, or shared book reading. Thus, there was not sufficient evidence to suggest that these three variables were able to predict the potential mediator (i.e., alphabet book accuracy) or the two reading outcomes (i.e., word identification and shared book reading) above and beyond the variance predicted by alliteration awareness and letter sound knowledge[2]. Therefore, letter name knowledge, rapid naming, and vocabulary were excluded as predictors from the mediation analyses.

Concerns have been raised with some methods of testing mediation, such as the Sobel test (1982), which can lack power and are based on the unlikely assumption that the sampling distributions of indirect effects are normally distributed, a particular issue for small samples (Preacher & Hayes, 2004). Bootstrapping methods have instead been recommended for testing mediation models. Bootstrapping is a nonparametric approach and creates an empirical

[2] In addition, when alliteration awareness and letter sound knowledge are entered in the first step of a hierarchical multiple regression, letter name knowledge, rapid naming, and vocabulary entered simultaneously in the second step produce very small changes in explained variance in alphabet book accuracy ($\Delta R^2 = .02$, *ns*), word identification ($\Delta R^2 = .03$, $p = .04$), and shared book reading ($\Delta R^2 = .01$, *ns*).

Table 2

Unstandardized Coefficients for Kindergarten Skills and Knowledge Variables Predicting Alphabet Book Accuracy, Grade 1 Word Identification, and Grade 1 Shared Book Reading

	Alphabet book accuracy		Grade 1 word identification		Grade 1 shared book reading	
Predictors	*b*	*SE*	*b*	*SE*	*b*	*SE*
Alliteration awareness	0.35**	0.11	1.19***	0.42	47.33***	12.26
Letter sound knowledge	0.16**	0.06	0.64**	0.23	7.49	6.84
Letter name knowledge	0.06	0.10	0.39	0.39	7.42	11.24
Rapid naming	-0.01	0.01	-0.10	0.11	-0.81	0.90
Vocabulary	0.03	0.03	-0.05	0.03	-3.45	3.36

Note. Table summarizes three separate multiple regression analyses. $N = 102$ except for regression involving Grade 1 shared book reading where $N = 94$.

*p <.05. **$p < .01$. *** $p < .001$.

representation of the sampling distribution of indirect effects by repeatedly sampling (with replacement) from the data set and estimating the indirect effect in each resample (Hayes, 2009). Benefits of bootstrapping methods for testing mediation models are that they do not require a normal distribution of indirect effects and they tend to have adequate power while sustaining control over the Type 1 error rate (Preacher & Hayes, 2004). In addition, bootstrapping was chosen for these analyses because it permitted testing of the indirect effects of each predictor while controlling for all other variables in the model (Hayes & Preacher, 2011). A large number of resamples are required to adequately form an empirical approximation of the sampling distribution of indirect effects, thus 5000 bootstraps have been recommended (Hayes, 2009) and are used in these analyses. A 95% bootstrap confidence interval is formed by sorting the obtained values for the indirect effects and determining the values that mark the lower and upper 97.5% of the vales of the distribution. If zero does not fall in the 95% confidence interval, it can be concluded that the indirect effect is significantly different from zero (i.e., significantly different from the null hypothesis that an indirect effect does not exist) at $p < .05$ (two tailed; Preacher & Hayes, 2004).

Two separate mediation models were tested examining Grade 1 word identification and Grade 1 shared book reading as outcomes by using the SPSS macro developed and written by Hayes and Preacher for bootstrap analyses with multiple predictors. Alliteration awareness and letter sound knowledge were entered as the predictor variables, and alphabet book accuracy was entered as the single mediator. The macro first produced a set of multiple regression analyses from which the effects of the models are estimated (i.e., predictors → mediator, predictors → outcome, predictors and mediator → outcome). It then yielded the estimated indirect effects (i.e., the difference between the total and direct effects) and their associated 95% confidence intervals (Hayes and Preacher, 2011).

Table 3 summarizes the initial sets of multiple regression analyses. Alliteration awareness and letter sound knowledge alone accounted for 44% of the variance in alphabet book accuracy[3], $F(2, 104) = 40.46$, $p < .001$, 44% of the variance in word identification, $F(2, 104) = 40.53$, $p < .001$, and 30% of the variance in shared book reading, $F(2, 96) = 36.25$, $p < .001$. When alphabet book accuracy was added as a predictor, 51% of the variance in word identification was explained, $F(3, 103) = 36.25$, $p < .001$, and 39% of the variance in shared book reading was explained, $F(3, 95) = 19.90$, $p < .001$. As shown in Table 3, the associated unstandardized coefficients for alliteration awareness and letter sound knowledge were reduced when alphabet book accuracy was added into each model as a predictor, suggesting possible mediation. The estimated indirect effects of alliteration awareness and letter sound knowledge on each reading outcome through alphabet book accuracy were next examined for statistical significance. The percentile bootstrap confidence intervals did not enclose zero for predicting Grade 1 word identification (alliteration awareness: 0.32 to 1.12; letter sound knowledge: 0.15 to 0.52) or for predicting Grade 1 shared book reading (alliteration awareness: 6.52 to 30.27; letter sound knowledge: 2.45 to 14.64), indicating that the indirect effects are statistically different from zero. Thus, mediation was supported for both reading outcomes.

[3] The text presents the results with $N = 106$ as used in the mediation tests with word identification as the outcome. As seen in Table 3, $N = 98$ for the mediation tests with shared book reading as the outcome. The corresponding values for alliteration awareness and letter sound knowledge predicting alphabet book accuracy are as follows: $R^2 = .43$, $F(2, 96) = 36.19$, $p < .001$.

Table 3

Unstandardized Coefficients for Alliteration Awareness and Letter Sound Knowledge Predicting Alphabet Book Accuracy and Predicting Grade 1 Reading with and without Alphabet Book Accuracy

	Mediator		Outcome	
Outcome	*b*	*SE*	*b*	*SE*
Grade 1 word identification (*N* = 106)				
Alliteration awareness	0.45***	0.09	1.96***	0.37
Letter sound knowledge	0.21***	0.05	0.74***	0.19
Alphabet book accuracy			1.46***	0.37
Alliteration awareness			1.30***	0.39
Letter sound knowledge			0.44*	0.19
Grade 1 shared book reading (*N* = 98)				
Alliteration awareness	0.45***	0.10	48.49***	10.23
Letter sound knowledge	0.20***	0.05	8.75	5.33
Alphabet book accuracy			37.27***	10.36
Alliteration awareness			31.68**	10.72
Letter sound knowledge			1.34	5.43

Note. Table summarizes six separate multiple regression analyses: alliteration awareness and letter sound knowledge predicting alphabet book accuracy (*N* = 106), predicating word identification, and predicting word identification with alphabet book accuracy, and alliteration awareness and letter sound knowledge predicting alphabet book accuracy (*N* = 98), predicating shared book reading, and predicting shared book reading with alphabet book accuracy.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Discussion

Study 1 examined the conceptualization of reading an alphabet book as a natural representation of emergent skill integration in the process of literacy development. To do so, known language, literacy and cognitive predictors of conventional reading were examined as concurrent correlates of the number of accurately labeled alphabet book pages. Alphabet book performance was examined as a longitudinal predictor of more advanced integration (i.e., subsequent decoding), and finally, as a mediator of the relationship between emergent skills in kindergarten and reading in Grade 1.

Concurrent correlates were consistent with previous results of the partial sample reported in Davis et al. (2010), and with the large body of research identifying phonemic awareness, letter knowledge, vocabulary and rapid naming as significant correlates of emergent reading (e.g., Bus & van IJzendoorn, 1999; Kim et al., 2010; Kirby et al., 2010; Melby-Lervåg, Lyster, & Hulme, 2012; NICHHD, 2000). However, phonemic awareness and letter sound knowledge were the only child skills that predicted unique variance in alphabet book accuracy when the emergent skills were examined simultaneously. In the specific case of reading a conventional English-language alphabet book, which follows the format "*letter* is for *object*", children need to identify the illustrated object printed in the text that begins with the page's target letter. Thus, when multiple labels can be applied to the illustration, being able to detect and isolate word onsets and connect these with known letter sounds is ostensibly essential for success on this activity. This assumption is consistent with the findings that both increases in alliteration awareness (i.e., the phonological measure of word onsets used in this study) and letter sound knowledge related to more alphabet book pages being accurately labeled. Remembering that the majority of this sample was unable to identify many basic words, these findings appear consistent with Ehri's (1995) description of children's early reading attempts as being guided by emerging levels of letter knowledge and phonemic awareness (i.e., in the partial alphabet phase). The importance of these two particular skills are also in line with intervention studies which highlight the need for training in both phonemic awareness and letter sound correspondences for training to translate into gains in decoding (Byrne & Fielding-Barnsley, 1989; NICHHD, 2000).

A lack of ability to predict variance in alphabet book accuracy over and beyond phonemic awareness and letter sound knowledge does not necessarily mean that the other measured emergent skills are completely uninvolved in children's early attempts to identify words. Alternatively, identifying the letter name may have indirectly provided a hint for children to identify the intended phoneme and then, the correct object (Piasta & Wagner, 2010). For example, a child may not be able to directly recall the sound represented by the letter *G*, but the phoneme included in its name may help the child who possesses that letter name knowledge and sufficient phonemic sensitivity to say the word *giraffe* rather than the also illustrated *scissors*.

While expressive vocabulary and rapid naming were significant zero-order correlates, they also failed to predict variance in alphabet book performance above and beyond that predicted by phonemic awareness and letter sound knowledge. Thus any relation between alphabet book accuracy and vocabulary and rapid naming in this study may be primarily accounted for by their overlap with phonemic awareness and letter sound knowledge (e.g., EKS-NICHHD et al., 2008; Wagner et al., 1994). Different findings may have emerged had composite measures of oral language been used, which have sometimes yielded significant findings above and beyond phonemic awareness (e.g., EKS-NICHHD et al., 2008). In addition, deficits in oral language and rapid naming may be more pronounced when the sample is primarily individuals with reading and/or language disabilities (e.g., Wolf & Bowers, 1999; Scarborough, 2001), rather than the range of abilities included in this and other studies which did not find that these variables were able to predict reading ability above and beyond phonemic awareness (e.g., Cunningham, Perry, Stanovich & Share, 2002; Wagner et al., 1994).

In terms of longitudinal relations with Grade 1 reading, alphabet book accuracy was the strongest kindergarten correlate measured in this study of both the standardized and shared-book reading measures of decoding (r = .64 and r = .56, respectively). This is consistent with findings that early measures of reading and spelling are the best predictors of later reading (e.g., EKS-NICHHD, NIH, & DHHS. 2008). Thus, early measures of integration may be better predictors of subsequent reading than individual skills themselves. In contrast to standardized word identification lists, labeling pages in an alphabet book may better assess the continuous nature of early skill integration, because neither full decoding skills nor sight word recognition is required for success. Invented spelling tasks may represent another way to observe early skill integration, because children who do not yet know correct orthographic rules appear to use their knowledge of letter names to help them translate the phonemes they hear in spoken language into written language (Treiman, 1994; Treiman, Tincoff & Richmond-Welty, 1997). The longitudinal correlations between alphabet book accuracy and reading in Grade 1 in this study are comparable to and greater than average longitudinal decoding correlates of invented spelling (r = .58; EKS-NICHHD et al., 2008). Similar to invented spelling tasks, the significant correlations of alphabet book accuracy with Grade 1 reading support the notion that children are applying their emerging skills in order to label items while reading an alphabet book in a way that connects to later, more mature levels of reading. The strength of the relation between alphabet book accuracy and Grade 1 standardized word reading may represent the similarity in tasks, in that both require the child to orally produce a word. Furthermore, the nature of the alphabet book task permitted the possible measurement of a broad range of emergent literacy application, from the child labeling pictures without any guidance from letter or phonemic information, to the child reading through full word decoding or sight recognition.

Findings demonstrated significant relative indirect effects of kindergarten emerging phonemic awareness and letter sound knowledge with Grade 1 reading through kindergarten alphabet book accuracy. The entire model supports conceptualizations of reading development, which emphasize integration as an emergent process (e.g., Adams, 1990; Scarborough, 2001; Storch & Whitehurst, 2002). Foundational skills and knowledge lead to subsequent reading partially through their application and integration with each other.

While the early integration described in Ehri's (1995) partial alphabetic phase had been previously demonstrated when young children tried to identify lists of isolated words and non-words (Ehri & Wilce, 1985, Rack et al., 1994), this and our previous work (Davis et al., 2010) suggest that skill integration may be observed and assessed in a typical and natural reading activity. Sulzby (1985) also examined how children engaged in relatively natural reading activities, and noted that children appeared first to make-up narratives for storybooks guided solely by the illustrations before then moving into reading attempts which were increasingly governed by the print. In the context of predictable alphabet books, the current study's findings suggest an intermediate stage, as children could potentially use their letter knowledge and phonemic awareness to help them chose the appropriate item in the illustration, without ever looking at the text. Eye tracking studies, however, would be needed to better clarify if, and the degree to which, this is occurring. If children are indeed drawing on their developing skills without ever looking at the text itself the distinction between the pre- and partial-alphabet phase becomes slightly blurred. As Stuart (1990) demonstrated, children may utilize even the earliest emerging levels of phonemic sensitivity to guide their word identification attempts. Rather than arguing that children therefore skip the pre-alphabetic phase (Stuart, 1990), this may simply illustrate the flexible and incremental nature of reading development.

