THE CONTRIBUTIONS OF FIRST AND SECOND LANGUAGE SKILLS TO
READING COMPREHENSION IN ENGLISH LANGUAGE LEARNERS

by

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Abstract

This study examined the language and cognitive factors underlying the development of reading comprehension in 120 elementary school English language learners (ELLs) from typologically different language backgrounds (Chinese and Spanish).

The study first examined the validity of an extended Simple View of Reading (SVR) model for ELLs that includes cognitive skills (phonological awareness, rapid naming speed) and word reading fluency in addition to decoding and oral language skills. Hierarchical linear regression was used to investigate the contributions of Grade 1 English cognitive skills, and word reading fluency, in addition to the SVR components, to Grade 4 English reading comprehension. The validity of the extended SVR framework with ELL children in both language groups was supported.

The second part investigated the contribution of parallel early L1 and L2 skills to English reading comprehension. There was no cross-language transfer of skills in Chinese ELLs; however, Grade 1 cognitive skills assessed in Spanish made significant contributions to Grade 4 English reading comprehension. The results underscore the importance of complementary theoretical perspectives. The “central processing hypothesis” is clearly relevant for Spanish speakers, but for Chinese ELLs, no additional information is gained by adding the L1 measures.
These differences can be attributed to typological differences and differential contribution of L1 processing skills to L2 reading comprehension.

The third part examined individual growth trajectories as predictors of Grade 4 reading comprehension in English. Hierarchical linear modeling and hierarchical linear regression were used to investigate the developmental trajectories of early predictor variables and the contribution of individual differences to these trajectories. The rate of growth on the cognitive variables (phonological awareness and rapid naming speed), SVR variables (receptive vocabulary and word reading), and word reading fluency made significant contributions to reading comprehension skills in Grade 4. The final model, consisting of non-verbal ability, the initial status of cognitive skills, cluster of the SVR skills, and of word reading fluency and the rate of growth on the SVR skills, explained 59% of the variance in reading comprehension three years later.

These results show that the same English cognitive and linguistic skills play critical roles in ELL’s development of English reading comprehension, despite the typological differences between L1 backgrounds.
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Chapter One:

Introduction

A growing number of children enter the school system in Canada with little or no prior exposure to English (Statistics Canada, 2011). These English language learners (ELLs) need to develop grade-level literacy skills in English to demonstrate proficiency similar to their monolingual, English-as-a-first language (EL1) classmates. However, due to the complex and multidimensional nature of reading comprehension (Dufva & Voeten, 1999; Spiro & Myers, 1984), it is one of the areas of weakness in ELLs (August, Carlo, Dressler, & Snow, 2005). Until recently, most of the research on the development of children’s reading comprehension concentrated on monolingual English speakers (e.g., Adams, 1990; Snow, Burns, & Griffin, 1998); however, this has changed in the last 15 years. Understanding the development of ELLs’ reading comprehension skills and the variables contributing to this development is of the greatest importance theoretically, and in informing instruction and early identification of those who might be at risk because of underlying learning difficulties.

The research forming the basis of this dissertation was designed to examine various questions concerning “early” (Grade 1) first (L1) and second (L2) language cognitive and linguistic skills that contribute to subsequent reading comprehension in ELLs. Participants were two groups of elementary school ELLs coming from two different language backgrounds (alphabetic and non-alphabetic). The research was also designed to examine the influence of Grade 1 L1 and L2 predictors and the variations in the patterns of individual developmental change over time (from Grade 1 to Grade 4) in L2 predictors on children’s English reading comprehension achievement. These objectives were selected for several reasons: first, while informative, the great majority of studies conducted to examine the reading comprehension skills
of ELLs have been limited to either cross-sectional designs (e.g., Morfidi, Van DerLeij, De Jong, Scheltinga, & Bekebrede, 2007; Swanson, Rosston, Gerber, & Solari, 2008) or to the inclusion of L2 predictors only (e.g., Chiappe, Siegel, & Gottardo, 2002; Geva & Farnia, 2012). Only a handful of studies examined the predictors of reading comprehension in ELLs using a longitudinal design that included children’s skills in their first or home language (L1) and L2 (e.g., Gottardo & Muller, 2009; Gottardo, Javier, Farnia, Mak, & Geva, 2014). A shortcoming of this area of research, however, is that there are no studies examining differences in reading comprehension development and potential L1 and L2 early predictors in sub-groups of ELLs with typologically different home languages. This is an important area to explore because a better understanding of differences in the development of both L1 and L2 skills in relation to English reading comprehension can provide insight into distinguishing those children who have difficulties in reading comprehension due to limited L2 proficiency from those who may also have an underlying learning disability (Durgunoglu, 2002). Second, to date not much is known about growth predictors (i.e., change in skill over time) and the role that growth indices may have on subsequent reading comprehension skills. More research is needed to clarify the importance of monitoring growth on early predictors of reading comprehension in identifying ELLs who might be at risk for later reading comprehension difficulties.

