Emergent Readers in the French Immersion Context:  
Development and Cross-Language Transfer of Orthographic and Semantic Learning

by

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Department of Applied Psychology and Human Development 
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Abstract
This study investigated the ability of emergent readers in French immersion to learn the orthographic (spelling) and semantic (meaning) representations of novel words encountered during shared storybook reading in English. We also examined the role of orthographic and semantic learning in predicting word reading concurrently and six-months longitudinally both within English and across languages from English to French, controlling for reading-related skills. Sixty-two Grade 1 children (35 girls; \(M\) age = 75.89 months) listened to 12 short stories as the examiner simultaneously pointed to the text. Orthographic and semantic choice post-test measures were administered immediately after reading each set of three stories and again approximately one week later. Results indicated that children performed above chance level on measures of orthographic and semantic learning. Orthographic learning predicted word reading in English and French both concurrently and longitudinally. Semantic learning did not predict word reading in either language at any time point.
Acknowledgements

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1 Introduction

There has been increasing interest among researchers to better understand the role of orthographic (e.g., Deacon, 2012; Deacon, Benere, & Castles, 2012) and semantic knowledge (e.g., Ricketts, Davies, Masterson, Stuart, & Duff, 2016; Nation & Snowling, 2004) in reading development. Orthographic knowledge refers to an individual’s existing store of orthographic representations or spelling of written words (Apel, 2011), while semantic knowledge refers to an individual’s existing store of semantic representations or word meanings (Ricketts, Bishop, Pimperton, & Nation, 2011). Research has shown that both orthographic (e.g., Conrad, Harris, & Williams, 2013; Deacon, 2012; Roman, Kirby, Parrila, Wade-Woolley, & Deacon, 2009) and semantic knowledge (e.g., Nation & Snowling, 2004; Ouellette, 2006; Ricketts et al., 2016) are related to word reading. It is not yet clear, however, whether children’s existing store of representations is adequate for explaining individual differences in word reading, or whether children’s ability to acquire such representations is also of importance (Deacon et al., 2012).

The present study therefore aims to contribute to our understanding of the role of children’s learning abilities in reading development. We do this by focusing specifically on the ability of emergent readers enrolled in a French immersion program in Canada to learn the orthographic (spelling) and semantic (meaning) representations of novel words, referred to as orthographic and semantic learning, respectively, within a shared storybook reading context. Although orthographic and semantic learning have both been explored in older children (Mimeau, Ricketts, & Deacon, under review, Ricketts et al., 2011; Ricketts, Bishop, & Nation, 2008), it is not yet clear whether younger children are also able to simultaneously learn orthographic and semantic representations of novel words. Furthermore, using a sample of emerging English-French bilingual children allows us to investigate both within-language
relationships between orthographic and semantic learning and word reading in English, and cross-language relationships between English orthographic and semantic learning and French word reading. We examine these relationships concurrently and six-months longitudinally.

1.1 Orthographic Learning and Word Reading

The most prominent theory of orthographic learning, known as the self-teaching hypothesis (Share, 1995), asserts that the ability to phonologically decode words is necessary for the acquisition of orthographic representations. More specifically, it is presumed that through the process of independently sounding out and blending unfamiliar written words, children self-teach the spelling patterns of those words. Consequently, research on orthographic learning in school-aged children has largely focused on the self-teaching framework and has typically used samples of children in Grade 2 and above. In the self-teaching paradigm, children are asked to independently read stories embedded with pseudowords, and are subsequently given post-test measures such as the orthographic choice task. In the orthographic choice task, the correct spelling of a given target word is presented along with alternative spellings that are phonologically and visually similar to the target. This line of research has shown that older school-aged children demonstrate orthographic learning after independently reading stories embedded with novel words (e.g., Share, 1999; Cunningham, 2006; Cunningham, Perry, Stanovich, & Share, 2002; Nation, Angell, & Castles, 2007). A positive relationship between orthographic learning and the number of target pseudowords (e.g., Cunningham et al., 2002; Ricketts et al., 2011) and unfamiliar real words (Cunningham, 2006) accurately decoded during readings of the stories has been reported as providing further support for the self-teaching hypothesis.
Despite strong evidence for the self-teaching hypothesis, some researchers have argued that orthographic learning is not entirely reliant on decoding ability (Apel, 2009; Cunningham, 2006; Cunningham et al., 2002, Ricketts et al., 2011). Rather, spelling patterns of written words may also be acquired without having to phonologically decode the words (Wolter & Apel, 2010). Support for this pathway to orthographic learning comes from a series of studies conducted by Apel and colleagues with young monolingual English-speaking children in preschool (Apel, Wolter, & Masterson, 2006) and kindergarten (Apel, 2010; Apel, Brimo, Wilson-Fowler, Vorstius, & Radach, 2013; Wolter & Apel, 2010) who had not yet mastered decoding skills. The procedures and materials across the studies were fairly similar. The stimuli consisted of 12 target pseudowords, each of which was presented four times within a story. The pseudowords were visually salient (larger, bolded, and presented in colour), and were also verbally stressed (Apel, 2010; Apel et al., 2006; Wolter & Apel, 2010) and/or pointed to (Apel et al., 2006; Wolter & Apel, 2010) by the examiner in several of the studies. Pictures were presented alongside the text, and for all but one study (Apel et al., 2006), the stories were presented on a computer screen with pre-recorded audio recordings. After each story was read, orthographic learning was assessed with orthographic choice and spelling tasks. Notably, in all of these studies, the orthographic choice task contained a foil that differed slightly in spelling (e.g., *zime*) from the target pseudoword (e.g., *sime*) and another that differed greatly in spelling (e.g., *dite*). A real word (e.g., *long*) was included as an additional foil in some of the studies (Apel, 2010; Apel et al., 2013). Incorporating a homophone spelling of the target pseudoword would have helped to further diminish the possible role of phonological decoding in choosing a response (Conrad et al., 2013).