The assertion that alphabet book performance represents a continuum of early integration means also that not all children in this study would be classified within the pre-alphabetic phase. Previous error analyses using a portion of the current sample found that children with lower phonemic sensitivity and letter knowledge made more errors in which they mislabeled the illustrated item with a word beginning with an alternate letter (Davis et al., 2010). It would follow that the children providing the fewest accurately labeled pages were primarily guided by the illustrations, and thus might be considered within Ehri's pre-alphabetic phase (1995). In addition, the children who provided the highest number of accurately labeled alphabet book pages are likely better classified as being within the full alphabet phase, in which most letter-sound correspondences are used to decode individual words (Ehri & Roberts, 2006). It is possible that the upper-most tail of the alphabet book accuracy distribution could represent children within Ehri's (1995) consolidated phase, however, only two of the 102 children in this sample had perfect alphabet book reading scores.

While the purpose of this study, and one of its primary strengths, was to observe children engaging in a typical reading activity in a natural setting, there are associated limitations to be considered. For example, though parents were encouraged to read with their children as they normally do, they were cognizant of the fact that they were being observed in a study about literacy and thus may have encouraged their children to attend to the print or to apply emergent literacy skills more than might actually be typical. Attempts to permit the natural reading setting also meant that many external factors were not controlled; for example, the degree of parental involvement and the presence and sometimes participation of participants' siblings.

In sum, this study provided support for the validity of conceptualizing how well a child labeled pages in an alphabet book as a representation of early skill and knowledge integration in literacy development. It is important to note that descriptions from stage theories have been used here to understand the various levels along the continuum of integration that may be represented by the alphabet book task. The parallels drawn between stage theories and how children chose labels for alphabet book pages, however, are speculative, as they were not specifically examined in this study. Efforts to assess how children with various levels of emerging skill development make efforts to label or read alphabet book pages should be undertaken to enrich the understanding of the integration process. A more controlled and in depth examination of how children solve the task of labeling each page may also help to better understand the process of reading development. This is the aim of the next study.

Chapter 3

Study 2

In previous work, we found evidence to suggest that children who cannot yet read at conventional levels draw on several emergent skills and knowledge base to identify words in a predictable alphabet book (Davis et al., 2010). More specifically, children who accurately labeled more target items in an alphabet book demonstrated higher levels of phonemic awareness and letter knowledge. We built on these findings in Study 1 by examining several additional emergent literacy skills. In addition, a significant and positive relation between accuracy in reading an alphabet book and subsequent Grade 1 reading (i.e., one year later) provided support for the validity of its representation of an integrative emergent literacy activity. Furthermore, the relations between kindergarten phonemic sensitivity and letter sound knowledge with subsequent reading in Grade 1 was found to be mediated by early integration as represented by alphabet book accuracy. Therefore, alphabet book performance for emerging readers appears to be more than simply a measure of picture identification, which could ostensibly be unrelated to literacy development.

Alphabet book performance as a variable was unique, and though it undoubtedly reduced the degree of experimental control, it maximized ecological validity as it is a typical reading experience of young children (Mason, 1980). Though the findings (Davis et al., 2010; Study 1) are in line with theories of reading development, questions remain regarding how young children begin to integrate their emerging skills and knowledge as they progress into reading. Stage theories classify children’s movement between stages based on prominent strategy use as emergent skills and knowledge increase (e.g., Ehri, 1995). At the same time, it is generally recognized that children use less sophisticated strategies from time to time. A more in depth evaluation of children’s strategy use may help to enrich our understanding of the integration of emergent skills and knowledge, the varied use of relatively more mature and less sophisticated strategies, and reading development.

Overlapping Waves Model

The overlapping waves model (Siegler, 1996) has been proposed as a framework to understand cognitive change in a variety of domains, and may be particularly useful in deepening our understanding of children's emergent literacy in terms of early strategy use. The overlapping waves framework highlights three fundamental features: (a) variability; (b) adaptive choice; and (c) gradual change. Variability refers to the perspective that children typically use a variety of ways of thinking to solve a given problem rather than only one. Variability has been observed across individuals as well as within individuals (i.e., a child using different strategies across different trial presentations of a problem or applying several strategies when solving a single problem; e.g., Bjorklund, Hubertz, & Reubens, 2004; Rittle-Johnson & Siegler, 1999, Siegler, 1988). Knowing and using diverse ways of thinking permits adaptive choice; children adapt their strategies based on task demands to weigh out efficiency (i.e., faster or slower strategies) with accuracy (Siegler, 1996). Siegler (1996) primarily distinguished retrieval from backup strategies and suggested that children use retrieval when they have sufficient experience to suggest that doing so will likely lead to accuracy (e.g., simply recalling the solution to an addition problem). When retrieval is unlikely to be successful, children use the slower but more accurate backup strategies (e.g., counting fingers). Finally, gradual change refers to the coexistence of varied strategies over prolonged periods of time, with change based on experience that results in shifts in the degree of reliance on existing strategies as well as the introduction of new ones.

Several researchers have successfully applied the overlapping waves perspective to build on the understanding of spelling development. Rittle-Johnson and Siegler (1999) conducted a longitudinal study following Grade 1 children into Grade 2, in which they examined the strategies children used to spell lists of words. After each word, children were asked "How did you figure out how to spell ____ ?". If needed, children were further probed with the following questions: "Did you just know how to spell it? Sound it out? Use another word to help you spell it? Use a rule? Do anything else?" (Rittle-Johnson & Siegler, 1999, p. 336). The researchers observed variability in the spelling strategies used, identifying six distinct categories and noting that each child used a number of strategies both in Grade 1 (2-5 strategies) and in Grade 2 (2-6 strategies). Adaptive choice was supported because children used more backup strategies on more difficult words. Despite the word lists being more difficult, children spelled faster and more accurately in Grade 2 than in Grade 1, suggesting gradual progression towards more effective strategy use overtime.

Sharp and colleagues (Sharp, Sinatra, & Reynolds, 2008) combined several aspects of Rittle-Johnson and Siegler's (1999) methodology with error feature analysis of spelled words, and used a microgenetic method (Siegler, 1995) to observe change as it occurs. This method requires repeated observations during a period of rapid change, trial-by-trial analysis using qualitative and quantitative techniques, and documentation of change as it occurs. Sharp et al. (2008) assessed first-grade students three times over the course of five months. Sharp and colleagues also observed variability, finding that children used both less and more sophisticated strategies to spell at the same point in time. The picture of adaptability was extended. More specifically, children appeared to use more strategies with difficult words that were *within their range of competence* and fewer strategies with words that were outside of this range. Thus, similar to previous findings in domains other than spelling (e.g., see Lemaire & Siegler, 1995; Siegler, 1988), when the fastest and least effortful strategy (i.e., retrieval) is unlikely to lead to accuracy, children employ more backup strategies. However, according to Sharp et al. (2008), when words fall outside of their range of competence, children decide that increased strategy use is unlikely to lead to success, and therefore do not waste the time or energy. The third foundational feature, gradual change, was evident through Sharp and colleagues' hierarchical linear modeling analyses, which suggested overall that children's spelling abilities grew over the five-month period, and that higher-performing students grew at a faster rate than lower-performing peers. Finally, relations between spelling error features and strategy use were interpreted as reciprocal, such that children's developing orthographic understanding supported an increase in more sophisticated strategy use, and more sophisticated strategy use allowed feature knowledge to become more efficient.

When examining strategy use while reading, it is important to distinguish strategies from skills. Afflerbach, Pearson, and Paris (2008) provided the following definitions:

> Reading strategies are deliberate, goal-directed attempts to control and modify the reader's efforts to decode text, understand words, and construct meanings of text.

> Reading skills are automatic actions that result in decoding and comprehension with speed, efficiency, and fluency and usually occur without awareness of the components or control involved. (p. 368)

While processes involved in early reading are considered emergent skills, how a beginning reader consciously applies them to identify an unknown word requires specific effort. As a reader develops, the strategies needed to decode words may decrease as this becomes a secured skill, while those needed to comprehend text may become increasingly more necessary (Paris, Lipson, & Wixson, 1983). However, for children who have not yet achieved conventional levels of word reading (as in the present study), attempts to reach the goal of figuring out a word are undoubtedly effortful, and thus, are considered to be strategies.

Several case studies have used young children's self-reports to examine their strategy use while reading. For example, Juliebö, Malicky, and Norman (1998) videotaped five Grade 1 children who were having difficultly learning to read while they read a storybook. The children then watched themselves on the videotapes and answered questions about how they were able to figure out particular words. Juliebö and colleagues (1998) found that children reported the use of a variety of strategies while reading, which is consistent with several other case studies using children's self-reports of reading strategies (e.g., Brenna, 1995; Kragler & Martin, 2009). More specifically, the children seemed to most often report the use of pictures and letter sounds as strategies to identify words, followed by letter strategies and context strategies (Juliebö et al., 1998). All five children reported the use of all four of these strategies at some point.

It is this variability, according to the overlapping waves model (Siegler, 1996), that permits adaptive choice. Siegler (1988) compared the strategy use of 36 first-grade children when reading lists of words sampled from their textbooks. Overt behaviour was defined as backup strategy use (e.g., sounding out) while a lack of overt behaviour was defined as retrieval (i.e., sight word identification). Percent backup strategy use on each word correlated strongly and positively with percent errors on that word and with median solution time. Siegler (1988) concluded that children made adaptive choices while reading because they used more backup strategies on more difficult words.

There have been other efforts to apply the overlapping waves model to the domain of reading, though primarily the focus has been to understand the development of sight word reading. Farrington-Flint and colleagues (Farrington-Flint, Coyne, Stiller, & Heath, 2008) presented the same 40-word list to 5- to 7-year-old children on three separate occasions separated by three weeks. Through the assessment of immediate self-reports, it was found that children used a variety of strategies to read the individually presented words, though they primary appeared to rely on retrieval from memory or phonological strategies (i.e., sounding out the words by blending each grapheme-phoneme correspondence). While this study highlighted the primary use of retrieval and phonologically based strategies, additional variability in children's strategy use has been observed when different measures are used. More specifically, 5- to 7-year-old children report the use of rhyme-based word analogies when the reading task provides relevant information to do so, such as the researcher orally reading to children one of two presented words which share similar spelling and pronunciation (e.g., Farrington-Flint, Canobi, Wood & Faulkner, 2010; Farrington-Flint & Wood, 2007). Farrington-Flint and colleagues (2008) inferred adaptive choice through children's selective use of phonological strategies and retrieval, with retrieval used more often for high frequency and shorter words. Over time, children used fewer phonological strategies and relied instead on direct word retrieval more. This is also consistent with higher reported use of retrieval for identifying individually presented words among older children (i.e., 6- to 7-year-olds) when compared cross-sectionally to younger children (i.e., 5- to 6-year-olds; Farrington-Flint, Vanuxem-Cotterill, & Stiller, 2009).

Lindberg and colleagues (2011) extended this work by examining the overlapping waves model with children further along in the process of reading development. Even among these more mature readers (i.e., 8- to 10-year-olds), variability in reading strategies was observed, particularly when children were asked to read individually presented uncommon words or pseudo-words. Children in this study read words through retrieval, orthographic strategies such as identifying words parts or using analogies, and phonological strategies such as letter-by-letter decoding. Retrieval was more heavily relied upon for common words. When required to use backup strategies, older children appeared to use strategies considered more sophisticated (i.e., orthographic based) than did younger children. Thus, it appears that even children with some consolidated word reading will revert to less sophisticated strategies depending on the words they are trying to read. While these studies demonstrate the applicability of the overlapping waves model to the process of sight word development, the current study investigates whether evidence can been found for the three components of the model in earlier stages in the process of reading development.

Assessing Metacognitive Processes in Young Children

Metacognition has been defined as active awareness, monitoring, and control of one's own cognitive processes (Flavell, 1979). It is often recognized as playing an important role in many aspects of communication, including reading and writing. Flavell (1979) distinguishes the following four interrelated phenomena that are involved in metacognition: (a) knowledge (i.e., stored world knowledge related to humans' thinking nature); (b) experiences (i.e., conscious or emotional experiences accompanying a cognitive activity); (c) goals or tasks (i.e., objectives of the cognitive activity); and (d) actions or strategies (i.e., thought processes and behaviours employed to work towards goals). It is the latter which is of interest to the present study.