In Chapter 2, I first review studies on cognitive and linguistic skills contributing to reading comprehension in EL1s, followed by a review of similar studies involving ELL populations relevant to this study. At the end of Chapter 2, I provide an overview of the theoretical frameworks underlying the present study, followed by research questions and hypotheses. Chapter 3 describes the research method, design, participants, measures used, and the data collection procedure. Chapter 4 discusses the results of the three parts of this
dissertation, which includes a general discussion of the findings, followed in Chapter 5 by a discussion of pedagogical implications, limitations, and suggestions for future studies.
Chapter Two: Literature Review

The purpose of this chapter is to review the relevant literature targeting the development of reading comprehension skills in monolingual as well as in ELL children. This review provides a context for addressing the adequacy of the Simple View of Reading (SVR) theoretical framework for understanding reading comprehension in ELLs, and the role of L1 and L2 skills in predicting reading comprehension in L2.

Reading Comprehension Development in EL1s

Reading is a complex process that entails the interaction and coordination of several skills, such as letter recognition, letter to sound translation, understanding the meaning of the words and language, and understanding and interpretation of the whole text (Adams, 1990).

A growing body of research with EL1 children indicates that various skills underlie the development of reading comprehension (e.g., Cain, Oakhill, & Bryant, 2004; Goff, Pratt, & Ong, 2005; Johnston & Kirby, 2006; Katzir et al., 2006; Kendeou, van den Broek, Whit, & Lynch, 2009; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004; Storch & Whitehurst, 2002). Although there is no general agreement regarding which skills make the most important contributions to reading comprehension, the SVR is a model that provides a useful conceptual framework to describe the skill clusters involved in text comprehension (Gough & Tunmer, 1986; Hoover & Gough, 1990). A model, such as SVR, provides an understanding of the basic components of reading comprehension as a complex process (Kendeou, Savage, & van den Broek, 2009). According to the SVR, reading comprehension is a product of word decoding (D) and language comprehension (LC), therefore RC= D x LC. Studies involving 8- to 16-year-old
have shown that 40 to 80% of the variance in reading comprehension can be explained by these
two skill clusters (e.g., Catts, Adlof, Hogan & Ellis Weismer, 2005; Johnston & Kirby, 2006;
Savage, 2006).

In their review, Nation and Norbury (2005) identified the crucial skills involved in the
reading process. In line with the SVR, they concluded that phonological processing skills such as
phonological awareness (PA) are crucial for the ability to decode words, while language skills
(e.g., semantics/vocabulary, syntax, morphology, and pragmatics) are important for text
comprehension. In the same vein, in their cross-sectional longitudinal study Kendeou, Van Den
Broek et al. (2009) examined decoding and oral language skills of two cohorts of 4- and 6-year-
old EL1 children and retested them two years later. The results demonstrated that kindergarten
decoding (PA and word recognition) and oral language skills (listening comprehension,
television comprehension, and receptive vocabulary) each made unique contributions to
children’s reading comprehension performance assessed with a written narrative test in the
second grade. However, while the impact of decoding gradually diminished as children became
more proficient, the contribution of oral language skills increased. These finding are consistent
with the wide consensus for a developmental shift in the importance of decoding and language
comprehension in reading comprehension development. The role of decoding skills is more
evident in beginning readers, but when accurate and fluent word reading skills are mastered,
reading comprehension skills become more closely linked to language comprehension (Carver,
1998; Perfetti 1987; Scarborough 1998; Stanovich 1991; Storch & Whitehurst, 2002; Tilstra,
McMaster, Van den Broek, Kendeou, & Rapp, 2009).

To illustrate, Carver (1998) in his study with EL1 children, using non-traditional and
unstandardized measures, showed that while the role of language comprehension in predicting
reading comprehension became increasingly significant from Grade 2 to Grade 6, the contribution of word decoding to reading comprehension remained the same in these grades. Tilstra et al. (2009) reported different results in their study with EL1 elementary, middle and secondary grades. They concluded that the contribution of listening comprehension increased from Grade 4 to Grade 7 and remained stable in Grade 9. They also showed that decoding, assessed with word attack skills, gradually made a smaller contribution to reading comprehension, assessed with the Gates-MacGinitie test, starting in Grade 4.