Nevertheless, Apel and colleagues found that children as young as 5- and 6-years old demonstrated orthographic learning of novel words encountered during shared storybook reading.
(Apel, 2010; Apel et al., 2013; Apel et al., 2006; Wolter & Apel, 2010). Using the eye tracking paradigm, Apel et al. (2013) further observed that young children were able to learn the spelling of novel words presented during shared storybook reading after spending only about one fourth of their time looking at the target pseudowords. A significant concurrent correlation between orthographic learning during shared book reading and word reading has also been established in these young children (Apel, 2010; Wolter & Apel, 2010). This is in line with a number of studies that have found a significant relation between orthographic learning during independent reading and word reading in older school-aged children (e.g., Cunningham, 2006; Cunningham et al., 2002; Mimeau et al., under review). However, our understanding of the unique contribution of orthographic learning to word reading in beginning readers remains limited. There is a need to investigate this relation longitudinally as well as cross-linguistically.

1.2 Orthographic Learning in Bilingual Children

Research on the cross-language transfer of orthographic processing to date has largely focused on orthographic knowledge. There is increasing evidence that the extent of transfer for orthographic knowledge is limited to languages that share similar writing systems such as English and French (Deacon, Wade-Woolley, & Kirby, 2009; Deacon, Commissaire, Chen, & Pasquarella, 2013; Pasquarella, Deacon, Chen, Commissaire, & Au-Yeung, 2014), and English and Spanish (Deacon, Chen, Luo, & Ramirez, 2013; Sun-Alperin & Wang, 2011). Studies that have examined the cross-language transfer of orthographic knowledge to reading in children bilingual in two languages with different writing systems such as logographic Chinese and alphabetic English (Wang, Perfetti, & Liu, 2005; Wang, Yang, & Cheng, 2009), or with different alphabets such as Korean and English (Wang, Park, & Lee, 2006) have consistently found no
evidence of cross-language transfer. In contrast, little is known about whether orthographic learning also transfers across languages for bilingual children.

The scant research that has been carried out on orthographic learning in bilinguals has focused on children in the upper elementary grades learning English as a foreign language (Schwartz, Kahn-Horwitz, & Share, 2014; van Daal & Wass, 2017). Although these studies point to the possibility of cross-language transfer of orthographic learning, this has not been tested directly. Schwartz and colleagues (2014), for instance, examined the role of self-teaching in orthographic learning among three groups of sixth grade children learning English as a foreign language: (1) Russian-Hebrew speaking children who were biliterate in both languages, (2) Russian-Hebrew speaking children who were literate in Hebrew only, and (3) monolingual Hebrew speaking children. All the children were experienced readers in Hebrew with only the first group who was also able to read Russian. The results demonstrated that the Russian-Hebrew biliterates performed significantly better than the other two groups on post-test measures of orthographic learning in English. The researchers argued that the Russian-Hebrew biliterates’ superior performance can be attributed to the similarity between the Russian and English writing systems, which facilitated the cross-language transfer of orthographic processing skills from Russian to English. Based on these results, it can be speculated that orthographic learning developed in one language may transfer to word reading skills developed in another language with a similar writing system. However, as mentioned earlier, this has not yet been directly tested. Another relevant finding is that orthographic learning was observed in all three groups despite relatively low levels of accurate decoding of the target pseudowords (~50%). This provides further evidence that decoding may not be necessary for acquiring orthographic representations.
1.3 Orthographic Learning and Semantic Learning

According to the lexical quality hypothesis (Perfetti, 2007; Perfetti & Hart, 2002), the ability to acquire high quality orthographic, phonological, as well as semantic representations is critical for skilled word reading. In line with this theory, research has found that semantic knowledge is linked to word reading skills (Mimeau et al., under review; Nation & Snowling, 2004; Ouellette, 2006; Ricketts et al., 2016; Ricketts, Nation, & Bishop, 2007). Recently, researchers have proposed the notion that semantic learning ability underlies the development of semantic knowledge (Ricketts et al., 2011). Examining both orthographic and semantic components of word learning is therefore necessary in order to understand how children develop high quality lexical representations that underlie skilled reading (Ricketts et al., 2008). However, it remains unclear whether emergent readers are able to acquire orthographic and semantic representations of words at the same time. These learning processes have not been investigated simultaneously in young children even though semantic learning during shared storybook reading has been documented in the literature (e.g., Evans & Saint-Aubin, 2013; Justice, 2002; McLeod & McDade, 2011; Sénéchal, 1997).