Though some researchers suggest that young children are unaware of many metacognitive processes involved when reading (e.g., Myers & Paris, 1978), questions in these studies tend to focus on metacognitive processes related to comprehension, rather than on processes related to the more basic word identification which is of interest to the present study. Fang and Cox (1999) coded the utterances made by 4- and 5-year-old preschoolers while engaging in a literacy task that required them to create and orally dictate a story for other children to read which was written down by a literate adult. Sixty-eight percent of the preschoolers made some utterances that reflected metacognitive processes during the literacy activity (e.g., "Let me think; Is that the way you spell 'mommy'?", p. 179). The children who did not make any metacognitive utterances were primarily those who seemed the least sophisticated as emergent readers, based on Sulzby's (1985) categorizations (i.e., pretend reading was picture governed and formed no coherent story). Thus, even children as young as age 4 and 5 do show some signs of emerging metacognitive processes while engaging in literacy related tasks.

Other researchers express doubts about the validity of using interviews and self-reports with young children to assess metacognition (e.g., Baker & Brown, 1984). A particular concern with young children's self-reports of metacognitive processes while reading is the difficultly they may have responding to frequently used interview and survey techniques, which often pose questions in hypothetical or retrospective ways, for example "What do you do when you come to a word you don't know?" (Brown, Pressley, Van Meter, & Schuder, 1996, p. 24). Though some researchers (e.g., Brown et al., 1996, Myers & Paris, 1978) have successfully employed these types of questions in studies with children as young as 7-years old, Paris and Flukes (2005) argue that questions about hypothetical events are not appropriate for younger children who lack the facility to respond to such levels of abstraction. For example, Dreher and Zenge (1990) found that less than one quarter of their sample of first-graders were able to respond accurately to the questions "What do we do when we read? What will you do when you learn to read". The majority, instead, were unable to respond, indicated that they did not know, or provided responses seemingly more connected with related teaching methods such as "Stay still" or "Copy off the board" (p. 16). In contrast, Wing (1989) found that the majority of her sample of 4- and 5-year-olds were able to respond to the question "What is reading and writing", including statements such as reading is "when you look at the letters and say the words and figure out what it says" or reading is "reading people a story" (p. 68). Stewart (1992) also found that a large majority (88%) of kindergarten students were able to provide clear, as opposed to vague, responses to the questions "Tell me, how are you beginning to learn to read at home?" and "How does your teacher teach you to read?" (p. 98). Most responses reflected letters, sounds, and reading books, and seemed in line with classroom instructional perspectives.

Due to potential difficulties, it has been recommended that interviews with young children be organized around specific reading occasions (Paris & Flukes, 2005). One such example is employing a think-along passage which includes interspersed questions while children read such as "How did you know that?" or "What could you do to find out the answer?" (Paris, 1991), though these methods have more typically been used to assess metacognition in relation to comprehension. There is some evidence to support this assertion that children are better able to respond to more specific, task-related questions. For example, in the previously described study by Juliebö and colleagues (1998), all 5 of the participating first-grade children were able to describe some personal strategy use when they watched themselves reading on a videotape and were asked several questions, such as "What word was causing you problems? How were you able to figure it out all by yourself?" (p. 29). Other research has found that first-grade children were also able to provide responses to questions probing their spelling strategies (e.g., "How did you spell ____?" Sharp et al., 2008).

Even with older children, there is often concern that they may report what they think they ought to do rather than what they really do (Paris & Flukes, 2005). Thus, in order for research to benefit from the use of young children's self-reports to assess their metacognitive processes while protecting against potential validity concerns, it is suggested that self-reported strategies are cross-validated with observations (Baker & Brown, 1984). Both Rittle-Johnson and Siegler (1999) and Sharp and colleagues (2008) found that the majority of first and second-graders' reported spelling strategies were in line with observations. Furthermore, on the few trials where self-reports did not match observations, solution time and accuracy differences suggested that children's reports were accurately reflecting their spelling strategies.

In summary, though young children's metacognitive strategies while reading lack the level of maturity typically seen in older readers (e.g., Flavell 1979; Myers & Paris, 1978), they nonetheless engage in strategic processes to figure out words and are able to express these processes when asked in direct and task-related ways (e.g., Juliebö et al., 1998). Cross-validating young children's reports with other data serves to strengthen the validity of self-reports (Baker & Brown, 1984).

Study 2 Overview

The primary goal of the current study is to understand how children choose among and combine their varied strategies before they can quickly identify a word through sight word recognition. This goal contrasts previous applications of the overlapping waves model to the domain of reading, which have instead compared the use of retrieval (i.e., sight word recognition) to backup strategies (i.e., phonological decoding; e.g., Farrington-Flint et al., 2008, 2009; Siegler, 1988). An alphabet book format was used to represent a relatively natural pseudo-reading activity in which children can identify words based on the predictable format and salient illustration and letter cues, despite not yet being conventional readers (Davis et al., 2010). Through the employment of trial-by-trial assessment of children's self-reported strategies while identifying words in an alphabet book, the current study aims to better understand the process of early skill integration in emergent reading development through identifying which strategies children are using, whether they chose adaptively among them, and how use changes over time. Furthermore, several aspects of children's skill development and cognitive processes will be examined to investigate possible relations with strategy use and integration. More specifically, Bialystok and Martin (2003) highlight the need for children to resist attending to misleading information when linking print with illustrations. Children's performance on a Stroop task requiring inhibition of automatic responses has also been linked with early literacy and language skills (Wilson, Lonigan, & Allan, 2010). In the case of the alphabet book, misleading information would include objects and characters depicted in the illustration but not written in the accompanying text. Thus, along with measuring emergent language and literacy skills, children's working memory and inhibition will be assessed.

Based on the overlapping waves model (Siegler, 1996) and theories of reading development (Ehri, 1995), it is expected that children will use a variety of strategies to label pages in an alphabet book, particularly picture cues and beginning letter sound cues. Descriptive statistics of tallied frequency counts of each strategy will be used to explore three expected aspects of strategy variation: (a) overall variation across children; (b) multiple strategies used by each child across the task; and (c) multiple strategies used by each child on individual items.

Adaptive choice and gradual growth will be examined in several ways. First, children's emergent literacy skills and knowledge base will be correlated with the reported use of letter-based strategies (i.e., graphophonemic strategies; see Methods section for description), with a higher use of these strategies expected for children with higher levels of emerging skills. Such positive relations would support adaptive choice, in that children draw on the skill-base available to them.

In previous studies, evidence for adaptive choice has typically been drawn from the assumption that children employ more backup strategies on more difficult problems (based on positive correlations between number of strategies and problem difficulty; e.g. Sharp et al., 2008; Siegler, 1988). Because emergent readers are not yet able to retrieve words through sight word recognition and what few words they may be able to recognize would be idiosyncratic (e.g. their name), it does not make sense to correlate response time with word difficulty per se (e.g., based on familiarity or length). More difficult items, instead, would be those whose picture cues are less salient. Davis and colleagues (2010) suggested that children will typically use illustration cues to help them identify the target words, while often drawing on their phonemic awareness and letter knowledge. Thus, when the target item is not as saliently illustrated (e.g., several items illustrated on the page, or most salient illustration does not begin with the target letter sound), it is expected that children will respond adaptively by searching for additional cues or by employing more time-consuming strategies. This will be tested by comparing average response times across page conditions, with higher response times expected when target items are less saliently illustrated than when target items are more clearly and obviously depicted in the illustrations. In addition, it is also speculated that children will report more strategies on pages with less salient target items, for example, drawing on letter knowledge to supplement illustration cues.

Finally, growth will be examined by comparing reaction times, strategy use, and accuracy in labeling target items over time. Proponents of emergent literacy highlight the need for foundational skills to become more tightly integrated (e.g., Adams, 1990; Scarborough, 2001; Storch & Whitehurst, 2002). Thus, an increase in the reported use of multiple strategies is expected over time. As skills become more tightly integrated, however, they would require less time to apply. Therefore a decrease in reaction times over time is expected to be a second indication of gradual growth. Growth is also expected to be reflected in accuracy, with children's performance labeling alphabet book pages becoming more accurate over time.

Study 1 demonstrated that phonemic awareness and letter sound knowledge predicted accuracy reading the conventional alphabet book. Study 2 aims to build upon these findings by examining strategy use as a mediator. Thus, a mediation model will be tested in which the relation between emergent skills and alphabet book accuracy is expected to be mediated by the reported use of graphophonemic strategies. While each emergent variable was examined to determine if it could predict unique variance in the mediator or in the outcome, specific predictions were made for phonemic awareness and letter sound knowledge as these were anticipated to be included based on prior research and Study 1. Significant relative (i.e., while holding the other emergent variable constant) indirect effects were expected: increased phonemic sensitivity and higher knowledge of letter sounds would each permit increased use of graphophonemic strategies, which would in turn lead to increased accuracy in labeling alphabet book pages.

Method

Participants. Ninety-one (47 boys and 44 girls) 4- and 5-year-old children, who were attending junior and senior kindergarten, were recruited through local school boards and daycare centers. Information and consent letters were sent home from participating schools and daycares to parents with all children, requesting that they be signed and returned if parents were willing to have their child participate in the research. All children with signed consent forms were invited to participate in all waves of the study, and verbal assent was achieved at each testing session before participation. Two children did not complete the final day of testing due to absence and a request by the child not to participate. The mean age of the full sample of children at the first testing session was 61.15 months (*SD* = 5.82). Sixty-eight children were tested between October and February of their senior kindergarten year of school (mean age at first testing = 64.91 months, *SD* = 3.51). Twenty-three were tested between January and May of their junior kindergarten year of school (mean age at first testing = 54.04 months, *SD* = 3.01). Parents were asked to indicate the child's first language on the consent form, and all but one reported that English was their child's first language. Seventeen children who were tested at daycare centers reported attending kindergarten in French.

Procedures and methods.

Alphabet book development. An alphabet book was designed for use in this study in order to allow children a relatively typical literacy experience as well as to ensure appropriate pages considering the study's goals. Three types of pages were developed that varied in the salience of target object illustration (i.e., how prominent the target object appeared in the illustration) and the match between salient illustrations and target letter sounds. Salient pages were designed to depict a high degree of salience of target item illustration. For example, on the page that reads "*D* is for duck", a clearly illustrated duck was the most prominently depicted. Different-sound pages were designed to have a mismatch between a relatively salient illustration and target word or letter sound. For example, on the page that reads "*N* is for nest", brightly coloured eggs were also saliently illustrated within the nest. Same-sound pages were designed to depict several items beginning with the intended letter sound, with a relatively low degree of target item salience (e.g., *V* is for vase, illustrated with equal or less salience than violets and a violin). Though pages were developed for the letters *X* and *Q* for alphabet book consistency, they were not included in the study's analyses due to the limited number of appropriate words that are familiar to young children and the fewest children knowing the letter sound.

Some differences in letter familiarity were noted when consulting published studies of Canadian (Evans et al., 2006) and American (Treiman et al., 1998, Worden & Boettcher, 1990) samples of young children. Therefore, in an effort to match the current sample with other children attending school boards with similar curricula, page groupings for the current study were based on the letter familiarity reported by Evans' et al., (2006) and that from the sample in Study 1. See Appendix A for the percent of children who knew each individual letter sound in the Study 1 sample. An average of the percentage of 5-year-old children knowing the sound of each letter was computed, weighted based on sample size. Letters were then split into three categories based on these weighted percentages, as well as on type of letter (i.e., consonant with sound at the beginning of its name, consonant with sound at the end of its name, vowel, no sound/multi-sound letters), and on position in the alphabet to ensure random flow of page types in the alphabet book itself. Mean percentages of each group were computed to ensure consistency across the three groupings. Table 4 presents the letters included in each page group.

Alphabet book pages were designed from a sample of existing alphabet books and clipart. Ten judges, blind to the study's hypotheses, were shown the illustrations without the corresponding "*letter* is for *object*" phrase, in random order. Judges were asked to name what they expected was the intended target object, rate its illustrated salience on a three-point scale (3 = high salience, 2 = medium salience, 1 = low salience), and rate the salience of one to two additional listed items. See Appendix B for the instruction sheet presented to judges, though it includes more information than was included in the reliability analyses. Internal consistency between the judges of all rated items (N = 75) was good with a Cronbach's alpha of .95 (.96 for target items only, N = 25).

Table 4

Letters Included in Each Page Type Grouping Based on Weighted Percentage and Type of Letter

Page type								
Salient			Different sound			Same sound		
Letter	Mean %	Letter Type	Letter	Mean %	Letter Type	Letter	Mean %	Letter Type
D	57.70	Cons - B	A	80.39	Vowel	B	60.06	Cons - B
I	69.76	Vowel	F	73.49	Cons - E	C	80.73	Multi-sound
J	72.84	Cons - B	G	58.71	Multi-sound	E	69.07	Vowel
L	58.01	Cons - E	K	84.86	Cons - B	H	64.19	No Sound
O	82.11	Vowel	N	68.66	Cons - E	M	76.57	Cons - E
R	69.00	Cons - E	P	79.02	Cons - B	S	88.97	Cons - E
W	61.49	No Sound	T	76.92	Cons - B	U	47.40	Vowel
Z	81.75	Cons -B	Y	37.47	No Sound	V	73.17	Cons - B
	69.08			69.94			70.02	

Note. Cons - B refers to Consonants with the letter sound at the beginning of its name. Cons - E refers to consonants with the letter sound at the end of its name. No sound refers to consonants whose names do not contain its letter sound. Multi-sound refers to consonants which contain multiple common sound pronunciations, one of which is represented in its name.

