

ORTHOGRAPHIC AND SEMANTIC LEARNING DURING SHARED READING:  
INVESTIGATING THE EXTENT OF LEARNING AND RELATIONS TO EARLY  
WORD READING

by

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Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the  
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## **DEDICATION PAGE**

This thesis is dedicated to my late grandmother, Loretta Gledhill, who participated in many hours of shared reading with me as a child. Thank you for inspiring my love of reading and for always believing in me.

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## ABSTRACT

During shared reading, pre-school aged children are frequently exposed to novel, low-frequency words. Abundant empirical evidence demonstrates that children can learn the meanings of such words during shared reading, referred to as semantic learning.

However, less is known about whether children learn the spellings of words during shared reading, referred to as orthographic learning. The present study tested whether 84 children, aged 4, 5, and 6 years, engaged in orthographic and semantic learning during shared reading. In an adaptation of the self-teaching paradigm, children listened to a storybook about novel inventions referred to with non-word names. Children then completed orthographic and semantic choice tests, as well as standardized measures of early word reading and phonological awareness. Each of 4- to 6-year-olds scored above chance on the semantic choice tests, while only 6-year-olds scored above chance on the orthographic choice tests. Individual differences in orthographic, but not semantic, learning during shared reading were related to early word reading, after controls for age and phonological awareness. This study provides a novel test of learning during shared reading, helping to specify the extent to which each of 4-, 5-, and 6-year-old children engage in semantic and orthographic learning and demonstrating a relation between this learning and their early word reading skill. These findings hold implications for theoretical perspectives on learning during shared reading and for educational practices.

## LIST OF ABBREVIATIONS USED

ANOVA	Analysis of variance
$\beta$	Standardized beta coefficients
$d$	Cohen's $d$ measure of effect size
$Df$	Degrees of freedom
$F$	$F$ test statistic
$N$	Total sample size
$n$	Partial sample size
$p$	$p$ -value indicating statistical probability
$R^2$	Measure of proportion of variance explained by the independent variables
$\Delta R^2$	Measure of proportion of variance explained by each independent variable
$SD$	Standard deviation
$t$	$t$ test statistic
$\eta_p^2$	Partial eta-squared measure of effect size
WRMT-III	Woodcock Reading Mastery Test Revised- Third Edition
VIF	Variance inflation factor

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## CHAPTER 1 INTRODUCTION

Adults often read stories to pre-school aged children, an activity described as shared reading (Hindman et al., 2008). Through shared reading, children are exposed to novel, low-frequency words (Sénéchal et al., 2017), which are much more common in print than in oral language (Beals & Tabors, 1995). It is well established that children can learn the meanings of such words during shared reading (see e.g., Sénéchal & Cornell, 1993; Robbins & Ehri, 1994), which we refer to here as semantic learning. Given this, shared reading is viewed as supporting children’s vocabulary development, which, in turn supports their ability to understand texts, or reading comprehension (e.g., Sénéchal et al., 2017; Sénéchal et al., 1998; Sénéchal & LeFevre, 2002; 2014). Much less is known, however, as to whether pre-school aged children can learn the spellings of novel words during shared reading, which is known as orthographic learning (Share, 1999). Theories make contrasting predictions as to whether pre-school aged children can engage in orthographic learning during shared reading (Conrad & Deacon, 2022; Sénéchal et al., 2017). The goal of the present study was to address this debate. We tested the extent of 4- to 6-year-old children’s orthographic and semantic learning during shared reading, and relations of this learning to early word reading skill.

Why might we care whether children can learn orthographic forms? Mental representations of word-specific spellings – referred to as orthographic representations – allow children to read words quickly and accurately (Nation & Castles, 2017; Share, 1995; Perfetti & Hart, 2002). A strong orthographic representation is one that is detailed and accurate; it includes all the letters of the word, in the right order, and is the same each

time a child retrieves it (Perfetti, 2007; Perfetti & Hart, 2002). Such precise orthographic representations are crucial to word reading (Share, 1995). Orthographic representations also support children's reading comprehension; when a child can quickly and accurately recognize written words, they have more resources to devote to comprehending what they are reading (Samuels, 2006; Perfetti & Hart, 2002).

Given the crucial role of word-specific orthographic representations in both word reading and reading comprehension, we ask whether children can establish word-specific orthographic representations during shared reading. The question is whether shared reading is a forum for orthographic learning? Or is it primarily a forum for semantic learning, with orthographic learning occurring later and potentially only through independent reading? On one hand, the home literacy model (Sénéchal et al., 2017) posits that children acquire oral, but not written language skills through shared reading. This prediction suggests that children learn semantic forms, but not orthographic ones. In contrast, the theoretical framework of print learning (Conrad & Deacon, 2022) argues that children do learn orthographic forms during shared reading. Here, we test these contrasting predictions in an empirical study with 4- to 6-year-old children. Our first goal was to test the extent to which each of 4-, 5-, and 6-year-old children engaged in orthographic and semantic learning during shared reading. Our second goal was to test whether individual differences in orthographic and semantic learning were related to early word reading. In the sections that follow, we review competing predictions on these fronts.

## **1.1 Orthographic Learning May Not Occur During Shared Reading**

According to the home literacy model (Sénéchal et al., 2017), shared reading is a meaning-focused activity, one in which the focus of the activity is on the meaning conveyed by the print. Meaning-focused activities are theorized to support the development of children's oral, but not written, language skills (Sénéchal, 2017; Sénéchal et al., 2017). Instead, the home literacy model predicts that children develop written language skills through code-focused activities, in which the focus of the activity is on print itself and often involve explicit instruction (Sénéchal, 2017; Sénéchal et al., 2017). The conceptualization of shared reading as a meaning-focused, rather than code-focused, activity suggests that it is a forum for learning words' meanings, but not their spellings. As such, the prediction is that pre-school aged children engage in semantic, but not orthographic, learning during shared reading.

Indeed, a strong body of evidence demonstrates that pre-school children can learn the meanings of novel words during shared reading. For instance, in a now classic study (Robbins & Ehri, 1994), 4- to 6-year-old children listened to a researcher read a storybook containing low-frequency target words, occurring less than 85 times per million in children's literature (e.g., Carroll et al., 1971; Thorndike & Lorge, 1944). Each target was repeated two or three times and their meanings could easily be inferred from the text. After listening to the stories, children chose which of four pictures best represented each target. Overall, children chose the correct picture significantly more often than expected by chance, suggesting that semantic learning had occurred. Similar evidence of semantic learning emerges across multiple studies with varied methods. It has been demonstrated in studies with targets of low-frequency real words (e.g., Evans &

Saint-Aubin, 2013; Justice, 2002; Sénéchal, 1997; Sénéchal & Cornell, 1993;) and non-words (e.g., McLeod & McDade, 2011; O’Fallon et al., 2019), and studies in which targets are presented once (e.g., Justice, 2002), twice (e.g., Robbins & Ehri; 1994), or three times (e.g., McLeod & McDade, 2011). Children have also been found to retain the meanings of the target over several days (e.g., Sénéchal & Cornell, 1993). Moreover, semantic learning has been demonstrated in studies with children aged 4, 5, and 6 years (e.g., Evans & St-Aubin, 2013; Justice, 2002; McLeod & McDade, 2011; Robbins & Ehri, 1994; Sénéchal, 1997; Sénéchal & Cornell, 1993). This wide range of methods and ages provides robust evidence that pre-school aged children engage in semantic learning during shared reading.

Indirect empirical evidence to support the prediction that children engage in semantic but not orthographic learning during shared reading comes from longitudinal studies in which frequency of shared reading in the pre-school years predicted later oral, but not written, language skills. One such study found that the frequency with which parents engaged their children in shared reading in Kindergarten predicted children’s gains in vocabulary, but not word reading, from Kindergarten to Grade 1 (Sénéchal & LeFevre, 2014). These relations emerged after controlling for parental education, parental literacy levels, Kindergarten vocabulary, and a composite measure of Kindergarten alphabet knowledge, word reading, spelling, and phonological awareness. In contrast, the frequency with which parents reported teaching their child about letters and words in Kindergarten was predictive of gains in word reading between Kindergarten and Grade 1, after implementing the same controls. Similar patterns of results have been found across other studies with similar age groups (e.g., Sénéchal & LeFevre, 2002; Sénéchal et al.,

1998). Such results demonstrate that the frequency of shared reading is related to gains in vocabulary, while the frequency of teaching about letters and words is related to gains in early word reading. As such, they provide support for the hypothesis that pre-school aged children engage in semantic, but not orthographic, learning during shared reading, with the latter potentially requiring explicit teaching.