To date, only three studies have investigated orthographic and semantic learning simultaneously, and all of these studies have been conducted using samples of older monolingual children engaged in independent reading. Ricketts et al. (2008) examined orthographic and semantic learning skills in 9 to 10 year-old English-speaking children who had deficits in reading comprehension despite having adequate word reading ability. These poor comprehenders did not differ from the skilled comprehenders in terms of orthographic learning, but they demonstrated poorer semantic learning which is consistent with the notion that the poor comprehenders had poorer existing semantic knowledge. In another study, Ricketts and colleagues (2011) supported
the simultaneous acquisition of semantic and orthographic representations of novel words in English-speaking children aged 7 to 8 years. Moreover, Ricketts et al. (2011) reported that both orthographic and semantic learning were associated with word reading and reading comprehension.

More recently, with a sample of 8 and 9 year-old English-speaking children, Mimeau and colleagues (under review) examined the contributions of orthographic and semantic learning to word reading and reading comprehension in a concurrent study. In order to distinguish existing knowledge from the ability to learn, orthographic and semantic knowledge were included as control variables along with other reading-related skills including nonverbal reasoning, working memory, and phonological awareness. The results revealed that orthographic learning predicted word reading, and also had an indirect effect on reading comprehension through word reading. Semantic learning on the other hand, was found to predict reading comprehension but not word reading. It is not clear why semantic learning was not related to word reading in this study. This relation needs to be explored further in future studies, especially with younger children, given the possibility of a more prominent role for semantic learning in word reading during the early stages of reading development.

1.4 Present Study

The present study aims to extend the research conducted on orthographic learning in emergent readers in a number of ways. First, we investigate the ability of emergent readers to simultaneously acquire orthographic and semantic representations of words encountered during shared storybook reading in English. Second, the homophone spelling of the target pseudoword was included as a distractor in the orthographic choice task in order to reduce the possible role of phonological decoding in choosing a response. Finally, using a sample of emerging English-
French bilingual children, we examine both the within and cross-language relations of orthographic and semantic learning to word reading with a six-months longitudinal design. Specifically, we have three research questions: (1) Do emergent readers simultaneously acquire lexical orthographic and semantic knowledge of novel words encountered in a shared storybook context? (2) Does English orthographic learning at the beginning of Grade 1 predict English and French word reading both concurrently and six-months longitudinally at the end of Grade 1? (3) Does English semantic learning at the beginning of Grade 1 predict English and French word reading both concurrently and six-months longitudinally at the end of Grade 1?

These research questions are addressed within the context of a Canadian French immersion program. French immersion education provides non-francophone children the opportunity to receive their education with French as the primary medium of instruction (Genesee & Jared, 2008). In total early French immersion, academic instruction is initially entirely in French, and commences in Senior Kindergarten or in Grade 1. English is gradually introduced in Grades 3 or 4 (Lazaruk, 2007). Because children enter early French immersion with a lack of proficiency in the language of instruction, the focus of instruction is initially on developing oral language skills in French (Wise, D’Angelo, & Chen, 2016). Accordingly, the experimental orthographic and semantic word learning task was administered in the fall of Grade 1 in order to examine orthographic and semantic learning prior to the start of formal literacy instruction. This task was only administered in English due to children’s limited proficiency in French upon entry into the first grade. Given that the majority of the children in the sample spoke English as a first language, some prior informal experiences with English print was expected. Based on the literature presented above, we predicted that emerging readers would demonstrate orthographic and semantic learning of novel words presented in a storybook reading context, and
that both skills would in turn predict word reading ability within English and across languages from English to French both concurrently and six-months longitudinally.

2 Method

2.1 Participants

Sixty-two typically developing first grade children (35 girls) enrolled in early French immersion at three schools located in Toronto, Canada participated in this study. The sample initially consisted of 67 children, however five children were excluded from the final sample because of a visual impairment (n = 1), an autism spectrum disorder (ASD) diagnoses (n = 1), or missed testing from being absent (n = 1) or moving to different schools (n = 2). In the fall of Grade 1, the final sample of 62 children ranged in age from 70 to 82 months (M = 75.89, SD = 3.24). The majority of these children spoke English as a first language (81.7%). Children were considered to speak English as a first language if parents reported that English was spoken in the home environment more than 50% of the time. Of the sixty-one mothers whose maternal education was reported, 88.5% completed at least a college (26.2%) or university degree (bachelor degree, 34.4%; Master degree, 23.0%; PhD, 4.9%), and 11.5% reported having a high school degree as their highest level of education. Most parents reported having more than 100 English children’s books at home (49.2%), followed by 50-100 (27.9%), 25-50 (8.2%), 10-25 (8.2%), and fewer than 10 (6.6%). Seventy-one percent of the children were read to every day, with the remaining children being read to at least once a week (22.6%) or almost never (6.5%).

2.2 Measures

Demographic Questionnaire. Parents completed a questionnaire on demographic information and the home language environment. The questionnaire included questions pertaining to parental education level, languages spoken at home, and home literacy activities.
Parents were also asked to indicate whether their child had diagnosed or suspected difficulties in the areas of speech, language, hearing, ASD, learning, and/or behavior.