Mean salience ratings were examined to support the validity of the categories. For salient pages, eight paired samples *t*-tests were computed comparing salience ratings of each page's target item with the next most highly rated item on that page (e.g., on *D* page, ratings for *duck* compared with ratings for *water*). All salient page target items were rated as significantly more salient than the same-page alternate items. Based on overall means, all different-sound page and same-sound page target items were rated as either equally or less salient than the alternate items.

Pretesting. First sessions occurred between late October and early December for the senior kindergarten cohort and between mid-January and mid-February for the junior kindergarten cohort. A researcher met individually with each child whose parents had provided consent and administered the following measures in a room separate from the classroom.

The Word Identification subtest of the WRMT-R (Woodcock, 1998), the Alliteration Awareness and Letter Sound subtests of the PIPA (Dodd, et al., 2003), and the EOWPVT (Brownell, 2000) were administered. The same letter name knowledge task from Study 1 was also administered. See Study 1 for a description of each task and the reported norming-sample reliabilities. Table 5 presents the descriptive statistics, maximum scores, sample range, and sample reliability coefficients. Due to the nature of the tasks, the reliability of the current sample could not be conducted for the WRMT-R-WI or the EOWPVT.

As a test of working memory, children completed the Numbers subtest from the Children's Memory Scale (Cohen, 1997). This task includes both a forward and a backward trial. The child is required to immediately repeat increasingly long strings of numbers orally said to them by the researcher in either exact or reverse order. Forward digit recall has been conceptualized as simply a measure of verbal short-term memory, whereas the increased processing load required to recall the number sequences in reverse order suggests that the backward trial is a better measure of working memory (Alloway & Alloway, 2009). Thus, children's performance on the reverse condition was used as the primary measure of working memory in this study. The test manual reports a split half reliability coefficient of internal consistency of .79 for 5-year-old children in the norming-sample, and 90% agreement over two time points based on scale score ranges.

Table 5

Means (Standard Deviations), Maximum Scores, and Sample Reliability Coefficients of Child Language, Literacy, and Cognitive Skills

Child skills [a]	*M*		Range	Maximum score	Reliability [b]
Alliteration awareness	7.38	(3.79)	0-12	12	.89
Letter sound knowledge	16.03	(8.04)	0-32	32	.94
Letter name knowledge	22.07	(6.41)	0-26	26	.96
Vocabulary	62.45	(12.60)	24-93	170	
Numbers reversed	2.09	(1.43)	0-5	14	
Sun-moon inhibition	29.63	(7.92)	11-54	--	

Note. *N* = 91. Sun-moon inhibition scores are the number of correctly labeled items in 45 seconds, thus there is no maximum score.

[a] Figures for each child literacy measure represent raw scores. [b] Figures represent Cronbach's alpha coefficients of internal consistency for the sample. Blank cells occur when internal consistency coefficients are not applicable given the nature of the tasks. Additional reliability statistics are provided in the text when applicable.

As a test of inhibition, children completed the Sun-Moon Stroop task as was used in a study by Wilson, Lonigan, and Allan (2010), based on the task created by Gerstadt, Hong, and Diamond (1994). Children were presented with individual pictures depicting a sun or a moon. First, the researcher pointed to the sun picture and told the child "When you see this picture, say *sun*" and pointed to the moon picture and said "When you see this picture, say *moon*." Children were then presented with a card displaying 30 randomly ordered sun and moon pictures, and were asked to name as many as possible within 45 seconds (repeating from the beginning of the card if time permitted). Children then completed the reverse condition in which the researcher informed them to say *moon* when they see the sun picture and say *sun* when they see the moon picture. See Appendix C for the administration script and protocol. The total number of accurately named cards in the reversed condition in 45 seconds constitutes the overall task score. This task of inhibition was chosen because it required a verbal rather than a gross motor response, which seemed most relevant for accurate alphabet book reading. The Sun-Moon Stroop task has been used successfully with 5-year-old children and has been shown to relate to print knowledge, vocabulary, and phonemic awareness (Wilson et al., 2010) as well as to a literacy-type task in which children matched text with pictures (Bialystok & Martin, 2003). To obtain an index of test-retest reliability, 19 children were randomly selected to complete the Sun-Moon task for a second time during their initial reading session. The number of correctly named items in the reverse condition significantly and largely correlated between the two administrations, $r = .76$, $p < .001$, providing support for the task's reliability.

Initial reading session (Time 1). After the completion of pretesting, the researcher returned to the child's school or daycare center within five weeks to meet again with each child individually. The mean number of weeks between pretesting and the first reading session was 1.67 ($SD = 1.26$), with the majority of children (79%) being met within three weeks. The alphabet book was introduced as a book which has a word on each page that goes with each letter. The researcher explained that she will say the first part of the phrases on each page (i.e., *A* is for), and that it is the child's job to complete the phrase with a word. A puppet character named *Sparks* was introduced to each child as someone who would be watching the book reading and asking some questions at the end because "he doesn't know how to read yet". The researcher turned all book pages and immediately read each initial phrase in order to standardize the process and to allow response times to be measured from audiotapes at a later time. Children were encouraged to read the book as best that they could, and to take their best guess if needed. If they sought help from the researcher, they were reminded that the researcher cannot offer help and were encouraged to take their best guess. If they still did not provide a response, the researcher suggested moving on to the next page. When children provided more than one response, they were be informed that there is only one word, and asked to choose just one. The researcher audiotaped these sessions and recorded any clearly observable non-verbal behaviour (e.g., pointing to word). See Appendix D for a complete protocol for the reading session.

After the completion of the alphabet book reading, a select 12 pages were reviewed (four from each page category) following similar methods as employed by Rittle-Johnson and Siegler (1999) to gather self-reports. Children were shown a page and asked how he or she figured out that a given letter is for the label of a given object (e.g. How did you know that *R* was for *rainbow*?). Children were prompted for additional strategies by asking the child to "Show me where you looked?" and "Did you think of anything else that helped you to finish off what I read?" To supplement the assessment of children's strategy use, the puppet, *Sparks,* then suggested an alternate label for each of the reviewed pages, asked the child if the alternate label could also be correct, and asked why or why not. If the child initially provided the correct label, an alternate label was provided. If the child provided an incorrect label, the correct label was provided. These interviews were also audiotaped and non-verbal behaviours noted.

Follow-up reading session (Time 2). After a period of two to three months following the first book reading session, the researcher returned to the child's school or daycare center and met again with each child individually. The number of weeks elapsed ranged from 8 to 17 (M = 11.59; SD = 1.31), with the majority of final sessions occurring within 12 weeks (90%). The procedures described in the initial reading session were repeated, using the same book, but the 12 pages that were not reviewed during the first session were reviewed in this second session.

Response Time and Coding. The time between when the researcher finished reading the statement "*letter* is for" and when the child provided their final label choice on each page was recorded from the audiotaped sessions using Adobe Audition.

Children's verbatim responses of each target item were categorized into four labeling attempts. These were guided by the six labeling attempts developed in a previous study (Davis, et al., 2010), and altered to better reflect the current study's goals.

1) Correct: Labeling the target object with the intended label (e.g., "*G* is for goat"). This also included small variations such as adding a plural (e.g., "*G* is for goats).
2) Incorrect label but correct letter sound: Providing a label that is not the target word, but begins with the correct letter sound (e.g., "*G* is for game"). Because this category was intended to reflect attempts by children to apply the intended letter sound, also included were labels with an incorrect letter form but a similar letter sound (e.g., "*G* is for jump"). There were comparatively few of these specific attempts. Finally, this category also included mispronunciations of the target word (e.g., "*G* is for go-at").
3) Incorrect label with incorrect letter sound: Providing a label with the incorrect letter sound (e.g., "*G* is for hopscotch").
4) No attempt: Child is silent or indicates he or she does not know.

Reported strategy use was also coded. Based on observations from previous work with an alphabet book (Davis et al., 2010), prior research that has assessed children's self-reported strategy use while reading (Brenna, 1995; Juliebö et al., 1998; Kragler & Martin, 2009), and a review of a sample of the current study's interviews, the following strategy categories were coded:

1) Illustration strategy: Pointing to or verbally referencing the picture.
2) Arbitrary rationale/knowledge strategy: Reporting the use of a strategy unrelated to the reading *process* (e.g., I have a puzzle at home that says this).
3) Reading report: Pointing to the text or expressing some awareness of a reading related strategy (e.g., I just read it), but unable to demonstrate or explain any application of the strategy.
4) Visual word strategy: Referencing the length or other visual aspect of the written word (e.g., there are not enough letters to say hopscotch).
5) Graphophonemic strategy:
    a) Letter name/form: Reference to the letter's name or visual form that is not connected to any part of the printed word (e.g., pointing to the isolated letter *G*).
    b) Confused beginning letter name/sound: An incorrect reference to the initial letter or phoneme (e.g., pointing to *G* in *goat* and saying, "because this is an *H*").
    c) Beginning letter name/sound: Reference to initial letter or phoneme (e.g., "it starts with /g/", or, "goat starts with *G*").
    d) Ending letter name/sound: Reference to final letter or phoneme.
    e) Middle letter name/sound: Reference to any letters or phonemes within the word.
    f) Sound it out: Demonstration of applying the letter grapheme-sound correspondences from beginning to end of the word.

Throughout both book reading sessions, only 13 instances across all participants and pages were noted when a child sought help. Therefore help seeking was not coded as a strategy or included in any analyses.

Children who were nearly accurate in labeling the object going with each letter in the alphabet book (i.e., made two or less errors, excluding responses on pages *Q* and *X*) were assumed to be engaging in more conventional levels of reading, and therefore their interview sessions were not coded for strategy use. Six children met this criterion for exclusion in the first book reading session. Word Identification raw scores were examined to support this decisions' validity. The four children with completely accurate alphabet book reading had the four highest Word Identification raw scores. The two children who made one and two errors had the sixth and seventh highest Word Identification raw scores. Therefore, it appeared that these children had developed the most consolidated reading skills, thus justifying the decision to not code their strategy use. In the second book reading session, these children's performances remained above the accuracy cut-off and thus again were not coded (though one of these children was absent for this session). For seven additional children in the second session, accuracy scores fell above the cut-off and their strategy use was also not coded.

Any clear audible strategies used by the child during the actual book reading portion of the session were first coded. Only utterances made on pages that would be reviewed during that same session were coded. These audible strategies during the book reading portion were used to examine the validity of the coding (see Validity of Self-Reports section), but not included in any primary analyses. Strategies reported during the interview phase both initially and after the puppet provided an alternate label were then coded. To allow for the broadest sampling of children's self-reports, strategies during the interview phase were collapsed across those reported before and after the puppet provided an alternate label, excluding any duplicates. Thus while multiple strategies could be coded per page, the child received credit for each category only once per page.

Across the two book reading time points, the primary researcher coded 162 strategy interview sessions. Eleven sessions were coded by a second judge to assess the reliability of the coding scheme, and included 402 coded instances. An overall Cohen's kappa coefficient of .93 supports very good agreement. Individual kappa coefficients range from .75 to .99, and are presented in Table 6.

Through completing the coding it became apparent that the category Reading Reports did not reflect a cohesive or a strategy based category. Instances included in this category seemed to be both those when children with little skill parroted phrases which they knew reflected reading related processes and those when children with high reading skill were unable to break down the consolidated process. Thus this category was not included in any of the analyses.

Results

Validity of self-reports. In efforts to support the validity of children's self-reports, audible utterances made during the actual alphabet book reading were compared with those reported by children during the follow-up strategy interview.

A total of 98 utterances were coded as reflecting a strategy during the alphabet book reading (56 at Time 1 and 42 at Time 2). These utterances were made by 42 different children. Instances were considered a match if the observed strategy was reported by the child on the corresponding page during the strategy interview and a mismatch if it was not reported. Eighty-six percent of observed instances were considered a match, and if graphophonemic categories are collapsed, the match rate increases to 94% percent. Therefore, though most strategies may not be audible, when they were, there was a very high match rate between those observed and those reported by children. This provides some support for the validity of the self-reports.

Variability. Frequency counts were computed for each of the coded strategies at both book reading time points to determine the overall prominence of the reported use of the various strategies and the variability in children's reported strategies. Table 6 presents both the percentage of children who reported the use of a particular strategy at least once throughout the book reading as well as the overall percentage use of each strategy type. For ease of interpretation, only those children who were present and did not exceed the accuracy criteria at Time 2 were included in the percentage frequencies in the table. Examination of these frequencies illustrates that children reported a variety of strategies while reading the experimental alphabet book. Illustration and beginning letter sound strategies were the most common strategies across both time points, as would be expected considering the nature of the alphabet book task. The least frequently reported were visual word strategies.