The abundant empirical evidence of semantic learning during shared reading, and potentially little, if any, orthographic learning aligns with empirical evidence that children pay little attention to print during shared reading (see Evans & St-Aubin, 2009) and that parents rarely draw their children's attention to it (see Sénéchal et al., 2017). Children's lack of attention to print was demonstrated in a study that used eye-tracking to determine how long 4- and 5-year-old children spent looking at print during a shared reading session with their parent or pre-school teacher (Evans & St-Aubin, 2005). Children spent roughly 500 milliseconds looking at print on any given page, approximately 27 times less than the time spent looking at illustrations. In another study 4- and 5-year-old children listened to a researcher read two storybooks, one with visually salient print and another with visually salient illustrations (Justice et al., 2005; see also Roy-Charland et al., 2007). While children spent slightly more time looking at print in the print-salient book than the illustration-salient one, they still only looked at the print 7% of the time in the print-salient book. There is also empirical evidence that parents do not typically draw their children's attention to print during shared reading. In a survey of mothers, less than 1% reported pointing to words as they read (Hindman et al., 2014). In contrast, 85% of mothers reported pointing to pictures. In an observational study, parents infrequently commented on or asked questions about the print in the storybook while

reading to their 3- and 4-year-old children (Hammet et al., 2003). Together, these studies demonstrated that pre-school rarely look at print and parents rarely draw children's attention to it during shared reading, supporting the idea that children are unlikely to engage in orthographic learning during shared reading.

In sum, empirical evidence consistently demonstrates that pre-school aged children engage in semantic learning (e.g., Evans & St-Aubin, 2013; Justice, 2002; McLeod & McDade, 2011; Robbins & Ehri, 1994; Sénéchal, 1997; Sénéchal & Cornell, 1993), but pay little attention to print during shared reading (e.g., Evans & Saint-Aubin, 2005; Justice et al., 2005). Similarly, the home literacy model (Sénéchal et al., 2017) theorizes that children do not acquire written language skills during shared reading. This prediction is supported by studies in which the frequency of shared reading was related to the development of children's oral, but not written language skills (e.g., Sénéchal & LeFevre, 2014). Taken together, this body of theory and evidence suggest that orthographic learning may not occur during shared reading.

## **1.2 Orthographic Learning May Occur During Shared Reading**

In contrast, the theoretical framework of print learning (Conrad & Deacon, 2022) speculates that shared reading is a forum through which children learn about print. Learning about print is thought to occur through exposure to it, and shared reading is a main source of print exposure for young children. The theoretical framework of print learning (Conrad & Deacon, 2022) predicts that learning about print starts with children's earliest exposures to it, before they can read, and continues as they learn to read independently. This is predicted to occur through statistical learning, a form of implicit learning that involves picking up on regularities in one's environment and storing them in

memory (Frost et al., 2019). The theoretical framework of print learning (Conrad & Deacon, 2022) predicts that learning about print includes learning the conventions of how print works on the page, the regularities of how letters combine to make words, and orthographic forms. Moreover, learning about print is thought to support the development of children's word reading skills.

The theoretical framework of print learning's (Conrad & Deacon, 2022) prediction that children learn about print during shared reading is supported by the abundant empirical evidence that pre-school aged children have considerable knowledge of print. A variety of studies have found that pre-school aged children understand the conventions of how print works on the page, such as that text is read from left to right (e.g., Clay, 1979; Justice & Ezell, 2001) and that it is words that are read, rather than pictures (e.g., Farry-Thorn & Treiman, 2022; Oatake et al., 2017). There is also substantial empirical evidence that pre-school aged children understand aspects of the regularities and legalities by which letters combine to make words. For instance, children aged 3 and up have been found to understand that words are made of letters, rather than numbers (Levy et al., 2006) and that words are generally composed of multiple different letters, rather than just one letter (Levy et al., 2006; Treiman et al., 2022). Studies have also demonstrated that children aged 4 and up are sensitive to the positions in words where letters can and cannot double (e.g., Cassar & Treiman, 1997; Zhang & Treiman, 2021) and the frequencies at which letters co-occur (e.g., Treiman et al., 2022). Clearly, pre-school aged children have substantial knowledge of print, knowledge which they might have acquired through shared reading (Conrad & Deacon, 2022).

Some empirical evidence as to whether pre-school aged children engage in orthographic learning during shared reading comes from a series of studies by Apel and colleagues (Apel, 2010; Apel et al., 2006; Apel et al., 2013; Wolter & Apel, 2010). In one study, 5-year-old children listened to a researcher read 12 short stories, each of which contained a target non-word (e.g., *sime*) that was bolded in text (Apel et al., 2006). After, children were asked to spell the target non-words and then identify their correct spellings from a set of four items: the target spelling and three distractors. One of these distractors differed from the target by one letter (e.g., *zime*), while the other two differed by two or more letters (e.g., *dite*). Results suggest some evidence of orthographic learning. Children correctly identified approximately 67% of the targets on the choice test, a level numerically higher than the chance level of 25%. That said, no statistical tests against chance were reported. Another concern is the extent to which the choice test assessed word-specific orthographic learning. As the choice test did not include homophonic distractors; children might have correctly chosen the target *sime* because they remembered that the new word in the story started with a /s/ sound, rather than because they recognised its precise spelling. Indeed, children spelled few, if any, targets correctly when asked to produce their own spellings (see also Apel, 2010; Apel et al., 2013; Wolter & Apel, 2010 for similar results), suggesting that they might not have established detailed and accurate word-specific representations of the targets. In sum, Apel and colleagues' studies provide evidence that 5-year-old children likely recognise some aspect of target non-words they are exposed to during shared reading, but it is not clear that they establish word-specific representations.



Further evidence that pre-school aged children recognize orthographic forms they are exposed to during shared reading comes from a study with 3- to 5-year-olds (Evans et al., 2008). Children listened to a researcher read two storybooks containing visually salient print (e.g., the word *walk* was presented in such a way that it resembled the ‘walk’ sign at a crosswalk). After listening to the stories, children were shown pairs of cards with print on them and were asked to choose which cards depicted print that they had seen in the storybook. In each pair, one card depicted a visually salient print target from the storybook while the other card was a distractor, depicting print that was not in the storybook but was equally visually salient. Three-year-old children did not choose the correct card at a rate statistically higher than expected by chance, but 4- and 5-year-old children did, answering, on average, seven and eight out of 12 questions correctly, respectively. However, as in Apel et al. (2006), it is unclear whether children established precise orthographic representations of the targets, as, without homophonic distractors, children could have chosen the correct answer on the basis of the target’s phonology and not their orthographic representation of it. Further, children may have simply remembered the visually salient features of the print in the storybook (e.g., that it looked like a ‘walk’ sign) and based their answer on that. As such, this study demonstrates that 4- and 5-year-old children can recognize orthographic forms they are exposed to during shared reading – at least when displayed in a visually salient manner – but whether they establish precise orthographic representations during shared reading remains unclear.

The strongest evidence for the acquisition of detailed and accurate word-specific representations during shared reading comes from a more recent study conducted with 6-year-old children enrolled in Grade 1 French Immersion instruction (Shakory et al.,

2021). Children were administered an adapted self-teaching paradigm (Share, 1999), in which they listened to a researcher read a series of short stories about novel inventions with non-word names (e.g., a *veap* was a fish tank cleaner). Orthographic and semantic learning were both measured using choice tests, administered immediately after hearing the stories and again five to seven days later. Children chose the spelling of the target from a set of four non-words; distractors included a homophonic spelling of the target (e.g., *veep*), a non-word that differed from the target by one letter (e.g., *feap*), and a target that differed from the homophone by one letter (e.g., *feep*). The use of a homophonic spelling as a distractor ensures that children choose the correct spelling on the basis of their word-specific representation of the target, rather than its phonology. On the semantic choice tests, children chose which picture represented the target from a set of four pictures. Distractors included a picture of a different invention acting on the same object as the target (e.g., a fish tank painter), and two pictures of different inventions acting on different objects than the target (e.g., a sock matcher and a sock mender). Mean scores on the immediate and delayed orthographic and semantic choice tests were significantly above chance, suggesting that both types of learning had occurred. These results provide evidence that 6-year-old French Immersion children can establish detailed and accurate word-specific representations during shared reading. However, this study is with older children who could likely read – and likely in French. Testing with younger children learning to read in English would be useful to determine when exactly orthographic learning during shared reading begins.