**Nonverbal reasoning.** The Matrix Analogies Test-Expanded Form (MAT-EF; Naglieri, 1985) was used as a measure of nonverbal reasoning. This measure is comprised of four subtests: (1) Pattern Completion, (2) Reasoning by Analogy, (3) Serial Reasoning, and (4) Spatial Visualization. Each subtest consists of 16 items that gradually increase in difficulty, and that require children to complete a figural matrix by choosing the missing piece from five to six possible choices. Each subtest was administered to all children, with a discontinue criteria of four consecutive incorrect responses for each subtest. A total raw score was derived by summing the number of correct responses obtained on each of the four subtests. Cronbach’s alpha reliability rating was .94.

**Vocabulary.** The Peabody Picture Vocabulary Test-IV (PPVT-IV; Dunn & Dunn, 2007) was used to assess breadth of English receptive vocabulary. This test contains 228 test items of increasing difficulty that require children to select one of four pictures that depicts a stimulus word presented orally by the examiner. The test items are divided into 19 sets, each of which consist of 12 items. The discontinue criteria for this measure consisted of eight incorrect responses within a set. Cronbach’s alpha reliability rating was .96.

**Phonological Awareness.** The Elision subtest of the Comprehensive Test of Phonological Processing-Second Edition (CTOPP-2; Wagner, Torgesen, Rashotte, & Pearson, 2013) was used to assess phonological awareness in English. This subtest contains 34 test items (with feedback provided on the first 14 items). For each item, children were asked to delete individual syllables or phonemes from words and to name the word that remains after the deletion (e.g., *Say “bold”. Now say, “bold” without saying /b*/). The discontinue criteria for this
measure consisted of three consecutive incorrect responses. Cronbach’s alpha reliability rating was .91.

**Word Reading.** The Letter-Word Identification subtest of the Woodcock-Johnson III Test of Achievement (WJ-III; Woodcock, McGrew, & Mather, 2001) was used to assess English word reading. This subtest consists of a total of 70 test items. The first 16 test items required children to identify letter names or to point to letters according to the letter name presented orally by the examiner. The remaining 54 test items required children to read aloud words that gradually increased in difficulty. The discontinue criteria for this measure consisted of six incorrect responses within a set. Cronbach’s alpha reliability rating was .96 for both English word reading Time 1 and Time 2.

The *Lecture de Mots* (word reading) subtest of the Wechsler Individual Achievement Test-Second Edition (WIAT-II; Wechsler, 2005) was used to assess French word reading. This measure has been standardized on Canadian children who are native speakers of French. The first 26 test items administered required the children to identify letter names. There was no discontinue criteria for the letter items. The remaining 84 items required children to read aloud words that gradually increased in difficulty. Testing was discontinued after having produced seven incorrect responses on the word items. Cronbach’s alpha reliability rating was .96 for French word reading Time 1 and .97 for French word reading Time 2.

**Orthographic and Semantic Learning Experiment**

To measure children's orthographic and semantic learning of novel words, children were read aloud 12 short stories in English that were embedded with pseudowords. The materials used in the present study were those used in a previous investigation of orthographic and semantic learning conducted by Mimeau et al. (under review). Children were told that they were going to learn about “Professor Parsnip” and his latest inventions. In line with previous research that has
shown that pointing to text increases children’s attention to print (e.g., Evans, Williamson, & Pursoo, 2008), the examiner pointed to each word in the text as it was read out loud. The target pseudowords were also verbally stressed by the examiner. After reading each set of three stories, children completed two multiple-choice tasks. The orthographic choice was administered first, followed by the picture choice task. The children were reassessed 5-7 days later ($M=5.90$, $SD=.95$) on the same orthographic and semantic choice tasks to determine the extent to which orthographic and semantic learning occurred.

**Stimuli.** Twelve pairs of homophonic pseudowords were selected to create two versions of the storybooks (see Table 1 for a list of the pseudowords; Mimeau et al., under review). The children were randomly assigned to one of the two storybook versions to control for any preferences for a given spelling of a pseudoword (e.g., *veap* vs. *veep*; *noak* vs. *noke*). The alternate homophone spelling of a pseudoword was also used as distractor in the orthographic choice post-test in order to ensure that this measure is not confounded by phonological processing skills. All the pseudowords were comparable in structure. They were monosyllabic, consisted of four-letters, and both started and ended with a consonant sound. Moreover, in accordance with the sound-letter correspondence rules outlined by Rastle and Coltheart (1999), all the pseudowords consisted of regular spelling patterns. The Children’s Printed Word Database (http://www.essex.ac.uk/psychology/cpwd) was used to ensure that the pseudowords were novel to the children.
Table 1

Pseudowords Used in the Orthographic and Semantic Learning Task

<table>
<thead>
<tr>
<th>Target sound</th>
<th>Version A</th>
<th>Version B</th>
</tr>
</thead>
<tbody>
<tr>
<td>/i/</td>
<td>veap</td>
<td>seef</td>
</tr>
<tr>
<td>/ɜ/</td>
<td>merl</td>
<td>lurg</td>
</tr>
<tr>
<td>/eɪ/</td>
<td>zabe</td>
<td>yaif</td>
</tr>
<tr>
<td>/yu/</td>
<td>tude</td>
<td>hewl</td>
</tr>
<tr>
<td>/oʊ/</td>
<td>bope</td>
<td>noak</td>
</tr>
<tr>
<td>/k/</td>
<td>kleb</td>
<td>crig</td>
</tr>
</tbody>
</table>

**Story Context.** Each story was comprised of five sentences, and contained one target pseudoword repeated four times (e.g., “Ben’s fish tank is dirty. Ben picks up the veap. The veap is used to clean fish tanks. Ben puts the veap in the fish tank. The veap cleans Ben’s fish tank.”; Mimeau et al., under review). The first sentence of each story introduced the problem of the main character in the story. Each subsequent sentence contained one mention of the target pseudoword. The contents of the sentences included information about the function of the invention. All sentences were in 36-point regular black Times New Roman font, and consisted of high frequency Dolch sight words (Dolch, 1936).