Table 6

Kappa Coefficients, Percent of Children Who Used Each Strategy at Least One Time, and Percent of Overall Strategy Use at Each Time Point (raw scores)

		Percent who used at least one time		Overall percent of use	
Strategy	Kappa	Time 1	Time 2	Time 1	Time 2
Illustration	.99	100 (77)	100 (77)	43 (876)	41 (901)
Arbitrary/Knowledge	.85	30 (23)	27 (21)	2 (36)	1 (32)
Visual word	.86	14 (11)	18 (14)	1 (23)	1 (26)
Letter name/form	.96	42 (32)	48 (37)	6 (119)	6 (143)
Confused BLN/S [a]	.75	83 (64)	71 (55)	8 (163)	8 (168)
Beginning LN/S [b]	.97	95 (73)	95 (73)	27 (549)	29 (634)
Middle LN/S [b]	.97	51 (39)	58 (45)	5 (111)	7 (146)
End LN/S [b]	.97	49 (38)	49 (38)	6 (119)	5 (114)
Sound it out	.90	26 (20)	26 (20)	2 (42)	2 (45)

[a] BLN/S stands for beginning letter name/sound. [b] LN/S stands for letter name/sound.

Nearly all children reported the use of a variety of strategies. All but one child at Time 1 and all but two children at Time 2 reported using at least two of the coded strategies, with 1 to 8 reported strategies at both book reading sessions (Time 1: M = 5.00, SD = 1.46; Time 2: M = 4.94, SD = 1.65). Children also reported a variety of strategies per page, ranging from 0 to 6 strategies per page at both time points (Time 1: M = 2.21, SD = 0.50; Time 2: M = 2.39, SD = 0.53). Thus variability, the first feature of the overlapping wave perspective, was evident here.

Descriptive Statistics. Children's kindergarten word identification scores (M = 6.71, SD= 13.03) were positively skewed with 71% of children able to accurately identify four or fewer words. Similar to in Study 1, the distribution suggests that most of the children were below conventional levels of reading.

The intercorrelations among child literacy, language and cognitive variables are displayed in Table 7 (descriptive statistics presented in Table 5). The majority of children knew

Table 7

Bivariate Correlations between Child Skill Variables, Graphophonemic Strategy Use, and Accuracy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Alliteration awareness		.70**	.58**	.52**	.63**	-.42**	.52**	.52**	.62**
2. Letter sound knowledge			.56**	.62**	.60**	-.57**	.64**	.63**	.76**
3. Vocabulary				.45**	.53**	-.27*	.46**	.48**	.60**
4. Sun-moon inhibition					.56**	-.31*	.42**	.37**	.61**
5. Numbers reversed						-.50**	.42**	.49**	.64**
6. Basic strategy use							-.40**	-.50**	-.53**
7. Moderate strategy use								.46**	.60**
8. Advanced strategy use									.63**
9. Alphabet book accuracy									

Note. *N* = 91 for columns 2-5; *N* = 77 for columns 6-8 and for rows 1-5 in column 9, *N* = 89 for rows 1-5 in column 9.

* $p < .05$ (2-tailed). ** $p < .001$ (2-tailed).

almost all of their letter names, with 70% knowing at least 23 of the 26 letters. Considering the little variability in letter name knowledge and the high significant correlation between letter sound and letter name knowledge, $r = .77$, $p < .001$, letter name knowledge was excluded from the remaining analyses.

Though examination of the Q-Q plots revealed some deviations from normality, the remaining child literacy, language, and cognitive skills demonstrated skewness and kurtosis values within acceptable ranges.

Adaptive choice and growth. Several methods were used to examine whether children choose and applied their strategies in an adaptive way and whether there was growth over time.

Intercorrelations. First, the relations between child literacy, language, and cognitive skills and graphophonemic strategy categories were examined to determine whether children who have developed higher levels of these skills apply them in strategies during the alphabet book reading task. Initial raw correlations between all graphophonemic strategy categories and the early skills factors revealed a pattern of positive correlations for the Beginning, Ending and Middle Letter Name/Sound and Sound it Out categories. See Appendix E for these initial correlations. In addition, Letter Name/Form strategies and Confused Beginning Letter Sound categories related negatively with the other graphophonemic strategy categories and with the literacy, language, and cognitive factors. Based on these relations, theoretical reasoning about the development of emergent literacy, and the aim to form better distributions, the graphophonemic strategies were collapsed to form three broader categories. Letter Name/Form strategies were combined with Confused Beginning Letter Sound categories to represent a Basic level strategy category. Beginning letter sound strategies remained as is to represent a Moderate level strategy category. Middle and End strategies were combined with Sound it Out strategies to form an Advanced strategy category. When correlations were conducted separately for each time point, the results mirrored each other. Thus, Time 1 and Time 2 scores were combined to form overall scores, also providing better distributions. To correct for violations in normality, the strategy categories were initially transformed and extreme scores were trimmed. However significant correlation and regression findings using the transformed scores remained unchanged. Therefore the initial raw variables were used and are presented here for ease in interpretation.

Table 7 presents the correlations between the three levels of graphophonemic strategy and the skill variables, and reveals consistent negative associations between basic strategy category and all skill variables and consistent positive associations between the moderate and advanced strategy categories with all skill variables. Children with higher levels of alliteration awareness, letter sound knowledge, vocabulary, inhibition, and working memory report fewer basic level strategies (e.g., identifying the letter's name) and report more moderate and advanced level strategies (e.g., using the end sound of the word). This pattern of relations supports the second feature of the overlapping waves model, adaptive choice; as children's skills and knowledge base develops, they adopt more adaptive strategies and rely less on the least sophisticated strategies.

Reaction times. Table 8 presents the descriptive statistics for reaction times, accuracy and strategy use variables used in the following analyses, separated by page type and by time. It was decided that response times from children who took longer to provide their responses were potentially meaningful, thus no cut-off criteria were applied and average response times per page type were computed for each child. As are typical for reaction times, the variables were primarily positively skewed. It was determined that ANOVA procedures would still be appropriate considering the similarities in the shape of distribution across conditions. Using the entire sample of children seen at both book reading time points excluding one child who had been particularly distractible throughout (N=88), the data were examined for whether mean reaction times varied across the three page types and whether they changed over time. A 2 (Time) X 3 (Page Type) repeated measures ANOVA revealed a main effect of Page Type, $F(2, 174) = 59.18$, $p < .001$, $\eta_p^2 = .41$. Neither the main effect of Time nor the interaction between Time and Page Type was significant. Pairwise comparisons with Bonferroni corrections revealed significant differences between the three page types, all $p \leq .001$. Children responded more quickly on salient pages (M = 1.19, SE = 0.10) than they did on different-sound pages (M = 3.13, SE = 0.21) and on same-sound pages (M = 1.65, SE = 0.13). Children responded the least quickly on different-sound pages. Thus, children spent more time providing a response on the

Table 8

Means (Standard Deviations) for Variables Used in Repeated Measures ANOVAs

	Time 1	Time 2
Reaction times [a]		
Salient pages	1.46 (1.42)	0.93 (1.20)
Different sound pages	3.14 (2.48)	3.12 (2.46)
Same sound pages	1.76 (1.54)	1.53 (1.56)
Accuracy [a]		
Salient pages	6.93 (1.16)	7.58 (0.70)
Different sound pages	4.25 (2.35)	5.25 (2.47)
Same sound pages	2.42 (1.85)	2.94 (2.34)
Overall strategy use [b]		
Salient pages	8.36 (1.88)	9.26 (2.09)
Different sound pages	8.78 (2.38)	9.52 (2.23)
Same sound pages	9.32 (2.71)	9.91 (2.97)
Advanced letter strategies [b]		
Salient pages	0.60 (1.09)	0.91 (1.40)
Different sound pages	0.96 (1.70)	0.97 (1.54)
Same sound pages	1.97 (2.27)	2.08 (2.43)

Note. Reaction times are a mean time per page. The remaining are means of sums over 8 pages (accuracy) or over 4 pages (strategies). [a] N = 89. [b] N = 77.

pages designed to be more difficult as compared to the easiest pages, thus providing further evidence for adaptive choice.

Though children did not show differences in the overall speed with which they provided page responses from Time 1 to Time 2, it was speculated that change in response time might depend on where children were in the process of emergent literacy development. Thus, letter sound knowledge as assessed just before Time 1 was entered as a covariate in a one-way repeated measures ANOVA comparing mean response times collapsed across the three types of pages at Time 1 (M = 2.21, SD = 1.30) to Time 2 (M = 1.98, SD = 1.33). The non-significant change in response times over time points, $F(1, 86) = 1.87$, *ns.*, was qualified by a significant interaction with the centered covariate of letter sound knowledge, $F(1, 86) = 7.38$, $p = .008$, $\eta_p^2 = .08$. The interaction was examined by re-conducting the repeated ANOVA analyses with the letter sound knowledge covariate centered one standard deviation above and below the mean. While results remained non-significant for children with low letter sound knowledge, there was a significant decrease in response times for children with high letter sound knowledge, $F(1, 86) = 8.37$, $p = .005$, $\eta_p^2 = .09$. Therefore, growth in terms of response times was supported for children with further developed letter sound knowledge. To better illustrate these findings, the sample was divided into three equal groups based on letter sound knowledge and the reaction time means for each group are displayed in Figure 1.

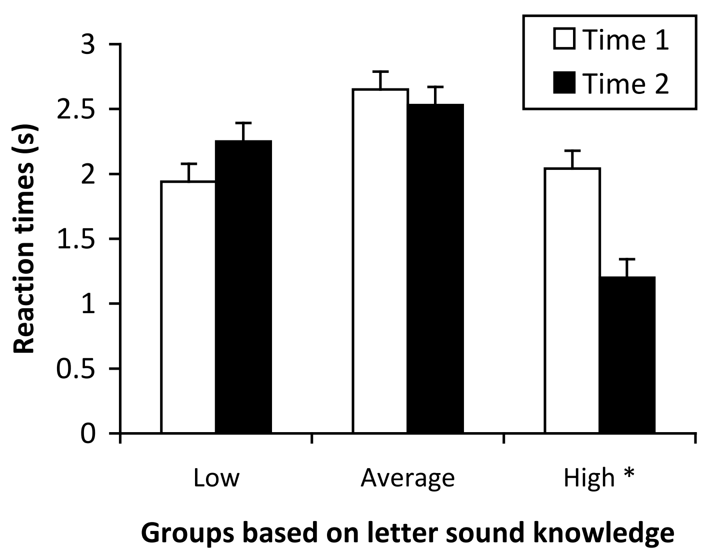

Figure 1. Mean reaction times (+*SE*) for children with low letter sound knowledge (n = 29), average letter sound knowledge (n = 29), and high letter sound knowledge (n = 30) at Time 1 and Time 2.
* $p < .05$.

Strategy use. Next, it was examined whether overall strategy use varied across the three page types at both alphabet book reading time points. A 2 (Time) X 3 (Page Type) repeated-measures ANOVA (using the Greenhouse-Geisser correction for sphericity) revealed a main effect of Time, $F(1, 76) = 7.85$, $p = .006$, $\eta_p^2 = .09$, and a main effect of Page Type, $F(1.80, 136.55) = 10.27$, $p < .001$, $\eta_p^2 = .12$. The interaction between Time and Page Type was not significant.

Children reported more strategies at Time 2 (*M* = 9.56, *SE* = 0.24) than they did at Time 1 (*M* = 8.82, *SE* = 0.23), providing support for the third feature of the overlapping waves model, growth. Pairwise comparisons between the three page types applying a Bonferroni correction revealed that children reported significantly more strategies on non-salient pages with same-sound items (*M* = 9.62, *SE* = 0.26) than they did on salient pages (*M* = 8.81, *SE* = 0.19), $t(76) = 4.28$, $p < .001$, $d = 0.41$. The number of strategies reported on non-salient pages with different-sound items (*M* = 9.15, *SE* = 0.21) did not differ significantly from either salient pages or from non-salient pages with same-sound items. Therefore, children reported applying the least number of strategies for the easiest pages, and the most number of strategies on the most difficult pages, suggesting that they approached the task in an adaptive way.

Finally, the data were examined for whether children chose adaptively among their strategy repertoire. That is, rather than simply applying more strategies, do children apply different strategies depending on the task at hand? Based on the alphabet book page types that had been developed, it was specifically examined whether children applied more Advanced level strategies on same-sound pages, which would require children to focus on sounds beyond the first letter of the printed word. A 2 (Time) X 3 (Page Type) repeated measures ANOVA was conducted to examine whether children applied Advanced level strategies differently across the two time points and the three page types. Greenhouse-Geisser corrections were applied when appropriate to correct for sphericity. Only the main effect of Page Type was significant, $F(1.41, 106.86) = 43.60$, $p < .001$, $\eta_p^2 = .37$.