When considering whether pre-school aged children engage in orthographic learning during shared reading, it is helpful to turn to the theory on orthographic learning

during independent reading. The self-teaching hypothesis (Share, 1995) posits that orthographic representations are acquired during independent reading through phonological decoding, with every successful decoding of a word strengthening its representation and making it easier to recall in the future (Share, 1995). The hypothesis also states that “beginning reading is beginning self-teaching” (Share, 1999, p.97), asserting that young children with basic alphabet knowledge and phonological awareness can establish rudimentary orthographic representations of words they encounter in their early reading attempts. Abundant evidence with the self-teaching paradigm (see Share, 1999) shows that children are capable of orthographic learning during independent reading. While the self-teaching hypothesis (Share, 1995) does not speculate about shared reading, it certainly opens the door to the possibility that orthographic learning may occur during shared reading, once children possess alphabet knowledge and phonological awareness. This prediction is supported by the empirical evidence that orthographic learning during independent reading can occur in the absence of successful whole word decoding. In one such study (Deacon et al., 2019), 6- to 8-year-old children established word-specific representations of target non-words during independent reading, even though they did not successfully decode the targets.

In sum, there is evidence that 4- and 5-year-old children can recognize at least aspects of words they are exposed to during shared reading (Apel, 2010; Apel et al., 2006; Apel et al., 2013; Wolter & Apel, 2010) and that 6-year-old children can establish precise word-specific representations during shared reading (Shakory et al., 2021). Taken together with the prediction that orthographic learning begins once children possess phonological awareness and alphabet knowledge (Share, 2004), it is possible that

children can engage in orthographic learning during shared reading. Indeed, the theoretical framework of print learning (Conrad & Deacon, 2022) speculates that children learn about print, including orthographic forms, during shared reading. However, the evidence to date comes from studies in which children did not need to have precise word-specific representations of the targets in order to answer the choice questions correctly (e.g., (Apel, 2010; Apel et al., 2006; Apel et al., 2013; Evans et al., 2008; Wolter & Apel, 2010), or from 6-year-old children receiving instruction in French and who can likely read already (Shakory et al., 2021). As such, it is important to test whether 4- to 6-year-old children receiving instruction in English can develop detailed and accurate word-specific representations, allowing us to specify whether and at what age orthographic learning occurs during shared reading.

### **1.3 Relations to Early Word Reading**

Our second question was whether either or both of orthographic and semantic learning during shared reading are related to early skill in word reading. In terms of orthographic learning, Share (2004) states that children start learning orthographic forms during independent reading once they develop basic alphabet knowledge and phonological awareness. The prediction then is that skill in orthographic learning during shared reading and in early word reading are also related. This relation has been demonstrated in a handful of studies. In one such study (Apel, 2010), 5- and 6-year-old children participated in a similar shared reading activity as in Apel et al. (2006). After, children attempted to spell the targets and then chose their spellings from a set of four items, which again did not include a homophonic distractor (e.g., *zime* was the most plausible distractor for *sime*). Results showed that children's performance on the spelling

and choice tasks were related to their early word reading skill, in an analysis with no other controls. However, as we noted earlier, it is unclear whether children established precise orthographic representations of the targets, as the questions could be answered correctly by remembering the targets' phonologies, rather than their spellings. As such, it would be useful to test this relation with tasks that assess children's abilities to establish precise orthographic representations during shared reading, and in analyses that include controls for key skills such as phonological awareness (see e.g., Shakory et al., 2021).

Stronger evidence for a relation between orthographic learning during shared reading and early word reading comes from Shakory et al. (2021). In this study, 6-year-old French Immersion children's performance on the orthographic choice tasks – which included homophonic distractors – was related to their word reading skill, after controls for age, vocabulary, non-verbal reasoning, and phonological awareness. This result demonstrates that individual differences in orthographic learning and word reading skill may be related, at least for 6-year-old children in French Immersion. Indeed, the children in this study were in Grade 1 and as such were likely reading independently. Moreover, they were learning to read in French. Working with a sample of younger children receiving instruction in English would help determine whether a relation between orthographic learning during shared reading and early word reading also exists for 4- and 5-year-old children. This is an important question to answer as children of this age are the ones who are frequently engaged in shared reading.

Turning to semantic learning during shared reading, the home literacy model (Sénéchal et al., 2017) is helpful to guide predictions on this front. The model would likely predict that semantic learning is not related to early word reading, as semantic

learning is a meaning-focused activity which have been found to be related to the development of oral, but not written, language skills (Sénéchal et al., 2017). Indeed, studies to date testing these predictions have found parent report of frequency of shared reading to be related to vocabulary, but not word reading (see Sénéchal & LeFevre, 2002; 2014; Sénéchal et al., 1998). However, relying on parental report is quite different from assessing what children actually learn during shared reading. While frequency of shared reading may not be related to word reading, it is possible that individual differences in the extent to which children learn words' meanings during shared reading may be. This distinction between frequency of shared reading and children's abilities during shared reading is not captured in the home literacy model, which seemingly assumes that because frequency of shared reading is unrelated to word reading, other meaning-focused aspects of shared reading are also unrelated to word reading. However, it is possible that individual differences in semantic learning during shared reading are indeed related to early word reading skill.

To the best of our knowledge, the only test of relations between semantic learning during shared reading and early word reading again comes from Shakory et al. (2021). In this sample of 6-year-old French Immersion children, individual differences in semantic learning during shared reading were not found to be related to word reading, after controls for age, vocabulary, non-verbal reasoning, and phonological awareness. This result suggests that semantic learning may indeed not be related to early word reading, at least among 6-year-old children in French immersion. However, when considering Shakory et al. (2021) one should again bear in mind that this study was conducted with Grade 1 children who were likely independent readers and were also learning to read in

French. It is possible that, among 4- and 5-year-old children receiving English instruction, individual differences in semantic learning are related to early word reading.

#### **1.4 The Present Study**

The first goal of the present study was to test the extent to which 4-, 5-, and 6-year-old children engaged in orthographic and semantic learning during shared reading. The second goal was to test whether individual differences in orthographic and semantic learning were related to early word reading. Answering these questions will help to specify a developmental time course for orthographic and semantic learning during shared reading and specify whether this learning is related to children's first steps into word reading.

Our decision to work with 4- to 6-year-old children was motivated by both empirical evidence to date and theoretical predictions. This is an age range in which children are frequently engaged in shared reading (Bus et al., 1995), as such it is important to determine what exactly children are learning from it. It has been clearly demonstrated that 4- to 6-year-old children can learn semantic forms during shared reading (e.g., Evans & Saint-Aubin, 2013; Justice, 2002; McLeod & McDade, 2011; Robbins & Ehri, 1994; Sénéchal, 1997; Sénéchal & Cornell, 1993). The core question that remains is whether 4- to 6-year-old children can also learn orthographic forms. We suspected that 6-, and potentially 5-, year-olds, could learn orthographic forms during shared reading, given the findings of prior studies (Apel, 2010; Apel et al., 2006; Apel et al., 2013; Shakory et al., 2021; Wolter & Apel, 2010). Working with 5- and 6-year-old children allowed us to compare our results to those of prior studies, and critically,

working with 4-year-old children allowed us to investigate whether this learning begins before age 5.

Working with 4- to 6-year-old children also allowed us to capture an important transition in word reading skill, with 4-year-olds largely not being able to read and 6-year-olds largely able to (Ehri, 1995; 2005). This gradual transition is illustrated in Ehri's phase theory of reading development (2005; 2015), which states that children go through four overlapping phases as they learn to read words. Children transition from one phase to the next as they develop letter knowledge and phonological awareness, allowing them to connect sounds to letters, first in part and then in full (Ehri, 2005; 2015). We suspect the ability to learn orthographic forms develops during the transition from not reading to reading. This idea is supported by the evidence that children aged 3 and up possess considerable knowledge of the conventions of print (e.g., Clay, 1979; Farry-Thorn & Treiman, 2022; Justice & Ezell, 2001; Oatake et al., 2017) and orthographic regularities (Levy et al., 2006; Cassar & Treiman, 1997; Treiman et al., 2022; Zhang & Treiman, 2021), suggesting that children gradually develop the skills they need to read words (Conrad & Deacon, 2022). Working with 4- to 6-year-old children allowed us to capture the transition from not reading to beginning reading, enabling us to investigate at what age and at what point of reading development orthographic learning during shared reading begins.

We chose to use an adapted version of the self-teaching paradigm, created by Shakory et al. (2021) for use with younger children during shared reading. In this paradigm, the researcher reads 12 short stories aloud to the child, pointing to the words on the page as they read, as empirical evidence demonstrates that pointing to print helps



draw children's attention to it (e.g., Evans et al., 2008; Justice et al., 2008). Each short story is about a novel invention with a non-word name (e.g., a *veap* is a fish tank cleaner). The non-word's spelling is the target for orthographic learning, and its meaning the target for semantic learning. Both types of learning are assessed in parallel with multiple choice tests. We adapted Shakory et al.'s (2021) paradigm to make it more similar to children's storybooks, which typically contain a plot and characters (Reese, 2015), rather than a series of unrelated short stories. To do so, we connected the short stories together with a central character. We administered the orthographic and semantic learning tests at two time points: immediately after listening to the story (the immediate test), and at the end of the testing session (the delayed test), approximately 25 minutes after listening to the story. This allowed us to test whether children retained the meanings and spellings of the targets.