**Orthographic Learning.** For the orthographic choice task (for an example, see Appendix A; Mimeau et al., under review), children were presented with four spelling choices, and were then asked to identify the spelling of the invention that they read about. The four spelling options consisted of the correct spelling of the pseudoword (e.g., *veap*), and three distractors, one of which was the alternative spelling of the target pseudoword (e.g., *veep*). The other two distractors were similar in spelling with the target pseudoword and its homophone.
distractor, but began with a different letter (e.g., *feap* and *feep*). Due to the low reliabilities of the immediate and delayed orthographic choice measures, the scores for these two measures were combined to create one measure of orthographic learning. Correlation and regression analyses were conducted with the scores from this combined orthographic learning measure. Cronbach’s alpha reliability rating was .78.

**Semantic Learning.** For the semantic choice task (for an example, see Appendix B; Mimeau et al., under review), the children were presented with four pictures and were asked to identify the picture of the invention that they read about. The four picture options consisted of the correct depiction of the invention (e.g., fish tank cleaner), along with three distractors. One of the distractors consisted of an invention that resembled the target pseudoword (e.g., fish tank painter). The other two distractors depicted a new object that was not related to the meaning of the target pseudoword (e.g., sock matcher and sock fixer). Due to the low reliabilities of the immediate and delayed semantic choice measures, the scores for these two measures were combined to create one measure of semantic learning. Correlation and regression analyses were conducted with the scores from this combined semantic learning measure. Cronbach’s alpha reliability rating was .78.

**2.3 Procedure**

Children were tested individually in a quiet room located in their school. The measures were administered by trained undergraduate or graduate researchers who were fluent in English and French. Testing took place at two time points, once during the fall semester of Grade 1 (October-November 2016), and once during the spring semester of Grade 1 (April-May 2017). The following variables were measured at Time 1: receptive vocabulary, phonological awareness, English word reading, French word reading, orthographic learning, and semantic
learning. The following variables were measured at Time 2: nonverbal reasoning, English word reading, and French word reading.

3 Results

Prior to analysis, the data were screened for data entry errors, missing values, and normality. The following variables were significantly positively skewed: English word reading Time 1, French word reading Time 1, English word reading Time 2, and French word reading Time 2. English word reading Time 2 was corrected using square root transformation and the remaining variables were corrected using logarithmic transformations prior to correlation and regression analyses. There were no univariate outliers identified ($z < \pm 3.29$; Tabachnick & Fidell, 2007), and inspection of Mahalanobis distances with $p < .001$ (Tabachnick & Fidell, 2007) indicated that there were no multivariate outliers. The assumptions of normality, linearity, homoscedasticity, and independent errors were met for all regression models analyzed. All correlation and regression analyses were conducted with the combined orthographic and semantic learning measures.

Table 2 presents descriptive statistics and internal consistency (Cronbach’s alpha) for the cognitive, linguistic, and reading measures used in the present study. The standard and raw scores are reported for all standardized measures except for the French word reading measure. The mean nonverbal reasoning and receptive vocabulary skills of participants fell within the high average range. The mean phonological awareness and English word reading skills of participants fell within the average range. The raw scores in which one point was awarded for each correct answer were used in all analyses.
Table 2

Descriptive Statistics of All the Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Max possible score</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonverbal Reasoning</td>
<td>64</td>
<td>3</td>
<td>54</td>
<td>26.94</td>
<td>12.37</td>
<td>.94</td>
</tr>
<tr>
<td>Standard Score</td>
<td>84</td>
<td>151</td>
<td>115.15</td>
<td>12.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receptive Vocabulary</td>
<td>228</td>
<td>84</td>
<td>172</td>
<td>121.31</td>
<td>20.94</td>
<td>.96</td>
</tr>
<tr>
<td>Standard Score</td>
<td>85</td>
<td>150</td>
<td>113.31</td>
<td>16.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phonological Awareness</td>
<td>34</td>
<td>1</td>
<td>30</td>
<td>14.92</td>
<td>5.53</td>
<td>.91</td>
</tr>
<tr>
<td>Standard Score</td>
<td>67</td>
<td>130</td>
<td>100.52</td>
<td>10.44</td>
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<td></td>
</tr>
<tr>
<td>English WR Time 1</td>
<td>70</td>
<td>11</td>
<td>67</td>
<td>26.21</td>
<td>11.94</td>
<td>.96</td>
</tr>
<tr>
<td>Standard Score</td>
<td>77</td>
<td>154</td>
<td>108.74</td>
<td>17.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English WR Time 2</td>
<td>70</td>
<td>14</td>
<td>62</td>
<td>31.84</td>
<td>12.13</td>
<td>.96</td>
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<tr>
<td>Standard Score</td>
<td>77</td>
<td>144</td>
<td>109.56</td>
<td>17.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>French WR Time 1</td>
<td>110</td>
<td>8</td>
<td>73</td>
<td>29.34</td>
<td>14.48</td>
<td>.96</td>
</tr>
<tr>
<td>French WR Time 2</td>
<td>110</td>
<td>14</td>
<td>96</td>
<td>37.16</td>
<td>18.41</td>
<td>.97</td>
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<td>OL</td>
<td>24</td>
<td>2</td>
<td>21</td>
<td>9.60</td>
<td>4.75</td>
<td>.78</td>
</tr>
<tr>
<td>SL</td>
<td>24</td>
<td>5</td>
<td>24</td>
<td>17.26</td>
<td>4.13</td>
<td>.78</td>
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<tr>
<td>OL (Immediate)</td>
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<td>0</td>
<td>12</td>
<td>5.48</td>
<td>2.72</td>
<td>.65</td>
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<tr>
<td>OL (Delayed)</td>
<td>12</td>
<td>0</td>
<td>11</td>
<td>4.11</td>
<td>2.50</td>
<td>.62</td>
</tr>
<tr>
<td>SL (Immediate)</td>
<td>12</td>
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<td>12</td>
<td>8.61</td>
<td>2.15</td>
<td>.57</td>
</tr>
<tr>
<td>SL (Delayed)</td>
<td>12</td>
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<td>12</td>
<td>8.65</td>
<td>2.28</td>
<td>.63</td>
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</tbody>
</table>