Follow-up comparisons of different page types with Bonferroni corrections revealed that significantly more Advanced level strategies were reported on same-sound pages (*M* = 2.03, *SE* = 0.24) than on salient pages (*M* = 0.75, *SE* = 0.11), $t(76) = 7.51$, $p < .001$, $d = 0.78$, and on different-sound pages (*M* = 0.97, *SE* = 0.15), $t(76) = 6.36$, $p < .001$, $d = 0.61$. Significantly more Advanced level strategies were also reported on different-sound pages than on salient pages, $t(76) = 2.18$, $p = .046$, $d = 0.19$. Thus, children more often reported applying strategies that extend beyond the first letter on pages for which illustration and beginning letter cues would not provide sufficient information, providing further support for adaptive choice.

Accuracy. See Appendix F for the percent of children who provided the correct label for each page as well as the next highest provided label. Using the entire sample of children seen at both book reading time points (*N*=89), the data were examined for whether overall accuracy varied across the three page types and whether it changed over time. A 2 (Time) X 3 (Page Type) repeated-measures ANOVA (using the Greenhouse-Geisser correction for sphericity when needed) revealed a main effect of Time, $F(1, 88) = 68.02$, $p < .001$, $\eta_p^2 = .44$, and a main effect of Page Type, $F(2, 176) = 278.52$, $p < .001$, $\eta_p^2 = .76$. The interaction between Time and Page Type was not significant.

As expected, children were more accurate at Time 2 (*M* = 5.26, *SE* = 0.16) than they were at Time 1 (*M* = 4.53, *SE* = 0.16). Pairwise comparisons between the three page types applying a Bonferroni correction revealed that children were significantly more accurate on salient pages (*M* = 7.26, *SE* = 0.09) than they were on different-sound pages (*M* = 4.75, *SE* = 0.24), $t(88) = 12.44$, $p < .001$, $d = 1.46$, and on same-sound pages (*M* = 2.68, *SE* = 0.20), $t(88) = 24.00$, $p < .001$, $d = 3.07$. Children were also significantly more accurate on different-sound pages than they were on same-sound pages, $t(88) = 10.87$, $p < .001$, $d = 0.98$. Thus, children's accuracy corresponds with their reported strategy use; they were most accurate on the pages designed to be the easiest and they reported the least number of strategies on these pages, while they were least accurate on pages designed to be the most difficult, and they reported the most number of strategies on these pages.

To better understand the increase in accuracy from Time 1 to Time 2, the type of errors children made over time were investigated with two separate paired samples *t*-tests. Children made significantly fewer errors in which they provided an incorrect label with an incorrect letter sound at Time 2 (*M* = 2.85; *SD* = 3.45) than they did at Time 1 (*M* = 4.33; *SD* = 4.11), $t(88) = 5.92$, $p < .001$, $d = .39$. They also made significantly fewer errors reflecting incorrect labels but correct letter sounds at Time 2 (*M* = 5.12; *SD* = 2.50) than they did at Time 1 (*M* = 5.70; *SD* = 2.19), $t(88) = 2.20$, $p = .03$, $d = .24$.

Previous analyses already showed that children did not report significantly more advanced graphophonemic strategies over time. A paired samples *t*-test revealed that children reported significantly more moderate level strategies (i.e., beginning letter name/sound strategies) at Time 2 (M = 8.23; SD = 3.03) than they did at Time 1 (M = 7.13; SD = 3.40), $t(76) = 3.15$, $p = .002$, $d = .34$. This significant increase in reporting strategies reflecting beginning letter sounds corresponds with the significant decrease in errors with incorrect beginning letter sounds. Thus, the increase in accuracy over time provides support for the feature of gradual growth in overlapping waves model. The increase in accuracy seems to reflect a decrease in both errors reflecting correct and incorrect beginning letter sounds, though the mean difference of the latter appears larger and corresponds with a significant increase in reported use of beginning letter sound strategies.

Strategy use as a mediator. Given that the same pattern of correlations was found between moderate level graphophonemic strategies and advanced level graphophonemic strategies, these two categories were combined to form one variable of accurate graphophonemic strategy use. This combined category was then examined for its role as a mediator between child skill and reading behaviour. Accuracy of and strategies reported on salient pages were not included in the accuracy or strategy variables as presumably only illustration cues would be needed for success on those pages.

Several hierarchical regressions were first conducted to reduce the child variables to be included in the mediation analyses. With the large body of research supporting phonemic awareness and letter sound knowledge as strong and consistent predictors of reading development, alliteration awareness and letter sound knowledge were entered first as simultaneous predictors of total accurate graphophonemic strategy use. Together these two skills accounted for 57% of the total variance in the number of reported accurate graphophonemic strategies, $F(2, 74) = 48.63$, $p < .001$. Alliteration awareness, $B = 0.48$, $SE\ B = 0.23$, $t(74) = 2.05$, $p = .04$, and letter sound knowledge $B = 0.73$, $SE\ B = 0.12$, $t(74) = 6.06$, $p < .001$, were each significant unique predictors. When added in separate hierarchical regressions, none of the remaining child variables added a significant amount of explained variance: expressive vocabulary, $\Delta R^2 = .01$, *ns.*, sun-moon inhibition, $\Delta R^2 = .003$, *ns.*, and numbers reversed $\Delta R^2 = .01$, *ns.*

Alliteration awareness and letter sound knowledge as predictors are consistent with results from Study 1, and thus were the only child variables included as predictors in the mediation model which tested the indirect effects of these two child skill variables on alphabet book accuracy through accurate graphophonemic strategy use. As outlined in Study 1, the mediation model was tested through the regression and bootstrap procedures described fully in Hayes and Preacher (2001). The number of reported accurate graphophonemic strategies was treated as a mediation variable between the predictors of alliteration awareness and letter sound knowledge and the outcome of alphabet book accuracy. One single mediation model was tested by using the SPSS macro developed and written by Hayes and Preacher for testing mediation with multiple predictors. 5000 bootstraps were employed as this number of resamplings has been recommended as sufficiently large enough to form an accurate estimation of the sampling distribution of indirect effects (Hayes, 2009). Bootstrap percentile confidence intervals were set at 95% to allow for the rejection of the null hypotheses (i.e., that each relative indirect effect does not exist) at $p < .05$ (two tailed) if zero does not fall within the confidence intervals (Preacher & Hayes, 2004).

Table 9 summarizes the initial sets of multiple regression analyses (i.e., predictors → mediator, predictors → outcome, predictors and mediator → outcome). Alliteration awareness and letter sound knowledge alone accounted for 46% of the variance in alphabet book accuracy, $F(2, 74) = 31.33$, $p < .001$. When accurate graphophonemic strategies were added as a predictor, the total explained variance in alphabet book accuracy increased to 54%, $F(3, 73) = 28.50$, $p < .001$. As displayed in Table 9, the associated unstandardized coefficients for both alliteration awareness and letter sound knowledge were reduced when accurate graphophonemic strategy use was included in the model, suggesting possible mediation. Because the percentile bootstrap confidence intervals did not enclose zero for either alliteration awareness (0.0007 to 0.29) or letter sound knowledge (0.07 to 0.31), the relative indirect effects can be interpreted as statistically different from zero. Thus, mediation was supported. It appears that greater levels of alliteration awareness and letter sound knowledge led to increased use of accurate graphophonemic strategies, which in turn led to increased accuracy while reading ambiguous pages of the alphabet book where the illustration could not be solely relied upon.

Table 9

Unstandardized Coefficients for Alliteration Awareness and Letter Sound Knowledge Predicting Alphabet Book Accuracy with and without Accurate Graphophonemic Strategies

	Mediator		Outcome	
Predictors	*b*	*SE*	*b*	*SE*
Alliteration awareness	0.48*	0.23	0.22	0.17
Letter sound knowledge	0.73**	0.12	0.45**	0.09
Accurate graphophonemic strategies			0.28**	0.08
Alliteration awareness			0.09	0.16
Letter sound knowledge			0.25*	0.10

Note. N = 76. Table summarizes three separate multiple regression analyses: alliteration awareness and letter sound knowledge predicting accurate graphophonemic strategies (mediator), predicating alphabet book accuracy (outcome), and predicting alphabet book accuracy with accurate graphophonemic strategies.

*p <.05. ** p < .001.

Discussion

Study 2 aimed to better understand how young readers begin to integrate their emerging skills and knowledge within the course of reading development. Siegler's (1996) overlapping waves model has been applied to a variety of domains to enhance understanding of cognitive change. Thus, in this study, young children's self-reported strategy use while 'reading' a predicative alphabet book was examined to determine if the three primary components of the overlapping waves model (i.e., variability, adaptive choice, and gradual growth) were applicable in this setting. Children's self-reported reading strategies were also understood through examinations with emergent literacy, language, and cognitive skill development as well as with the accuracy with which children were able to read the alphabet book.

Findings supported all three characteristics of the overlapping waves model. The first component, variability in strategy use, was evident in several ways as 4- and 5-year-old children labeled pages in a predictive alphabet book. There was variability in reported strategies among the sample of children. In addition, nearly all children reported using more than one strategy across the alphabet book and children reported applying a variety of strategies on individual pages. For example, as the following transcript illustrates, one child reported three different strategies on one page, and only one on another:

Researcher: *Tell Sparks, how did you figure out that "A was for Airplane"?*

Child: *Cause I readed the word* (pointed to word).

Researcher: *Oh you read the word, and I saw that you pointed to it. Can you show me how you read it?*

Child: *By looking at the picture.* [illustration strategy]

Researcher: *Oh you also looked at the picture. Okay. Now, is there anything else that helped you know to say airplane for this one?*

Child: *Yup, because A begins with airplane and P* (pointed to the letter *P* in the word) *is for plane. This is air-plane.* [beginning letter name/sound and middle letter name/sound strategies]

…

Researcher: *You said "U is for unicorn". Tell sparks how you figured this one out.*

Child: (pointed to picture) [illustration strategy]

Researcher: *I see, so you pointed to that picture and you knew what that was. Anything else that you thought about or looked at that helped you know to say unicorn?*

Child: *Uh, unicorn is holding an umbrella to keep dry.* [illustration strategy, repeat]

Such variability illustrates that children use less and more sophisticated strategies both across the task, and at times, in tandem to solve individual items. In this particular task, across both time points, children relied most heavily on illustration strategies and on strategies involving the correct beginning letter name or sound of words. The third most frequently reported strategies were those reflecting confused beginning letter names or sounds. Ehri's (1995) model of reading development describes phases by the prominent strategies children use to identify words, but also acknowledges and accepts that children rely on more than this one strategy, and at times, revert to strategies which might be considered more characteristic of a less sophisticated phase in the process. The variability in our findings is in line with this conceptualization. The observation that children sometimes reported strategies reflecting beginning letter names and sounds of words that were *incorrect* demonstrates that children are attempting to integrate letter sounds with the letters names, illustrations, or text during a reading task (at least during an alphabet book), even before they have secured accurate knowledge. Continued use of illustrations, despite developing literacy skills, suggests that while children may decrease reliance on this less sophisticated strategy, it will continue to inform their reading decisions. For example, though Pike and colleagues (Pike, Barnes, & Barron, 2010) found that illustrations' effect on school-aged children's reading comprehension decreased from Grade 3 to Grade 5, results from their experimental conditions comparing consistent and misleading illustrations suggests that illustrations at times played a role even for the older children.

It should be noted that the most frequently reported strategies (i.e., illustration and beginning letter name/sound strategies) were also those which corresponded most highly with the particularly salient cues in the alphabet book, which introduced each page with the phrase "*letter* is for…", and had large, colourful illustrations. It is recognized that the exact strategies observed and reported by children while they read the predictive alphabet book would not necessarily extend to all word reading contexts. In slightly older children (i.e., 5- to 7-year-olds), Farrington-Flint and colleagues (2009) had children read individually presented words and found that direct retrieval from memory and sounding-out words through grapheme-phoneme correspondences were the most frequently reported strategies. In contrast, Farrington-Flint and Wood (2007) found that 5- to 6-year-old children frequently applied rhyme-based analogies to identify words, but only when relevant information was cued by the task (e.g., the experimenter presents and says aloud the word *sait*, then presents the child with the word *nait* to read). The very few instances of reading by analogies in the current study likely reflects the lack of relevant cues and the limited number of words the children had secured to their sight memory (Ehri, 1995; Share, 1999). Taken together, it appears that children will integrate their skill and knowledge base and the cues available to them – from book features or reading partners – and select from their repertoire of strategies accordingly. It is having a variable repertoire of strategies, according to Siegler (1996), that permits children to select adaptively among them depending on task demands, and to grow accordingly based on outcomes and experiences.

Evidence was also apparent for the remaining two features of the overlapping waves model, adaptive choice and gradual growth. Adaptive choice was supported by four sets of findings. First, children drew on their skill base in an adaptive way, such that as they developed greater levels of emergent literacy (i.e., phonemic awareness, letter knowledge), language (i.e., vocabulary), and cognitive skills (i.e., working memory and inhibition), they reported less use of the most rudimentary strategies and relied on increasingly sophisticated strategies. Second, children worked efficiently, responding most quickly on the pages designed to be the easiest to solve. Third, more strategies were reported on the most difficult pages compared to the least difficult pages. Finally, children chose adaptively among their strategy repertoire, reporting more strategies which extended beyond the first letter of words when illustrations and beginning letter cues would not provide sufficient information for accuracy. In terms of growth, children reported overall more strategies over time, particularly those involving beginning letter sounds. This growth translated into an increase in accuracy. Though illustration strategies were reported relatively consistently, which corresponds accordingly with the picture book format used in this study, error analyses revealed that children made fewer errors that required them to look beyond the illustration overtime. Therefore, while children consistently use the illustration to guide their responses, growth is apparent in the decrease in the ostensible reliance on this least sophisticated strategy overtime.