We also tested relations between both types of learning and early word reading skill. This was a key test of theoretical predictions about the relation between orthographic (Share, 2004) and semantic (Sénéchal et al., 2017) learning and word reading, and also allowed us to confirm the patterns of results from previous studies (Apel 2010; Shakory et al., 2021). We used two measures of early word reading: a measure of letter identification and a measure of word reading. This decision was made because of the variability in word reading skill across 4- to 6-year-olds; some children in this age range may just be learning the letters of the alphabet while others may already be reading words (Ehri, 1995), therefore using both measures allowed us to capture more variance in early word reading skill than only using one or the other. We also measured children's phonological awareness so that we could see unique effects of orthographic

and semantic learning on early word reading independent from this key skill (see e.g., Shakory et al., 2021).

Our first goal was to investigate the extent to which 4-, 5-, and 6-year-old children engage in orthographic and semantic learning during shared reading. We predicted that the extent of semantic learning would be similar across ages 4 to 6, given the strong evidence of this learning within each of these age groups (e.g., Evans & Saint-Aubin, 2013; Justice, 2002; McLeod & McDade, 2011; Robbins & Ehri, 1994; Sénéchal, 1997; Sénéchal & Cornell, 1993). Turning to our key question of orthographic learning, we expected increases across ages 4 to 6. While there is some evidence that 4-year-olds recognize words they were exposed to during shared reading (Evans et al., 2008) the nature of the evidence provides little confidence that they can establish detailed and accurate orthographic representations. Given the empirical evidence that 4-year-olds rarely look at print during shared reading (e.g., Evans & St-Aubin, 2005; Justice et al., 2005), it seems that at this age, the focus of shared reading may be learning meanings, rather than word specific forms. By age 5, it seems that children can recognize words they were exposed to during shared reading (Apel, 2010; Apel et al., 2006; Apel et al., 2013; Wolter & Apel, 2010), but it is unclear whether they establish precise representations of these words. However, it has been clearly demonstrated that children can establish detailed and accurate orthographic representations by age 6 (Shakory et al., 2021). Keeping with prior studies (e.g., Shakory et al., 2021; Sénéchal & Cornell, 1993), we also tested each age group's performance on the orthographic and semantic learning tests against chance using one-sample t-tests. We then test these age-based predictions

with a repeated measures ANOVA. This allowed us to determine at what age children begin engaging in orthographic and semantic learning during shared reading.

Our second goal was to investigate whether individual differences in orthographic and semantic learning were related to early word reading. To do so, we conducted linear regression analyses with controls for age and phonological awareness. Critically, we also included interactions between each of orthographic and semantic learning and age in the model to confirm that the pattern of results was the same for children of each age. We predicted that across all ages, individual differences in orthographic learning would be related to early word reading, while individual differences in semantic learning would not be. Our predictions for the relation between orthographic learning during shared reading and early word reading are based on Share's (2004) assertion that acquiring basic letter knowledge and phonological awareness allows children to start engaging in orthographic learning. If this is true, then one would expect skill in orthographic learning and early word reading to be related, even in a shared reading paradigm. Our predictions on the relation between semantic learning during shared reading and early word reading are based on the home literacy model (Sénéchal et al., 2017), which states that meaning-focused activities are not related to children's written language skills. Semantic learning can be conceptualized as a meaning-focused activity, as such, we expected that it would not be related to early word reading.

## CHAPTER 2 METHODOLOGY

### 2.1 Participants

Eighty-four children (44 girls) ranging in age from 4 years and 6 months to 6 years and 11 months participated in the study. Of these 84 children, 22 were 4 years of age (mean age = 4 years and 8 months; SD = 2 months), 30 were 5 years (mean age = 5 years 5 months; SD = 3 months), and 32 were 6 years (mean age = 6 years 5 months; SD = 4 months). Children were recruited from the general population in an urban area of Eastern Canada. We only recruited children that were at least 4 years and 6 months old as this is the youngest age that one of our key measures is standardized for. The only exclusion criteria for participation was receiving education in a language other than English (e.g., French Immersion). Parental report revealed that 53 children were English monolinguals, 14 children spoke English as a first language but also spoke one or more additional languages<sup>1</sup>, and 17 children spoke English as a second language<sup>2</sup>.

We conducted an a priori power analysis to determine the number of participants needed to detect significant differences in the extent of orthographic and semantic learning across ages. To obtain an appropriate effect size to use in the power analysis, we first calculated the effect size for the difference between 5- and 6-year-olds' orthographic learning in two studies with comparable methods (Apel et al., 2021 and Shakory et al., 2021; see e.g., Cohen, 1992). As we were interested in the interaction between age and

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<sup>1</sup> Reported additional languages included Bengali, German, Newari, Punjabi, Yoruba ( $n = 1$  for each), Hindi, Nepali, Spanish ( $n = 2$  for each), French ( $n = 3$ ), and Tamil ( $n = 5$ ). Some parents reported multiple languages.

<sup>2</sup> Reported first languages other than English included Bengali, Farsi, French, Hindi, Marathi ( $n = 1$  for each), Malayalam, Telugu, Vietnamese ( $n = 2$  for each), Spanish, and Tamil ( $n = 3$  for each).

learning, we then divided the resulting effect size in half, as interaction effects are always smaller than main effects (see e.g., Cox, 1984). The resulting effect size of  $\eta_p^2 = .01$  was entered into the power analysis, along with a significance criterion of  $\alpha = .05$  and power level of .80. The power analysis, conducted in G\*Power version 3.1.9.6 (Faul et al., 2007), revealed that the minimum number of participants required to detect an interaction in the repeated measures ANOVA was 54, or 18 participants per age group. As such, our study was adequately powered to answer our first research question. With respect to our second research question, 10 participants per independent variable are required to detect significant effects in linear regression analyses (Hair et al., 2010). Our sample size ( $N = 84$ ) more than satisfied this requirement as there were only five independent variables in each regression. As such, we were powered to detect relations between orthographic and semantic learning and early word reading.

## **2.2 Measures**

### ***2.2.1 Shared Reading Activity***

Orthographic and semantic learning were assessed using a version of the self-teaching paradigm (Share, 1999). This paradigm was originally developed for independent reading with elementary school aged children (Share, 1999); as such we used an adapted version created by Shakory et al. (2021) for use with younger children during shared reading. As in Shakory et al. (2021), we used 12 short stories about novel inventions with non-word names, which were the targets for orthographic and semantic learning. After listening to each set of three short stories, children completed multiple-choice tasks to assess their orthographic and semantic learning. The targets and multiple-choice tasks were the same ones used in Shakory et al. (2021). We adapted Shakory et

al.'s (2021) paradigm to make it more similar to children's typical shared reading experiences by adding a central character to connect the stories together. We also added a title and cover page, and additional text and pictures before and after the short stories.

**2.2.1.1 Storybook.** The storybook was titled *Professor Parsnip's Inventions*. It started with four pages of text introducing the character of Professor Parsnip, a scientist who makes inventions to help people solve their problems. This initial text was accompanied by pictures of Professor Parsnip and his invention factory. The short stories and multiple-choice tasks followed this text. After each set of multiple-choice tasks, there was a page with a line of text such as 'Let's learn about some more inventions!' that served as a transition back to the short stories. After the final set of tasks, the storybook ended with two pages of text to summarize the story.

**2.2.1.2 Story Content.** The storybook included 12 short stories in which a character used a novel invention to solve a problem. Each invention had a non-word name which was repeated four times in its respective short story. All short stories were five sentences long. The first sentence introduced the character and stated their problem. In the subsequent sentences, the function of the invention was explained, and the character used it to solve their problem. The short stories were all composed of high-frequency Dolch sight words (Dolch, 1936) and were presented in 40-point regular Times New Roman font in black ink.

**2.2.1.3 Non-Words.** Each invention was given a non-word name which was four letters long and monosyllabic. The non-words all started and ended with a consonant sound, and each started with a different letter. All non-words followed regular spelling patterns as determined by Rastle and Coltheart's (1999) letter-sound correspondence

rules. The Children's Printed Word

Database(<https://www1.essex.ac.uk/psychology/cpwd/>) was consulted to ensure that none of the non-words were real words. Two homophonic spellings were created for each non-word (e.g., *veap* and *veep*) to control for any potential preference for one spelling over another. As such, there were two versions of the storybook, one containing one spelling of each target word (e.g., *veap*) and the other containing the alternate spelling (e.g., *veep*).