Note. WR = Word Reading; OL = Orthographic Learning; SL = Semantic Learning.

3.1 Orthographic and Semantic Learning

To determine whether the children acquired orthographic and semantic representations of the target pseudowords, we contrasted scores of the immediate and delayed orthographic choice and semantic choice post-tests against chance (i.e., identified more than 3 targets) with one-sample t-tests. Performance was significantly above chance level both on the immediate, \( t(64) = 7.342, p < .001 \), and delayed orthographic choice tasks, \( t(64) = 3.542, p = .001 \). On the semantic choice task, performance was also significantly above chance level both immediately, \( t(64) = 20.559, p < .001 \), and 5-7 days after the storybook readings, \( t(64) = 20.018, p = .001 \). These
results suggest that the children simultaneously learned the orthographic and semantic representations of novel words.

3.2 Predicting Word Reading

Correlational Analyses

Correlational analyses were conducted to examine the relations between nonverbal reasoning, receptive vocabulary, phonological awareness, orthographic learning, semantic learning, and Time 1 and Time 2 English and French word reading. Bivariate correlations among all the variables are presented in Table 3. All variables were significantly positively correlated with one another. Notably, based on Cohen’s (1988) criteria, both orthographic and semantic learning were strongly correlated with French and English word reading across both time points. Phonological awareness was strongly correlated with orthographic and semantic learning, and with English and French word reading at both time points. Nonverbal reasoning and receptive vocabulary were moderately to strongly correlated with the other variables.

Table 3

Correlation Matrix of Variables

<table>
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<tr>
<th></th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<th>9</th>
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<td>1. Nonverbal reasoning</td>
<td>.35**</td>
<td>.52**</td>
<td>.43**</td>
<td>.43**</td>
<td>.50**</td>
<td>.55**</td>
<td>.54**</td>
<td>.65**</td>
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<tr>
<td>2. Receptive Vocabulary</td>
<td></td>
<td>.53**</td>
<td>.47**</td>
<td>.64**</td>
<td>.44**</td>
<td>.46**</td>
<td>.39**</td>
<td>.41**</td>
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<tr>
<td>3. Phonological Awareness</td>
<td></td>
<td></td>
<td>.53**</td>
<td>.52**</td>
<td>.65**</td>
<td>.64**</td>
<td>.70**</td>
<td>.41**</td>
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<td>4. Orthographic Learning</td>
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<td></td>
<td></td>
<td>.57**</td>
<td>.73**</td>
<td>.65**</td>
<td>.73**</td>
<td>.61**</td>
</tr>
<tr>
<td>5. Semantic Learning</td>
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<td></td>
<td></td>
<td></td>
<td>.53**</td>
<td>.53**</td>
<td>.52**</td>
<td>.52**</td>
</tr>
<tr>
<td>6. English WR Time 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.84**</td>
<td>.91**</td>
<td>.80**</td>
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<tr>
<td>7. French WR Time 1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.80**</td>
<td>.82**</td>
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<tr>
<td>8. English WR Time 2</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>.84**</td>
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<tr>
<td>9. French WR Time 2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. WR=Word Reading.

**p < .01
Regression analyses

To examine whether children’s orthographic and semantic learning skills predict unique variance in word reading within English and across languages from English to French, a series of hierarchical linear regressions were conducted. These are presented in Table 4. The change in $R^2$ and the standardized beta coefficients from the final step of the regression models are reported. In separate regressions, English or French word reading at Time 1 or Time 2 was entered as the outcome variable. Because the goal was to determine the unique contribution of orthographic or semantic learning, variables were entered in an a priori sequence. In each regression, nonverbal reasoning was entered at Step 1, receptive vocabulary was entered at Step 2, and phonological awareness was entered at Step 3. In the final step, orthographic or semantic learning was entered.