Several specific questions emerged from the pattern of findings. In the past, it has been theorized and statistically demonstrated that response times tend to positively correlate with item difficulty and with increased strategy use (e.g., Siegler, 1988). This has been understood as children applying more strategies on the most difficult tasks, which requires more time. In this study, what was designed to be the most difficult page (i.e., same sound pages) elicited on average the highest number of reported strategies, however, the pages designed to be of medium-difficulty (i.e., different sound pages) produced the longest average response times. Children's approach was still considered efficient as they spent the least amount of time, and reported the least number of strategies on the easiest pages (i.e., salient pages). However, the higher number of strategies reported on same sound pages would suggest that these should also have the longest response times.

Sharp and colleagues (2008) found that children used more strategies when trying to spell words *within their range of competence*, but fewer when the words were too difficult and fell outside of this competence range. The findings here suggest a slightly different picture in which adaptive choice within a range of competence may not always reflect the *number* of strategies applied. Children with higher emergent skill development applied more advanced graphophonemic strategies, as demonstrated by positive correlations between these strategies and phonemic awareness and letter sound knowledge. Thus the more advanced children, who do not represent the entire sample, may be the ones to account for the higher number of reported strategies on same sound pages. If children had the required skills and knowledge to apply grapheme-phoneme correspondences beyond the first letter, they may have been able to successfully decipher that the text said "*C* is for cake" after looking at the picture of a cat eating a cake, hearing that both words begin with the letter *C*, but seeing that the printed word did not end with the letter *T*. Applying the final strategy to the end of the word would require more time than applying only the first two strategies. For much of the sample, however, same sound pages may have fallen outside of their range of competence. These children may have quickly identified "*C* is for cat" without any awareness that the printed word might not be correct because they see an illustrated cat and knew that cat begins with the letter *C* (or with a hard /c/ sound), or even explicitly choose not to waste time determining if the word might say "cake" because they did not have sufficient skills to do so.

In contrast, different sound pages more likely fell within more of the sample's range of competence as they could potentially be solved with relatively high accuracy by drawing on illustration cues and beginning letter sound knowledge alone, without even looking at the written text itself. Thus it was not necessarily an increase in strategies here that would suggest an efficient and adaptive approach, but rather an increase in the time devoted to solving a task which a child has the skills to do. A child who noticed the picture of a female flying a kite might think at first "*K* is for lady" or "*K* is for girl", but when applying their beginning letter sound knowledge realizes that she has made a mistake. Rather than applying an additional and different strategy, this child continues to apply her knowledge of beginning letter sounds and searches the illustration for additional cues, such as is demonstrated in the following transcript:

Researcher: *K, K is for…*

Child: */l/ (pause 1.0 sec), um (pause 1.3 sec), /k/ (pause 2.0 sec), /g/ (pause 1.0 sec) um, /k/, kite!*

Therefore, Sharp and colleagues' (2008) qualification of the overlapping waves model by explicitly considering adaptive choice in combination with a child's range of competence appears consistent with this study's findings. In addition, the discrepancy between page conditions in terms of the number of strategies reported and the longest response times suggests that adaptive choice may not always be represented by an increase in the number of strategies, but rather in the time devoted to solve a problem.

A second question in the findings arose from the initial lack of observed growth in reaction times. A decrease in reaction times from Time 1 to Time 2 had been expected based on the idea that as literacy skills become more tightly integrated, as emergent conceptualizations of reading imply that they do (e.g., Adams, 1990; Scarborough, 2001; Storch & Whitehurst, 2002), their application would require less time. Previous research in the domain of spelling also suggested a decrease in reaction times over time (Rittle-Johnson & Siegler, 1999). However, contrary to this prediction, overall changes in reaction times were not observed across the 2 to 3 month time interval in this study. It was speculated that the range of abilities of the sample of children masked any changes in reaction times, and thus growth in terms of decreasing reaction times might depend on children's literacy skills. This was supported by follow-up analyses which demonstrated significantly faster reaction times at Time 2 than at Time 1 for the children with higher initial levels of letter sound knowledge. Therefore, it appears that children with low to average levels of skill development are not yet at a stage when they are integrating their skill base to a degree that would be reflected in a change in reaction times (i.e., neither by taking more time to apply multiple strategies nor by taking less time as they become faster at applying more tightly integrated multiple strategies). Growth in emergent skill consolidation, however, is apparent for those children who have developed higher levels of emergent skills as indexed by letter sound knowledge, who even over the course of two to three months, require less time to apply their skills as they read or label pages within a predictive alphabet book. Some of these children may have even retrieved the words from their sight vocabulary, as would be expected to be the next stage in the reading process (e.g., Ehri, 1995, Perfetti, 1992). Increased reports of retrieving sight words from memory are generally found as children progress through the school years, and is also associated with reduced response times (Farrington-Flint et al., 2009). Efforts to distinguish which children are responding more quickly due to more tightly integrated skills thus more efficient strategy application versus those who have retrieved words directly from their sight vocabulary would help to clarify changes occurring at this part of reading development. These efforts could clarify whether skills are simply becoming more automatic overtime.

These response time results do not conflict with those from the spelling domain (Rittle-Johnson & Siegler, 1999), but likely reflect the shorter time interval between assessments (2 to 3 months vs. 12 months). Had a longer time interval been used here, it is speculated that more of the children would have had the opportunity to become more efficient and a significant overall time effect would have been found.

Mediation analyses further strengthened the applicability of the overlapping waves model to the domain of emergent reading. Most of the research investigating this model in relation to reading has focused on the relation between strategies applied and the accuracy and speed of generating responses (e.g., Farrington-Flint et al., 2008, 2009; Lindberg et al., 2011; Siegler, 1988). Less research has related strategy use to children's skill-base through cluster analyses (Farrington-Flint & Wood, 2007). Study 2 joined the two together in one model. Findings suggested that greater levels of alliteration awareness and letter sound knowledge lead to increased use of accurate graphophonemic strategies, which in turn lead to increased accuracy while reading ambiguous pages of the alphabet book when the illustration could not be solely relied upon for accuracy. Therefore, as suggested by the overlapping waves model (Siegler, 1996), how children adaptively choose among their strategy repertoire for word identification partially links their emerging phonemic awareness and letter sound knowledge with their basic reading attempts. The results from Study 1 extend this picture further by demonstrating positive relations between accuracy reading a simple alphabet book and subsequent reading ability. Thus, adaptive choice among a repertoire of strategies relating to a growing base of emergent skills may be one mechanism which permits early growth in reading.

The findings and interpretations from this study should be considered in light of several limitations. While evidence was gathered to provide some support for the validity of children's reported strategies, self-reports made by this young age group nevertheless are limited by some uncertainties. For example, potential valuable information was lost in this study because children who parroted the phrase "I read it" could not be distinguished from those who did in fact read the word but perhaps lacked the meta-cognition to describe the process in more detail, even with follow-up questions. More rigorous observations of non-verbal behaviours, perhaps in combination with eye tracking measures, might clarify some ambiguities in children's self-reports and strengthen interpretations made from this type of data.

Some limitations relate to the alphabet book used here as the primary tool for assessing performance and strategies. Pages were developed with efforts to vary the order of the presentation of page categories and the type of letters in each category. Relatively common target words were chosen with the aim that it would be likely for children to have heard the words before. However the familiarity and length of words varied somewhat in each of the three page categories (see Appendix F for word list and frequency scores). Variations in these and other characteristics may have influenced how children specifically responded. On retrospect, a word other than *trees* may be chosen for future studies to reduce the confusion children had when they incorrectly heard the blend of *T-R* as the *C-H* digraph. However, this confusion resulted in children applying more strategies on a difficult page, a response that is consistent with the general findings supporting the overlapping waves model.

Overall, the overlapping waves model was supported through the use of and measurement within a relatively natural reading activity for 4- and 5-year-old children. The findings add to the growing body of work which has found the features of the overlapping waves model applicable to the domain of reading (Farrington-Flint et al., 2008; 2009; 2010; Farrington-

Flint & Wood, 2007; Lindberg et al., 2011; Siegler, 1988), and extend the model's applicability to younger children who are unable to read standardized word lists.

Chapter 4

General Discussion

The findings from both Study 1 and Study 2 suggest that the picture of emergent reading is not as simple as skill development. The complexity in which children determine the best way to solve a literacy task, such as is required in early stages of word identification, depends both on their skill and knowledge repertoire but also on the specific demands of the task, which influences how they choose to apply their skills.

As has been demonstrated in the past (e.g., EKS-NICHHD et al., 2008; NICHHD, 2000) the results from both Study 1 and 2 again highlight the predictive power of phonemic awareness and letter sound knowledge in early reading development. While these emergent skills have been shown as robust predictors of subsequent reading in previous research, the current studies demonstrated that phonemic awareness and letter sound knowledge relate to young children's performance on a pseudo-reading task (i.e., working through a predictive alphabet) and to the strategies that they report using to identify words.

Study 1 suggested that the relation between emergent literacy skills (i.e., phonemic awareness and letter knowledge) and subsequent reading ability is partially mediated by the integration and application of these skills, as measured by the pseudo-reading task of identifying words in a predictable alphabet book. These findings provided support for the validity of considering performance on the predictable alphabet book as a typical and natural literacy activity involving the integration of emerging skills and knowledge. As such, it was used as an activity to assess emergent readers' abilities and word identification strategies in Study 2.

As suggested in the domain of spelling (e.g., Sharp et al., 2008), Siegler's (1996) overlapping waves model helps to bridge conceptualizations about literacy development occurring in both stages and degrees. Stage theories primarily describe children at various points in their literacy by what they tend to do (e.g., Ehri, 1995), and suggest that movement between stages occurs as children develop the necessary knowledge and skill base. Non-stage theories emphasize the incremental nature of literacy development by explaining observed changes with underlying mechanisms (e.g., Perfetti, 1992; Seidenberg, 2005). By examining emergent reading and literacy strategies through the framework of the overlapping waves model, answers emerge to the questions of both *why* we observe certain behaviour and *how* changes occur. Ehri (1995) noted that emergent readers rely primarily on particular strategies, but also that they use less and more sophisticated strategies at a given time. The overlapping waves model suggests that this observed intravariability is because children are working in an adaptive way, choosing from their diverse strategy repertoire based on the demands of a particular task. This framework suggests that change emerges through children's discovery of new strategies and their continual gathering of evidence regarding the effectiveness of each strategy through experience (Shrager & Siegler, 1998). The overlapping waves model does not contradict previous theories of reading development, but rather supplements a growing understanding of the process of literacy development.

With numerous home, school, and child variables affecting children's early encounters with printed text, the process of literacy development is certainly intricate. In previous work with a subset of the sample from Study 1, Davis et al. (2010) found that 5-year-old children's reading errors were predicted by features of the book, namely word familiarity and salience of the illustrations. Evans and colleagues (2009) also demonstrated the interaction between child skills and book features, finding that children with higher levels of letter knowledge spent more time looking at the printed letters in a children's alphabet book. The image is complicated further by considering the additional variables of reading partners, such as parents or teachers who respond to children's reading attempts based on their own goals (Audet, Evans, Williamson, & Reynolds, 2008) and their child's skill base (e.g., Davis et al., 2010, Evans, Moretti, Shaw, & Fox, 2003). While controlled experimental procedures and standardized literacy measures have certainly contributed substantially to conceptualizations of how children learn to read, it is argued here that trial-by-trial assessment during relatively typical reading activities can deepen our understanding of the complex process of its development. These endeavors are without doubt limited by potential ambiguities. Yet the use of typical literacy activities and self-reports of young children, in combination with more controlled efforts, may provide glimmers of insight into the wonders of a young persons' developing mind, and ultimately help to richen our understanding of the process of learning to read.

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Appendix A

Table A1

Percent of Children Giving Correct Response for the Sound of each Alphabet Letter (N = 142)

Letter	%
a	90.1
b	75.4
c	85.2
d	62.7
e	72.5
f	87.3
g	71.8
h	76.8
i	73.9
j	80.3
k	97.2
l	71.1
m	93.7
n	85.2
o	85.9
p	85.9
r	81.7
s	99.3
t	94.4
u	53.5
v	83.8
w	71.8
y	39.4
z	90.1

Appendix B

Page Ratings

Picture an alphabet book that follows the format "*letter* is for *object*", such as "A is for apple". The text is accompanied by an illustration, where sometimes more than just the target item appearing in print is depicted in the picture. Please:

a) Name the item that you think is intended to be the target object (chose only one) and rate its salience. Salience refers to how prominent an object is depicted in the illustration, and is affected by a variety of characteristics including size, location, and background colour.
   High = clearly the most prominently illustrated item
   Medium = approximately as salient as at least one other item on the page
   Low = other items are clearly more prominent
b) Rate the salience of other listed objects in the illustration (previously rated target object can be skipped).
c) Turn over the illustration to view the target letter. Knowing that target letter, name one target item (you can indicate the same as before or write a new word).