**2.2.1.4 Orthographic Learning.** Orthographic learning was assessed using multiple-choice tests. Children were shown four spellings and were asked to identify which one was the spelling of the invention they heard about in the story (e.g., *veep*). The distractors included the homophonic spelling from the alternate version of the story (e.g., *veap*), a non-word that started or ended with a different letter than the target (e.g., *feep*), and a non-word that started or ended with a different letter than the homophonic distractor (e.g., *feap*). The spellings were presented on paper in a two-by-two grid and children pointed to their answers. The internal consistency reliability for the immediate and delayed tests together was .65.

**2.2.1.5 Semantic Learning.** Multiple-choice tasks were administered to assess semantic learning, following those assessing orthographic learning. Children were shown four pictures and chose which one depicted the invention they heard about in the story (e.g., a fish tank cleaner). One of the distractors performed a different action than the target invention but on the same object (e.g., a fish tank painter), while the other two performed different actions on different objects than the target invention (e.g., a sock matcher and a sock mender). The pictures were presented on paper in a two-by-two grid

and children pointed to their answers. The internal consistency reliability for the immediate and delayed tests together was .86.

### **2.2.2 Early Word Reading**

**2.2.2.1 Letter Identification.** The Letter Identification subtest of the Woodcock Reading Mastery Test Revised —3<sup>rd</sup> edition (WRMT-III; Woodcock, 2011) assessed children's abilities to correctly name letters of the alphabet. In this test, the researcher points to a letter of the alphabet and asks the child to name it. Letters are presented in both upper- and lower-case, and 17 letters of the alphabet are queried. Testing is discontinued after four consecutive errors. The Letter Identification subtest is standardized for use with children aged 4 years and 6 months to 6 years and 11 months. As such, all children were administered the Letter Identification subtest. The subtest has good reliability, with a manual reported split-half reliability of .88 for children in our age range.

**2.2.2.2 Word Reading.** The Word Identification subtest of the WRMT-III (Woodcock, 2011) assessed children's word reading skill. In this test, children are asked to read a list of 46 increasingly difficult words. Testing is discontinued after four consecutive errors. The Word Identification subtest is standardized for use with children aged 6 and up; however, it may also be administered to younger children who answer all items on the Letter Identification subtest correctly (Woodcock, 2011). Therefore, we administered the Word Identification subtest to all 6-year-olds ( $n = 32$ ) and only to 4- and 5-year-olds who answered all items on the Letter Identification subtest correctly ( $n = 4$  and 15, respectively). The subtest has excellent reliability, with a manual reported split-half reliability of .91 for 6-year-old children.



### **2.2.3 Phonological Awareness**

Children's phonological awareness was assessed with the Elision subtest of the Comprehensive Test of Phonological Processing — Second Edition (Wagner et al., 2013). In this test, children are asked to say a word (e.g., *stale*), and then say it again while deleting one sound (e.g., *stale* without the /t/). This subtest is standardized for use with children aged 4 and up, therefore it was administered to all participating children. The Elision subtest has excellent reliability, with a manual reported test-retest reliability of .93 for children in our age range.

### **2.3 Procedure**

All children were tested individually in a quiet room in the Language and Literacy Lab at Dalhousie University. The testing session started with the shared reading activity. Children were told they were going to learn about some new inventions, and they should try to remember what the inventions were used for and how their names were spelled. Children were randomly assigned to a version of the storybook, with 41 children administered the first version (e.g., *veap*) and 43 the second (e.g., *veep*). The shared reading activity was followed by the Letter Identification subtest, the Word Identification subtest (for children who met the administration criteria), and the Elision subtest. Finally, children were again administered the orthographic and semantic choice tests, approximately 25 minutes after completing the shared reading activity. The duration of the testing session was approximately 40 minutes. Children took a short break after completing each measure. At the end of the session children received a small prize, such as a colourful eraser, a certificate, and a \$10 Amazon gift card as a token of thanks for their participation.

## CHAPTER 3 RESULTS

### 3.1 Preliminary Analyses

The data were first examined for accuracy of input and missing values. Two children were missing phonological awareness scores; these missing values were replaced with the mean score for each child's respective age group (Tabachnick & Fidell, 2007). One univariate outlier was detected and winsorized. No multivariate outliers were detected using the  $p \leq .001$  criterion for Mahalanobis distance (Tabachnick & Fidell, 2007). As per the WRMT-III manual instructions, scores on the Letter Identification and Word Identification subtests were added together to create an early word reading score. Similarly, and as in Shakory et al. (2021), immediate and delayed orthographic learning scores were added together to obtain a total orthographic learning score. The same was done for immediate and delayed semantic learning. These total scores for each of orthographic and semantic learning were used in the linear regression analyses.

We inspected skew and kurtosis within each age group and for the sample as a whole. Total orthographic learning was corrected to normality with a square root transformation. Total semantic learning, age, and phonological awareness could not be transformed to normality; however, the skew and kurtosis values of the raw scores fell within an acceptable range (-2 to 2 for skew and -7 to 7 for kurtosis; Hair et al., 2010). As such, we report here on results with transformed scores for total orthographic learning and raw scores for all other variables. The same pattern of results emerged when analyses were conducted with raw scores for total orthographic learning, and with logarithmic transformed scores for phonological awareness (Tabachnick & Fidell, 2007).

Descriptive statistics for all measures are reported in Table 3.1. Mean standard scores on the Letter Identification and Word Reading subtests were within the normal range, with standard deviations roughly in the normal range. As such, our sample was composed of typically developing readers.

Table 3.1

*Descriptive Statistics for All Measures, With Standard Scores Where Available*

Measures (maximum score)	4-year-olds			5-year-olds			6-year-olds		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Age (in months)	4:8	2	4:6 - 4:11	5:5	3	5:0 - 5:11	6:5	4	6:0 - 6:11
Orthographic learning									
Immediate test (12)	3.5	1.9	1 - 9	3.5	2.4	0 - 10	4.9	2.8	0 - 10
Delayed test (12)	3.8	1.7	0 - 7	3.3	1.8	0 - 8	4.2	1.7	1 - 8
Total (24)	7.3	2.7	4 - 15	6.9	3.8	2 - 17	9.1	4.1	3 - 18
Semantic learning									
Immediate test (12)	5.6	2.7	2 - 12	5.7	3.0	1 - 12	8.2	2.4	3 - 11
Delayed test (12)	5.0	3.1	1 - 11	5.9	3.0	2 - 12	8.0	2.6	3 - 12
Total (24)	10.6	5.0	5 - 23	11.6	5.7	3 - 24	16.2	4.8	5 - 23
Phonological awareness (34)	8.2	5.5	0 - 26	11.9	7.2	0 - 27	15.8	6.7	0 - 29
Letter Identification <sup>a</sup>									
Raw score (17)	12.4	4.8	0 - 17	14.3	4.3	0 - 17	16.5	1.1	12 - 17
Standard score	112.9	12.2	82 - 127	105.4	11.5	70 - 118	103.9	5.7	80 - 108
Word Identification <sup>a</sup>									
Raw score (46)	3.4	6.6	0 - 22	5.3	8.8	0 - 28	15.1	10.1	0 - 36
Standard score	–	–	–	–	–	–	111.1	17.7	76 - 145
Early word reading (63)	15.7	9.2	0 - 39	19.6	11.2	0 - 45	31.6	10.7	1 - 53

<sup>a</sup> Indicates a standard score with a mean of 100 and standard deviation of 15.

*Note:* Mean age is written as years:months. Standard scores on the Word Identification subtest are only available for 6-year-old children.

Pears on correlations between all variables are reported in Table 3.2. Within the measures of orthographic learning, scores on the immediate and delayed tasks were moderately correlated to each other ( $p \leq .001$ ). Within the measures of semantic learning, scores on the immediate and delayed tasks were highly correlated to each other ( $p \leq .001$ ). Correlations are less clear between measures of orthographic and semantic learning. Immediate orthographic learning was modestly positively correlated to immediate ( $p \leq .05$ ) and delayed semantic learning ( $p \leq .001$ ), while delayed orthographic learning was not significantly correlated to either semantic learning variable. Turning to predictor variables, the pattern of relations differed for immediate and delayed orthographic learning. Immediate orthographic learning was modestly positively correlated to age ( $p \leq .001$ ), and moderately positively correlated to both phonological awareness and early word reading ( $p \leq .001$ ), while delayed orthographic learning was not significantly correlated to age and was modestly positively correlated to both phonological awareness and early word reading ( $p \leq .001$ ). In contrast, immediate and delayed semantic learning showed the same pattern of relations to the predictor variables; both were modestly positively correlated to age and early word reading ( $p \leq .001$ ), and moderately positively correlated to phonological awareness ( $p \leq .001$ ). Across all pairs of variables, none that would be in the same analysis were correlated at a level higher than  $r = .79$ , suggesting that multicollinearity was not a concern. Multicollinearity was also checked using tolerance values and VIFs in the regression output (Tabachnick & Fidell, 2007). These values were all within an acceptable range, with tolerance values ranging from .26 to .58, and VIFs from 1.72 to 3.87.