To address whether orthographic learning predicts English and French word reading both concurrently and six months longitudinally, four hierarchical linear regressions were computed. Orthographic learning was found to predict unique variance in English and French word reading both concurrently and longitudinally, after controlling for the variance accounted for by nonverbal reasoning, receptive vocabulary, and phonological awareness. More specifically, orthographic learning accounted for 17.3% and 16.5% of the variance in English word reading at Time 1 and Time 2, respectively. With regard to French word reading, orthographic learning accounted for 8.9% and 4.7% of the variance at Time 1 and Time 2, respectively. We then conducted four additional hierarchical regressions in order to investigate whether semantic learning predicts English and French word reading both concurrently and six months longitudinally. Semantic learning was not a significant predictor of English or French word reading at either time point.
Table 4

Hierarchal Regression Analyses of the Concurrent and Longitudinal Independent Contributions of Orthographic and Semantic Learning to English and French Word Reading

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>Time of English Word Reading Assessment</th>
<th>Time of French Word Reading Assessment</th>
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<tr>
<td></td>
<td></td>
<td>Time 1</td>
<td>Time 2</td>
</tr>
<tr>
<td></td>
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<td>$\Delta R^2$</td>
<td>$\beta$</td>
</tr>
<tr>
<td>Orthographic Learning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>NR</td>
<td>.251</td>
<td>.118</td>
</tr>
<tr>
<td>2</td>
<td>VOC</td>
<td>.079</td>
<td>-.014</td>
</tr>
<tr>
<td>3</td>
<td>PA</td>
<td>.138</td>
<td>.322**</td>
</tr>
<tr>
<td>4</td>
<td>OL</td>
<td>.173</td>
<td>.518***</td>
</tr>
<tr>
<td>Semantic Learning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>NR</td>
<td>.251</td>
<td>.176</td>
</tr>
<tr>
<td>2</td>
<td>VOC</td>
<td>.079</td>
<td>.008</td>
</tr>
<tr>
<td>3</td>
<td>PA</td>
<td>.138</td>
<td>.445***</td>
</tr>
<tr>
<td>4</td>
<td>SL</td>
<td>.023</td>
<td>.212</td>
</tr>
</tbody>
</table>

Note. NR = nonverbal reasoning; VOC = receptive vocabulary; PA = phonological awareness; OL = orthographic learning; SL = semantic learning.

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

4 Discussion

The present study examined orthographic and semantic learning during shared storybook reading in emergent readers in French immersion. We sought to determine whether (1) emergent readers simultaneously demonstrate orthographic and semantic learning of novel words encountered in a shared storybook reading context, (2) English orthographic learning at the beginning of Grade 1 predicts English and French word reading both concurrently and six-months longitudinally at the end of Grade 1, and (3) English semantic learning at the beginning of Grade 1 predicts English and French word reading both concurrently and six-months longitudinally at the end of Grade 1. The children in the present study demonstrated the ability to
learn the spelling and meaning of the novel words presented during shared storybook reading in English. Orthographic learning predicted English and French word reading concurrently in the fall of Grade 1 and six-months longitudinally in the spring of Grade 1, after controlling for nonverbal reasoning, receptive vocabulary, and phonological awareness. In contrast, semantic learning did not predict English or French word reading at either time point, after accounting for the same covariates. These findings and their implications are discussed in turn.

We found that orthographic learning of novel words occurred in emergent English-French bilingual children despite the fact that they had not received formal literacy instruction in English. Some informal exposure to English print was however expected given that the majority of the sample spoke English as a first language. Our finding adds to a growing body of research demonstrating that young children are able to learn the spelling patterns of novel words without having to directly decode the words (Apel, 2010; Apel et al., 2013; Apel et al., 2006; Wolter & Apel, 2010) and extends this research to bilingual children. The orthographic choice task used in our study incorporated the alternate homophone spelling of a target pseudoword in addition to other foils. This approach which was not utilized in previous studies on orthographic learning in emergent readers, allowed us to further diminish the role of phonological decoding in choosing a response. As such, our findings extend prior research on orthographic learning in emergent readers (Apel, 2010; Apel et al., 2013; Apel et al., 2006; Wolter & Apel, 2010) and provides further evidence that orthographic learning is not entirely dependent on phonological decoding.

Moreover, our study showed that young children were able to rapidly acquire semantic representations at the same time as they acquired orthographic representations of novel words. This is a remarkable finding because the children were relatively young and they were only exposed to the target words briefly during shared book reading. These results are consistent with prior research that has found that young children demonstrate semantic learning during shared
storybook reading (e.g., Evans & Saint-Aubin, 2013; Justice, 2002; McLeod & McDade, 2011; Sénéchal, 1997). However, our study indicates that young children have robust word learning abilities that allow them to attend to and acquire semantic as well as orthographic representations of novel words at the same time. These findings underscore the importance of shared storybook reading as an early activity for developing language and literacy skills. To the best of our knowledge, our study is the first to investigate orthographic and semantic learning simultaneously in young emergent readers as previous studies only examined these processes in older school-aged children during independent reading.