1. a) Target word: _______________ *high medium low*	b) elephant *high medium low* eggs *high medium low*	c) Target word: _______________
2. a) Target word: _______________ *high medium low*	b) cake *high medium low* cat *high medium low*	c) Target word: _______________
3. a) Target word: _______________ *high medium low*	b) island *high medium low* water *high medium low* palm trees *high medium low*	c) Target word: _______________
4. a) Target word: _______________ *high medium low*	b) unicorn *high medium low* rain *high medium low* umbrella *high medium low*	c) Target word: _______________

5. a) Target word: _______________ *high medium low*	b) fridge *high medium low* kitchen *high medium low* stove *high medium low*	c) Target word: _______________
6. a) Target word: _______________ *high medium low*	b) butterfly *high medium low* boat *high medium low* balloon *high medium low*	c) Target word: _______________
7. a) Target word: _______________ *high medium low*	b) horse *high medium low* airplane *high medium low* tree *high medium low*	c) Target word: _______________
8. a) Target word: _______________ *high medium low*	b) rainbow *high medium low* clouds *high medium low* children *high medium low*	c) Target word: _______________
9. a) Target word: _______________ *high medium low*	b) eggs *high medium low* nest *high medium low*	c) Target word: _______________
10. a) Target word: _______________ *high medium low*	b) lion *high medium low* tree *high medium low*	c) Target word: _______________

11. a) Target word: _______________ *high medium low*	b) balloon *high medium low* boat *high medium low* bee *high medium low*	c) Target word: _______________
12. a) Target word: _______________ *high medium low*	b) queen *high medium low* tea *high medium low* dessert *high medium low*	c) Target word: _______________
13. a) Target word: _______________ *high medium low*	b) donkey *high medium low* flowers *high medium low* chipmunk *high medium low*	c) Target word: _______________
14. a) Target word: _______________ *high medium low*	b) vase *high medium low* violin *high medium low*	c) Target word: _______________
15. a) Target word: _______________ *high medium low*	b) helicopter *high medium low* hippo *high medium low*	c) Target word: _______________
16. a) Target word: _______________ *high medium low*	b) zebra *high medium low* grass *high medium low*	c) Target word: _______________
17. a) Target word: _______________ *high medium low*	b) jeep *high medium low* lizard *high medium low* island *high medium low*	c) Target word: _______________

18. a) Target word: _______________ *high medium low*	b) octopus *high medium low* guitar *high medium low* drum *high medium low*	c) Target word: _______________
19. a) Target word: _______________ *high medium low*	b) flowers *high medium low* yellow *high medium low*	c) Target word: _______________
20. a) Target word: _______________ *high medium low*	b) duck *high medium low* water *high medium low*	c) Target word: _______________
21. a) Target word: _______________ *high medium low*	b) mice *high medium low* moon *high medium low*	c) Target word: _______________
22. a) Target word: _______________ *high medium low*	b) goat *high medium low* hopscotch *high medium low* chipmunk *high medium low*	c) Target word: _______________
23. a) Target word: _______________ *high medium low*	b) cat *high medium low* pie *high medium low*	c) Target word: _______________
24. a) Target word: _______________ *high medium low*	b) bedroom *high medium low* teddy bear *high medium low* window *high medium low*	c) Target word: _______________

25. a) Target word: _______________ *high medium low*	b) sun *high medium low* squirrel *high medium low* snail *high medium low*	c) Target word: _______________
26. a) Target word: _______________ *high medium low*	b) baby *high medium low* balloon *high medium low* bottle *high medium low*	c) Target word: _______________
27. a) Target word: _______________ *high medium low*	b) whale *high medium low* water *high medium low*	c) Target word: _______________
28. a) Target word: _______________ *high medium low*	b) ice cream *high medium low* smiley face *high medium low*	c) Target word: _______________
29. a) Target word: _______________ *high medium low*	b) tree *high medium low* woman *high medium low* deck *high medium low* kite *high medium low*	c) Target word: _______________

Appendix C

Sun/Moon Task

Materials: 1 sun card, 1 moon card, 1 laminated sheet of paper with suns and moons, stopwatch

Scoring: Record the number of pictures identified in 45 seconds. Do not allow a child to move on to subsequent items until previous ones have been identified correctly. It is important to *stay positive* during this task.

Directions: Instruct children to name the pictures as quickly as possible. See script below.

In this game, when you see this picture (show sun card), ***I want you to say "sun." Can you say "sun"?*** (wait for response) ***Good! And when you see this picture*** (show moon card), ***I want you to say "moon." Can you say "moon"?*** (wait for response) ***Good job! So what do you say for this one?*** (show sun card, correct as needed) ***And what do you say for this card?*** (show moon card, correct as needed)

Ok, let's play the game! When I say "go," I want you to say the names of these pictures (point to 8x10 sheet with suns and moons) ***as fast as you can. Ready? … GO!***

As child goes through the task, redirect the child to wrong answers by pointing to the picture they got wrong and saying, ***What do you say for this one?***

If the child gets to the end of the sheet (i.e., 30 responses), then have the child start over again on the card until 45 seconds have elapsed; then record the TOTAL number the child got correct (should be more than 30)

Number completed in 45 seconds: ________

That was GREAT! Now we are going to play an opposites game. THIS TIME, when you see this card (show sun card), ***you say "moon." Can you say "moon"? Good! And when you see this card*** (show moon card), ***you say "sun." Can you say "sun"? Good job! So what do you say for this one?*** (show sun card, correct as needed) ***And what do you say for this card?*** (show moon card, correct as needed)

****Repeat directions as needed until child understands the task; if child does not understand the task after three tries, write "untestable" on the lines below and move to the next task.****

Ok, let's play the game! When I say "go," I want you to say the names of these pictures (point to sheet with suns and moons) ***as fast as you can. Ready? … GO!***

As child goes through the task, redirect the child to wrong answers by pointing to the picture they got wrong and saying, ***What do you say for this one?*** If child still does not know the correct answer, say ***Remember, this is the OPPOSITES game.***

Number completed in 45 seconds: ________

Task notes (e.g., child's behavior, whether s/he tired of the task, anything environmental that may have affected the child's performance, etc):

____

____

Appendix D

Book Reading

Today we are going to look at a book together. This is a tape recorder, and I am going to tape the session so I can listen to it later. [*Present puppet*] **This is Sparks. He hasn't learnt how to read yet, but he knows a little about letters and he really likes to look at books. Today Sparks is going to listen to us read a book.**

[*Present book*]. **This is an alphabet book. Every page starts the same way (A is for….B is for….), and I will read that part. Your job is to read the last word on each page. Let's try a practice page.** (see practice page below)

[*Point to words on this page only*]. **I say "A…A is for…" you would say…?** [pause briefly].

If child says "apple": **Say "Yes that's right! It says, A is for apple"**

If child does not respond or responds incorrectly: Say **"This says, A is for apple."**

Now we are going to go through this book. You might think you've seen some of these pages before, but I have changed some of the words, so try to figure out what these pages say, and not what you remember. Some pages might seem really easy, but others might seem pretty tricky. It is always okay to take a guess – just try your best. Remember, I say the first part, and you say the last word on each page. Let's get started.

- As needed, remind child it's always okay to guess. Provide encouragement and praise throughout.
- If child requests help, encourage to take their best guess. If they still do not respond or seek more assistance, move on by saying, **"Let's try the next page!"**
- If child provides more than one response say, **"There is only one word to finish what I read. Tell me the one word you think it says."**

Strategy Interview

Wow! We made it through the whole book together. That is excellent! Sparks has some questions for you because he is just learning about letters, books, and reading.

[*Return to select book page. Pretend that puppet is whispering in researcher's ear*]. **Sparks wants to know how you figured out that "*letter* is for *provided label*?"** [Record response]. **Is there anything else that helped you know to say "*provided label*"?**

- If child provides no response, give additional prompts: **"Did you look at something? Show me where you looked. Did you think of anything that helped you to finish off what I read?"**

[*Pretend puppet is whispering in researcher's ear*]. **Sparks wondered if it said "*letter* is for *alternate label*". Do you think Sparks could be right?** *(Alternate label = correct if child provided initial incorrect response; incorrect if initial response was correct).* "**How come? Tell me why *provided label* is/is not right?"**

**Repeat for 12 selected pages to review. **

At end: **Wow – Sparks sure learned a lot today about reading books. Thanks so much for helping. And for helping me too!**

Appendix E

Table E1

Initial Raw Correlations between the Early Skills Factors and all Graphophonemic Strategies

	1	2	3	4	5	6	7	8	9	10	11
1. Alliteration awareness						-.36*	-.31*	.33*	.47**	.44**	.23*
2. Letter sound knowledge	.70**					-.51**	-.51**	.52**	.55**	.51**	.30**
3. Vocabulary	.58**	.56**				-.27*	-.21	.41**	.46**	.45**	.38**
4. Sun-moon inhibition	.52**	.62**	.45**			-.26*	-.24*	.35**	.30*	.38*	.23*
5. Numbers reversed	.63**	.60**	.53**	.56**		-.37*	-.50**	.34*	.39*	.48*	.27*
6. Letter name/form strategy	-.31*	-.39**	-.21	-.37*	-.40**	.65**	.34*	-.25*	-.23*	-.32**	-.14
7. Confused BLN/S strategy [a]	-.34*	-.37**	-.16	-.13	-.32*	.23*	.53**	-.20	-.29*	-.26*	-.08
8. Beginning LN/S strategy [b]	.58**	.61**	.44**	.45**	.44**	-.21*	-.16	.55**	.37*	.33*	.25*
9. End LN/S strategy [b]	.36*	.43**	.24*	.25*	.31*	-.26*	-.30*	.26*	.45**	.41*	.04
10. Middle LN/S strategy [b]	.29*	.43**	.31**	.27*	.36**	-.18	-.29*	.40**	.45**	.45**	.14
11. Sound it out strategy	.38**	.41**	.46**	.22*	.29**	-.14	-.22*	.30*	.41**	.31**	.07

Note. Correlations with Time 1 strategies are reported on the bottom of the diagonal (*N*=85). Correlations with Time 2 strategies are reported on the top of the diagonal (*N*=77)

[a] BLN/S stands for beginning letter name/sound. [b] LN/S stands for letter/name sound.

*p <.05. **p<.001.

Appendix F

Table F1

Target Words and their Frequency, Most Frequent Alternate Labels, and Percent of Children Providing Each

Target words	Frequency	Percent saying target word		Most frequent alternate label	Percent saying alternate word	
		T1	T2		T1	T2
Salient pages						
Duck	158	97.8	98.9	Swimming	1.1	1.1 [a]
Ice Cream	192	94.5	100.0	Sun	2.2	-
Jeep	49	44.0	75.3	Car	13.0	9.0
Lion	170	91.2	96.6	Tiger	6.6	2.2
Octopus	28	90.1	96.6	Ostrich [b]	1.1	2.2
Rainbow	133	91.2	95.5	Boys [b]	1.1	1.1
Whale	104	86.8	98.9	Water [b]	2.2	1.1 [a]
Zebra	20	98.9	96.6	Lion	1.1	2.2 [a]
Different-sound pages						
Airplane	131	41.8	56.2	Horse/Horsey	33.0	23.6
Flowers	461	39.6	59.6	Donkey	25.3	21.3
Goat	160	54.9	68.5	Hopscotch	8.8	11.2
Kite	108	73.6	83.1	House	6.6	4.5
Nest	223	49.5	59.6	Egg/Eggs	44.0	39.3
Pie	241	73.6	82.0	Cat	20.9	10.1
Trees	865	40.7	46.1	Island	22.0	20.2
Yo-yo	9	52.7	69.7	Zebra	30.8	20.2
Same-sound pages						
Boat	678	39.6	43.8	Butterfly	56.0	53.9
Cake	345	19.8	28.1	Cat	76.9	65.2
Eggs	555	18.7	30.3	Elephant	79.1	68.5
Helicopter	112	30.8	32.6	Hippopotamus	61.6	60.7
Moon	609	26.4	28.1	Mouse	41.8	36.0
Snail	18	70.3	74.2	Squirrel	12.1	20.2
Umbrella	59	31.9	36.0	Unicorn	53.8	58.4
Vase	56	11.0	22.5	Violin	53.8	57.3

Note. N = 91 at Time 1, N = 89 at Time 2. Frequency scores represent the number of times the word occurred in juvenile fiction or children's magazines as indicated by the Corpus of Contemporary American English (2011).
[a] Most frequent alternate labels at Time 2 differed from Time 1 on these pages. The percentages refer to children labeling the *D* page as *goose*, the *W* page as *dolphin*, and the *Z* page as *grass*.
[b] Several other labels were provided by the same small percentage of children on these pages.