Table 3.2  
*Correlations Between Measures*

Measure	1	2	3	4	5	6	7	8	9
1. Age	–								
2. OL immediate test	.32**	–							
3. OL delayed test	.16	.51**	–						
4. OL total	.29**	.92**	.82**	–					
5. SL immediate test	.42**	.32**	.10	.26*	–				
6. SL delayed test	.42**	.27*	.19	.27*	.79**	–			
7. SL total	.46**	.31**	.16	.28*	.94**	.95**	–		
8. Early word reading	.64**	.64**	.43**	.63**	.44**	.45**	.47**	–	
9. Phonological awareness	.47**	.61**	.37**	.58**	.60**	.56**	.61**	.77**	–
Mean	5 years and 7 months	4.1	3.8	7.8	6.6	6.5	13.1	23.16	12.48
SD	9 months	2.5	1.7	3.7	3.0	3.1	5.7	12.42	7.19

*Note.* \* $p \leq .05$ , \*\* $p \leq .01$ . OL = orthographic learning; SL = semantic learning.

### 3.2 Extent of Learning During Shared Reading Across Ages Four to Six

Our first goal was to investigate the extent to which 4-, 5-, and 6-year-old children engaged in orthographic and semantic learning during shared reading. We started by comparing each age group's performance on the semantic and orthographic choice tests to the level expected by chance (e.g., identification of three targets) to determine whether there was evidence of either type of learning at each age. We did so with one-sample  $t$ -tests with a Bonferroni adjusted alpha level of .004 (.05/12 tests). Each of 4-, 5-, and 6-year-old children performed above chance on both the immediate ( $t(21) = 4.45, p \leq .001, d = .95$ ;  $t(29) = 4.92, p \leq .001, d = 0.90$ ;  $t(31) = 12.10, p \leq .001, d = 2.14$ , respectively) and delayed semantic learning tests ( $t(21) = 3.06, p = .003, d = 0.65$ ;  $t(29) = 5.33, p \leq .001, d = 0.97$ ; and  $t(31) = 10.92, p \leq .001, d = 1.93$ , respectively). Turning to our key question of orthographic learning, 4- and 5-year-olds did not perform significantly above chance on either the immediate ( $t(21) = 1.11, p = .14, d = .024$ ; and  $t(29) = 1.24, p = .11, d = 0.23$ , respectively) or delayed tests ( $t(21) = 2.25, p = .02, d = 0.48$ ; and  $t(29) = .93, p = .18, d = 0.17$ , respectively). Six-year-olds however performed significantly above chance on both the immediate ( $t(31) = 3.86, p \leq .001, d = 0.68$ ) and delayed orthographic learning tests ( $t(31) = 3.97, p \leq .001, d = 0.70$ ). These results suggest that 4-, 5-, and 6-year-olds all engaged in semantic learning, but only 6-year-olds as a whole engaged in orthographic learning to a significant extent.

We also conducted a 3 x 2 x 2 repeated measures ANOVA with age group (ages 4, 5, and 6) as a between-subjects factor and type of learning (orthographic and semantic) and time of test (immediate and delayed) as within-subject factors. Results indicated a significant main effect of age group,  $F(2, 81) = 10.55, p \leq .001, \eta_p^2 = .21$ , with



performance on the orthographic and semantic learning tests increasing with age. There was also a significant main effect of learning,  $F(1, 81) = 62.83, p \leq .001, \eta_p^2 = 0.44$ , with higher performance on the semantic than orthographic learning tests. The main effect of time of test was not significant,  $F(1, 81) = 1.25, p = .27, \eta_p^2 = 0.02$ . There were also no significant interactions between type of learning by time of test ( $F(1, 81) = .02, p = .90, \eta_p^2 = .00$ ), time of test by age ( $F(2, 81) = .66, p = .52, \eta_p^2 = .02$ ), and type of learning by time of test by age ( $F(2, 81) = 2.39, p = .10, \eta_p^2 = .06$ ). The type of learning by age interaction approached significance,  $F(2, 81) = 3.03, p = .05, \eta_p^2 = .07$ .

As we had clear predictions about changes in the extent of orthographic and semantic learning across ages 4 to 6, we followed up these results with planned contrasts. The contrasts revealed that the extent of orthographic and semantic learning did not differ across ages 4 and 5, with 4- and 5-year-olds scoring similarly to each other on both total semantic ( $t(2, 81) = 0.67, p = .51, d = 0.19$ ) and total orthographic learning ( $t(2, 81) = -0.40, p = .69, d = 0.11$ ). The extent of learning did however increase from ages 4 and 5 to age 6. Four- and 5-year-olds scored significantly lower than 6-year-olds on both total semantic learning ( $t(2, 81) = -4.33, p \leq .001, d = 0.98$ ) and total orthographic learning ( $t(2, 81) = -2.46, p = .02, d = 0.19$ ). These results demonstrate that 6-year-old children engaged in significantly more semantic and orthographic learning than 4- and 5-year-olds, who engaged in similar levels of both types of learning. We also attempted to probe the age by type of testing interaction by testing whether children of each age engaged in orthographic and semantic learning to a similar extent. Paired samples t-tests revealed that each of 4-, 5-, and 6-year-olds engaged in orthographic learning to a lesser extent than they engaged in semantic learning ( $t(21) = -3.07, p = .01, d = 0.65$ ;  $t(29) = -.396, p \leq$

.001,  $d = 0.72$ ;  $t(31) = -7.34$ ,  $p \leq .001$ ,  $d = 1.30$ , respectively). As we found children of all ages engaged in a greater extent of semantic than orthographic learning, these results are not particularly helpful for understanding how age and type of learning might interact. The difference in extent of orthographic learning compared to extent of semantic learning was the greatest for the 6-year-olds however, suggesting this finding might be driving the trend towards an interaction between age and type of learning.

### **3.3 Relations to Early Word Reading**

Our secondary goal was to examine whether individual differences in semantic and orthographic learning are related to early word reading. To address this question, we conducted two linear regression analyses, the results of which are presented in Table 3.3. In both analyses, age and phonological awareness were entered as the first and second steps to control for their effects, and early word reading was entered as the outcome variable. Together, age and phonological awareness explained 69% of the variance in early word reading. All standardized beta weights ( $\beta$ ) presented in Table 3.3 are from the step in the model at which their corresponding  $\Delta R^2$  values were entered.

To examine the contribution of semantic learning to early word reading, total semantic learning was entered in the third step of the first regression. To assess the interaction between semantic learning and age, we computed an interaction term by mean centering each of these two variables and then multiplying age by semantic learning, the product of which was entered in the final step of the regression (Pedhazur & Schmelkin, 1991). After the variance explained by age and phonological awareness, semantic learning did not predict a significant proportion of the variance in early word reading

( $\Delta R^2 = .01, p = .25$ ), nor did the semantic learning by age interaction ( $\Delta R^2 = .00, p = .47$ ).

To examine the contribution of orthographic learning to early word reading, total orthographic learning was entered in the third step of the second linear regression. The age by orthographic learning interaction was assessed by mean centering each of age and orthographic learning and then multiplying them together, the product of which was entered in the final step of the regression (Pedhazur & Schmelkin, 1991). Total orthographic learning predicted a significant proportion of the variance in early word reading ( $\Delta R^2 = .05, p \leq .001$ ), independent of the variance explained by age and phonological awareness. The orthographic learning by age interaction however did not explain any unique variance in early word reading ( $\Delta R^2 = .00, p = .92$ ), suggesting that the relation between orthographic learning and early word reading existed across all ages.

Given that 4- and 5-year-old children performed at chance on the orthographic learning tests, we were curious if the extent of orthographic learning they did engage in was related to their early word reading. As such, we conducted the second linear regression analysis again with just 4- and 5-year-olds, the results of which are presented in Table 3.3. Age and phonological awareness were entered in the first and second steps of the regression, total orthographic learning in the third step, and the orthographic learning by age interaction in the fourth step. Early word reading was entered as the outcome variable. Together, age and phonological awareness explained 56% of the variance in early word reading. After the contributions of these variables, total orthographic learning still explained a significantly significant proportion of the variance in early word reading ( $\Delta R^2 = .04, p = .03$ ). The age by orthographic learning interaction

did not explain any of the variance in early word reading ( $\Delta R^2 = .00, p = .74$ ). The results of this analysis confirm the pattern of results from our analysis with 4- to 6-year-olds. Further, they demonstrate that orthographic learning during shared reading and early word reading skill are related even when children, on average, did not engage in a significant extent of orthographic learning.