With regard to the within-language relation between orthographic learning and word reading, we found that English orthographic learning predicted a unique amount of variance in English word reading after controlling for nonverbal reasoning, vocabulary, and phonological awareness. This is in line with studies that have investigated orthographic learning during independent reading in older monolingual children (e.g., Cunningham, 2006; Cunningham et al., 2002; Mimeau et al., under review). However, in our study the children were younger and were read to using a shared storybook reading setting. As such, we extended research by Apel and colleagues (Apel, 2010; Wolter & Apel, 2010) who reported a concurrent correlation between orthographic learning and word reading in monolingual English-speaking emergent readers. Importantly, our results add to the accumulating evidence supporting the unique and separate roles of orthographic and phonological processing skills in the development of word reading ability (e.g., Cunningham, Perry, & Stanovich, 2001; Cunningham et al., 2002; Deacon, 2012).

By using a sample of emergent English-French bilingual children in French immersion, we were also able to address the theoretical issue of whether orthographic learning ability developed in one language, namely English, is specific to that language or whether this ability can transfer across languages with similar alphabetical writing systems. We found that English
orthographic learning predicted a unique amount of variance in French word reading both concurrently and six-months longitudinally after controlling for nonverbal reasoning, vocabulary, and phonological awareness. To date, research on cross-language transfer of orthographic processing skills has focused on orthographic knowledge. Our results suggest that orthographic learning also transfers from English to French. However, because English and French have many language-specific spelling patterns (e.g., *ea* in English; *eur* in French), the extent to which this transfer of orthographic learning skill depends on the orthographic commonalities between English and French should be investigated in future studies (Commissaire, Duncan, & Casalis, 2011).

Contrary to what we hypothesized, semantic learning did not predict a significant amount of unique variance in English or French word reading at any time point. These findings suggest that word reading in young children is primarily driven by phonological and orthographic processing skills. Semantic learning, on the other hand, may be more important for reading comprehension as children’s ability to read independently increases. This line of reasoning is in accordance with the study conducted by MIMEAU ET AL. (UNDER REVIEW) which found that the semantic learning ability of English-speaking children in Grade 3 concurrently predicted reading comprehension but not word reading. Based on their results, these researchers postulated that the ability to learn the meaning of novel words is specifically uniquely related to the ability to extract meaning from text rather than word reading.

Although the present study makes an important contribution to the literature on literacy development, there are limitations that must be acknowledged. Similar to other studies that have investigated orthographic learning in emergent readers (Apel, 2010; Apel et al., 2013; Apel et al., 2006; Wolter & Apel, 2010), all the target pseudowords used in this study represented names of objects, and were therefore nouns. Other word forms such as verbs have been shown to be more
difficult for children to learn compared to nouns (e.g., Rice & Woodsmall, 1988). As such, future research should investigate whether orthographic and semantic learning are influenced by the word forms. Furthermore, the current study used a single experimental measure to assess each word learning ability. Our tasks required children to identify the targets among distractors. Using production tasks such as asking children to explain the meaning of the pseudowords and to spell the pseudowords would have provided more information on the extent to which orthographic and semantic learning took place. It’s also important to note that the reliability for the immediate and delayed orthographic and semantic choice measures were low. We were, however, able to reach acceptable reliability for our orthographic and semantic learning measures after combining the immediate and delayed scores for each respective construct.

Our study also has important educational implications. The parents of children in French immersion, who are also non-francophones, may be encouraged to engage in shared storybook reading in English as a means to improve their children’s French literacy skills. Notably, previous research has shown that during shared storybook reading, parents do not typically engage in print-related interactions; parents tend to engage in more meaning-related interactions to help their child understand the meaning of the story (Han & Neuharth-Pritchett, 2015; Hindman, Connor, Jewkes, & Morrison, 2008; Roy-Charland, Saint-Aubin, & Evans, 2007). Although young children typically do not pay attention to print, preferring to look at illustrations instead (Justice, Pullen, & Pence, 2008), engaging in verbal and/or nonverbal print referencing strategies, that is, discussing, pointing to or tracking words in the text, significantly increases children’s attention to print (Evans et al., 2008; Justice et al., 2008). This increasing of attention to print has in turn been shown to contribute to reading achievement (Piasta, Justice, McGinty, & Kaderavek, 2012).
In conclusion, the present study aimed to investigate the ability of young children to learn both orthographic and semantic representations simultaneously, and clarify the relation between these learning abilities and word reading skills within- and across-languages. Our study supports the proposition that individual differences in orthographic learning are not entirely parasitic on phonological decoding, and that young children can engage in semantic learning at the same time as orthographic learning. With respect to early word-level reading development, orthographic learning makes a unique contribution that is separate from the contribution made by phonological awareness. The contribution of orthographic learning in English to word reading was observed within- and across-languages from English to French, both concurrently and six-months longitudinally. As such, the development of orthographic learning ability in English may be particularly beneficial to emergent English-French bilingual children in French immersion as this ability transfers to their French word reading skills. Our study affirms that shared storybook reading is a powerful tool for the development of language and literacy skills in young children.
References


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of orthographic processing. Reading and Writing: An Interdisciplinary Journal, 14, 549-568.


Evans, M. A., & Saint-Aubin, J. (2013). Vocabulary acquisition without adult explanations in


Mimeau, C., Ricketts, J., & Deacon, S. H. (under review). The role of orthographic and semantic learning in word reading and reading comprehension. *Journal of Educational Psychology.*


Appendix A

Example of an Item Presented in the Orthographic Choice Task

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<tbody>
<tr>
<td>feap</td>
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</tbody>
</table>
Appendix B

Example of an Item Presented in the Semantic Choice Task