Table 3.3

*Results of Linear Regression Analyses Predicting Early Word Reading from Age, Phonological Awareness, Semantic Learning, Orthographic Learning, and the Interactions of Semantic and Orthographic Learning with Age*

Step	Predictor	Semantic Learning			Orthographic learning					
		4- to 6-year-olds			4- and 5-year-olds			4- to 6-year-olds		
		$\beta$	R <sup>2</sup>	$\Delta R^2$	$\beta$	R <sup>2</sup>	$\Delta R^2$	$\beta$	R <sup>2</sup>	$\Delta R^2$
1	Age	.64**	.41	.41**	.33*	.11	.11*	.64**	.41	.41**
2	Phonological awareness	.60**	.69	.28**	.71**	.56	.45**	.60**	.69	.28**
3	Semantic learning	-.09	.70	.01	–	–	–	–	–	–
4	Age x semantic learning interaction	-.05	.70	.00	–	–	–	–	–	–
3	Orthographic learning	–	–	–	.20*	.60	.04*	.28**	.70	.05**
4	Age x orthographic learning interaction	–	–	–	.05	.60	.00	.01	.70	.00

Note. \* $p < .05$ , \*\* $p < .01$ .

## CHAPTER 4 DISCUSSION

The present study provided a novel test of learning during shared reading. Specifically, we tested the extent to which 4-, 5-, and 6-year-old children engaged in orthographic and semantic learning during shared reading, and whether this learning was related to their early word reading skill. To do so, we utilized an adapted version of the self-teaching paradigm (Share, 1999), created by Shakory et al. (2021) for use with younger children during shared reading. We found that each of 4-, 5-, and 6-year-olds engaged in semantic learning, while only 6-year-olds engaged in orthographic learning to a significant extent, as demonstrated by statistically above chance performance on choice tests. We also found that individual differences in orthographic, but not semantic, learning were predictive of early word reading after controls for age and phonological awareness, with no interaction with age. Our findings help specify the age at which children begin learning orthographic forms during shared reading. Moreover, our findings demonstrate that, consistent with Share's (2004) predictions, orthographic learning and early word reading are indeed related, suggesting that children engage in orthographic learning as they acquire beginning word reading skill.

In comparing our findings to those of prior studies, it is helpful to break down our results by age. We found that 4-year-olds, on average, did not engage in orthographic learning, as demonstrated by at chance performance on the orthographic choice tests. This finding aligns with prior studies demonstrating that 4-year-olds rarely look at print during shared reading (e.g., Evans & St-Aubin, 2005; Justice et al., 2005). If children do not look at the words in a storybook, then it is very unlikely that they would learn their orthographic forms. Four-year-olds' at chance performance on the orthographic choice

tests are however inconsistent with Evans et al.'s (2008) study, in which 4-year-old children performed above chance at recognizing visually salient print they were exposed to during shared reading. However, this learning was assessed by a choice task that did not in any way require children to have established detailed and accurate representations of the target words in the print; children could answer correctly by simply remembering the visually salient features of the target print (e.g., that it looked like a 'walk' sign) and recognizing that the distractor did not contain these features. In contrast, to answer the questions on our orthographic choice test correctly, children need to establish precise orthographic representation of the targets. As such, it seems that while 4-year-olds may be able to recognize visually salient print they are exposed to during shared reading, they cannot, as a whole, establish detailed and accurate orthographic representations.

Similarly, we found that 5-year-olds on average did not engage in orthographic learning, as demonstrated by chance performance on the choice tests. This result helps to clarify our interpretation of Apel et al. (2006; see also Apel, 2010; Apel et al., 2013; Wolter & Apel, 2010). We previously speculated that as the choice tests in Apel et al. (2006) did not include homophonic distractors (e.g., *zime* was the most plausible distractor for *sime*), children may have simply answered correctly based on phonology and not their orthographic representation of the target. This might explain why 5-year-olds, on average, performed above the chance level in these studies. Our study however utilized homophonic distractors (e.g., *veap* was a distractor for *veep*), so answering correctly likely required children to establish a detailed and accurate representation of the target. This might explain why, on average, 5-year-olds in our study performed at the chance level. Taking these results together, it seems that 5-year-olds are unlikely to

develop precise orthographic representations during shared reading, though they might recognize some aspects of novel words they are exposed to during shared reading (Apel et al.'s (2006)

Finally, we found that 6-year-old children performed above chance on both the immediate and delayed orthographic learning tasks, demonstrating that they had engaged in orthographic learning. This finding is consistent with Shakory et al.'s (2021) study, in which 6-year-old French Immersion children also performed above chance on orthographic learning tests utilizing homophonic distractors, both immediately after listening to the stories and five to seven days later. Our findings extend Shakory et al.'s (2021) by demonstrating that children enrolled in English instruction can also, on average, establish precise orthographic representations during shared reading by age 6.

In terms of semantic learning, we found that each of 4- to 6-year-olds engaged in semantic learning during shared reading, as demonstrated by above chance performance the choice tests. These results are consistent with previous studies in which 4- to 6-year-old children scored above chance on measures of semantic learning, both when tested both immediately after listening to the stories (e.g., Evans & St-Aubin, 2013; Justice, 2002, McLeod & McDade, 2011; Robbins & Ehri, 1994; Sénéchal, 1997) and several days later (Sénéchal & Cornell, 1993; Shakory et al., 2021). We extend this previous work by demonstrating that, while each of 4- to 6-year-olds engaged in semantic learning during shared reading, the extent of learning was significantly greater for 6-year-olds than it was for 4- and 5-year-olds. This result suggests that older children may have more abilities to engage in semantic learning during shared reading than younger children.



Further, we demonstrated that, at least for 6-year-olds, semantic learning during shared reading can occur in parallel to orthographic learning.

Turning to our second question of relations to word reading, we found that individual differences in orthographic, but not semantic, learning during shared reading were related to early word reading, after controls of age and phonological awareness. There were no interactions with age, suggesting that the relation existed for children of each age group. Notably, the same pattern of results emerged when analyses were conducted with the whole sample of 4- to 6-year-olds as when they were conducted with just 4- and 5-year-olds. This is an interesting finding as 4- and 5-year-olds, on average, performed at chance on the orthographic learning tests. However, there was a great deal of variability in performance in this age range, with total orthographic learning scores ranging from zero to 10 on the immediate test and zero to eight on the delayed test, while chance performance was a score of three on each test. As such, it seems that there is quite a range in the ability to learn orthographic forms during shared reading at ages 4- to 5, and individual differences in abilities are related to early word reading.

Our results suggest that children's orthographic, but not semantic, learning during shared reading is relevant to their early word reading. This finding is consistent with Shakory et al.'s (2021) study with 6-year-old children French Immersion children, which found relations between orthographic, and not semantic, learning and word reading, after controls for non-verbal reasoning, vocabulary, and phonological awareness. We extend these findings by demonstrating that the pattern of relations between orthographic and semantic learning during shared reading and early word reading are similar for 4- to 6-year-old children enrolled in English instruction. Further, as our early word reading

assessment partly consisted of a measure of alphabet knowledge, we demonstrate that orthographic learning during shared reading is related to alphabet knowledge, in addition to measures of word reading. This finding is notable as it suggests that orthographic learning during shared reading may be relevant for younger children who just beginning to learn the letters of the alphabet, in addition to older children who have some beginning skill in reading words. Our findings are also consistent with studies of learning during independent reading, which found that orthographic, but not semantic, learning was related to word reading (see e.g., Deacon et al., 2019; Mimeau et al., 2018). We extend this work by demonstrating that the pattern of results for shared reading is similar to that for independent reading.

Our findings enrich several key theoretical perspectives. It seems that at ages 4- and 5-, shared reading may be primarily a basis for learning words' meanings. This finding is consistent with predictions of the home literacy model (Sénéchal et al., 2017), which states that children acquire oral, but not written, language skills during shared reading. It is only at age 6 that children, on average, learnt both meaning and orthographic forms during shared reading. This finding is at odds with predictions from the theoretical framework of print learning, which predicts that children learn orthographic forms right from the outset of their shared reading experiences, prior to age 6 (Conrad & Deacon, 2022). We can reconcile this discrepancy by extending Share's (2004) predictions about the requirements for orthographic learning during independent reading to shared reading. Share predicts that children begin learning orthographic forms during their early reading attempts once they possess basic alphabet knowledge and phonological skill (2004). It seems that the same may be true for shared reading. Perhaps

knowing the letters of the alphabet makes children more likely to look at the print during shared reading (see, e.g., Evans et al., 2009) in turn allowing them to learn orthographic forms. Further, the ability to connect sounds to letters may help children match a target's pronunciation to its spelling on a choice test. In line with this idea, we found correlations between orthographic learning during shared reading and early word reading.

Taking these theoretical perspectives together, we suggest that, as predicted by the home literacy model (Sénéchal et al., 2017), shared reading is primarily a forum for learning word meanings. Refining this theory, it does seem that some orthographic learning can happen during shared reading and in the absence of explicit teaching. However, it seems that children do not engage in as much orthographic learning during shared reading as the print learning theoretical perspective would suggest, but there is also more going on during shared reading than the home literacy model would suggest. Certainly, the extent of orthographic learning during shared reading and its theoretical implications are worth exploring further.

As we consider these interpretations, we remain aware that these relations are correlational, from a single point in time. Clearly, specifying the direction of the relation between orthographic learning during shared reading and early word reading is important. From our perspective, the relation is likely bi-directional. On one hand, early word reading skills may support children to learn orthographic forms during shared reading. For instance, 5-year-old children who know at least half the letters in the alphabet have been found to spend significantly more time looking at print than their peers who know less than half the letters (Evans et al., 2009) – a relevant finding because to engage in orthographic learning, children must look at print. On the other hand, orthographic

learning may support children's early word reading skill. Precise orthographic representations are crucial for successful word reading (Nation & Castles; 2017; Perfetti & Hart, 2002; Share, 1995), so acquiring these representations during shared reading may help children make their first steps into independent reading. Specifying the direction of the relation between orthographic learning and early word reading would require longitudinal research and analyses with controls for prior levels of both skills (see e.g., Deacon et al., 2012; Heintzman et al., 2023). This will be an important direction for future research.

#### **4.1 Educational Implications**

Our results resonate with widespread suggestions that shared reading is a way to facilitate children's vocabulary development (e.g., Bus et al., 1995; Sénéchal, 2006; 2017). During shared reading children are exposed to many novel, low-frequency words that they might not hear in oral language (e.g., Beals & Tabors, 1995; Sénéchal et al., 2017). Our results demonstrate that simply listening to a short story with four occurrences of a novel word is enough for 4- to 6-year-old children to learn its meaning. As such, shared reading provides a valuable opportunity for pre-school aged children to learn new words. This learning can happen in the absence of explicit instruction from teachers on the words' meanings, simply listening to the story is sufficient for children to learn. Therefore, we echo calls that shared reading is an important tool for building children's vocabularies and should continue to have a place in the classroom.

It is less clear whether shared reading is a way to enrich children's orthographic learning. We found relations between orthographic learning during shared reading and early word reading across 4- to 6-year-old children, and also found that 6-year-old

children as a whole engaged in orthographic learning. Given these findings, we suggest two possible recommendations. One is to encourage instruction in areas that are known to be effective in developing early word reading skill, such as alphabet knowledge (e.g., Hammill, 2004; Whitehurst & Lonigan, 1998) and phonological awareness (e.g., Bus & van IJzendoorn, 1999; Ehri et al., 2001). As early word reading is related to skill in learning orthographic forms during shared reading, then boosting children's word reading may help them engage in orthographic learning during shared reading. Given the crucial role of precise orthographic representations in word reading (e.g., Nation & Castles, 2017; Perfetti & Hart, 2002), supporting children's orthographic learning may in turn also support their word reading.

Our second, more speculative, recommendation is to implement strategies during shared reading that support orthographic learning. The present study utilized pointing to the words while reading as a strategy, given the empirical evidence that doing so increases children's attention to print (e.g., Evans & St-Aubin, 2005; Justice et al., 2005). However, this strategy was not effective, as 4- and 5-year-old children still performed at chance on the orthographic learning tests. Certainly, more research is required to identify what strategies might be effective. Studies of print-focused shared reading interventions however may be useful as a starting point for identifying strategies. In one such study, 3- and 4-year-old children who participated in print-focused shared reading demonstrated greater gains in word reading, reading comprehension, and spelling than their peers who participated in non-print-focused shared reading (Piasta et al., 2012; see also Chen & Chang, 2013). In this study, teachers who led the print-focused shared reading sessions were trained to reference a variety of aspects about print, such as its' function and

organization, and concepts pertaining to letters and words. In our view, some of these aspects of print referencing may be more relevant to orthographic learning than others; particularly, referencing letters and words may be more helpful than referencing the function or organization of print. Overall, we suspect that referencing print during shared reading may encourage children to pay attention to the print they see in the book and not just the story that they hear orally. Paying more attention to print during shared reading would likely support children to engage in a greater extent of orthographic learning. Testing the effectiveness of such print-focused instruction for orthographic learning is an interesting and important direction for future research.

#### **4.2 Limitations and Future Directions**

When considering the present study's implications, it is also important to consider its limitations. First, the reliability for the delayed orthographic learning test was quite low ( $\alpha = .13$ .) This is likely because children's performance was, on average, lower on the delayed test than the immediate test, suggesting that children may have guessed more answers on the delayed test. However, the reliabilities for the immediate orthographic learning test and for total orthographic learning were within the acceptable range ( $\alpha = .64$  and  $.65$  respectively; Lowenthal, 1996). We also repeated analyses with just the immediate orthographic learning scores to confirm that the same pattern of results emerged as with the total scores. It should also be noted that low reliability simply makes it more difficult to find significant effects. Second, our delayed test was only approximately 25 minutes after the initial test, meaning we were unable to test whether children retained the meanings and spellings of the target non-words over the long term. Other studies of both semantic and orthographic learning (e.g., Sénéchal & Cornell, 1993;

Shakory et al., 2021) administered the delayed test five to seven days after the initial story reading. Doing so would have been a more effective test of children's retention; however, due to logistical constraints, administering the delayed test at the end of the session was the best option available to us. Our delayed test still allowed us to test whether children retained the meanings and spellings over a short period of time. Future studies should test whether children retain the meanings and orthographic forms they learn during shared reading over a longer time period.

Third, our shared reading activity was different from children's typical shared reading experiences. In some ways this is a strength of our study, as we had the strong experimental control required to test our research questions. However, this is also a limitation as our activity's design may have made it easier for children to engage in orthographic learning than it might be during typical shared reading. For instance, text in children's storybooks is typically accompanied by illustrations (Reese, 2015), while our short stories were not. The presence of illustrations might affect children's learning. Given the evidence that 4- and 5-year-old children spend much longer looking at illustrations than print (e.g., Evans & St-Aubin, 2005; Justice et al., 2005), children might engage in less orthographic learning when the text is accompanied by illustrations. Were we to include illustrations in our storybook, children might have scored lower on the orthographic choice tests; critically, 6-year-old children might have not scored above chance. Conversely, the presence of illustrations might aid children in learning the meanings of the targets, potentially increasing the extent of semantic learning. Indeed, multiple studies with 4- to 6-year-old children demonstrated semantic learning in storybooks that included illustrations (e.g., Robins & Ehri, 1994; Sénéchal, 1997;

Sénéchal & Cornell, 1993). An important future direction for research would be to test both orthographic and semantic learning during shared reading of a storybook where the text is accompanied by illustrations. Doing so would test whether the extent of each type of learning is different in a more ecologically valid paradigm than in a more tightly experimentally controlled one.

A final limitation comes from the linguistic background of our sample. Our target words were based on English orthographic patterns (see Mimeau et al., 2018), so children who are learning to read in a different language, and therefore are unfamiliar with English orthographic patterns, might have a harder time learning them than their peers who are learning to reading in English. We minimized this concern by restricting participation to children who received education entirely in English (e.g., not French Immersion). However, approximately 20% of children in our sample spoke English as a second language. While they all received education in English, it is possible that they might be learning to read in a different language at home, and as such might be familiar with different orthographic patterns. However, including children from different linguistic backgrounds increases the generalizability of our results.

### **4.3 Conclusions**

In sum, the present study specifies the extent to which 4- to 6-year-old children engage in orthographic and semantic learning during shared reading. We demonstrated that children across ages 4 to 6 years engaged in semantic learning, but only 6-year-olds as a whole engaged in orthographic learning to a significant extent. This finding suggests that what children learn during shared reading changes as they age. Further, we found that consistent with Share (2004)'s predictions, individual differences in orthographic



learning were related to early word reading skill. This relation highlights the potential role of shared reading in supporting children to acquire written language-related skills.

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