In line with the developmental perspective, Storch and Whitehurst (2002) argued that the nature of the relationship between different skills and reading comprehension changes over time, as children become more experienced and efficient in reading. They found that there is a significant relationship between word recognition and reading comprehension in the early stages of reading (kindergarten to Grade 2) as in that stage, reading comprehension is largely a function of word reading. Furthermore, in the early stages of reading development, the impact of oral language skills (e.g., receptive and expressive vocabulary, narrative recall, conceptual knowledge, and syntactic ability) on reading comprehension is mediated by print knowledge and PA. However, as children move to the upper grades, reading accuracy and comprehension appear to be separate skills. By Grades 3 and 4, early reading ability and both concurrent reading accuracy and concurrent oral language skills play direct and important roles in children’s reading comprehension. Consistent with the Storch and Whitehurst (2002) study, in their longitudinal comparative study Schatschneider et al. (2004) found that tasks of oral language proficiency (e.g., vocabulary knowledge, expressive and receptive syntax) in kindergarten were not strong predictors of first and second grade reading comprehension skills assessed with the Woodcock Passage Comprehension task (Woodcock & Johnson, 1989). However, PA, letter sound
knowledge, and rapid automatized naming (RAN) of letters were the strongest kindergarten predictors of reading comprehension at the end of first and second grades. Relatedly, Goff et al. (2005), in their study of primary school children, showed that word reading skills (word and non-word) were the strongest predictor of reading comprehension assessed with the Progressive Achievement Test in Reading Comprehension (PAT Reading – Revised, 2000), after taking into account the contribution of age and general intellectual ability. On the whole, more recent research tends to support the conclusion that decoding and oral language skills are predictive of reading comprehension in monolinguals, but that the relative contribution of these skills to reading comprehension changes over the primary grades.

**Reading Comprehension Development in ELLs**

Considerable advances in our understanding of skills contributing to L2 reading comprehension development have been made over the past two decades (e.g., Farnia & Geva, 2013; Geva & Farnia, 2012; Gottardo & Muller, 2009; Lesaux, Rupp, & Siegel, 2007; Nakamoto, Lindsey, & Manis, 2007; Pasquarella, Gottardo, & Grant, 2012; Swanson et al., 2008). Cognitive and linguistic skills, such as working memory, phonological processing, and language comprehension assessed with syntactic awareness have been reported to be significantly related to early stages of reading acquisition in ELLs (e.g., Geva & Siegel, 2000; Limbos & Geva, 2001; Manis, Lindsey, & Bailey, 2004; Swanson, Sáez, & Geber, 2006). Several studies have examined models of reading comprehension, including the SVR framework in L2 learners (e.g., Geva & Farnia, 2012; Gottardo & Muller, 2009; Hoover & Gough, 1990; Mancilla-Martinez & Lesaux, 2010; Proctor, Carlo, August, & Snow, 2005; Yaghoub Zadeh, Farnia, & Geva, 2012; Verhoeven, 2000). The SVR framework appears to account for ELLs’
reading comprehension across diverse alphabetic orthographies (for a review, see Florit & Cain, 2011).

To illustrate, building on Hoover and Gough's (1990) study, Proctor et al. (2005) and Gottardo and Muller (2009) examined the validity of the SVR model for young ELLs from Latino/a backgrounds, using the Woodcock Passage Comprehension task (Woodcock, 1991). The findings support the unique contributions of word reading skills (alphabetic knowledge, word-reading, and fluency) and language comprehension (vocabulary, listening comprehension, and syntactic knowledge) to reading comprehension. Similar findings were reported by Mancilla-Martinez and Lesaux (2010), in a longitudinal study that also focused on Spanish-speaking language minority children from the age of 4.5 years to 11 years.

Yaghoub Zadeh et al. (2012) examined predictors of reading comprehension longitudinally in a study involving ELLs from various home language backgrounds. They used a mediation modeling approach to expand the SVR framework, and showed that oral language proficiency (listening comprehension) assessed in Grade 1 makes direct contributions (independent of word reading) to reading comprehension (measured via story retell) and to reading fluency assessed two years later.

To summarize, previous studies provide support for the validity of the SVR framework with regard to second language learners. This was shown in studies using regression analysis (Geva & Farnia, 2012; Hoover & Gough, 1990), path model analysis (Proctor et al., 2005), structural equation modeling (Droop & Verhoeven, 2003; Nakamato, Lindsey, & Manis, 2008), mediation modeling (Yaghoub Zadeh et al., 2012), and latent growth curve analysis (Mancilla-Martinez & Lesaux, 2010).
In addition, research focusing on L2 immigrant groups in Canada, the US, and The Netherlands identified similar cognitive processes such as PA (Carlisle, Beeman, Davis, & Spharim, 1999; Manis, Seidenberg, & Doi, 1999; Proctor et al., 2005; Verhoeven, 2000), RAN (Geva & Farnia, 2012; Johnston & Kirby, 2006; Joshi & Aaron, 2000, Parrila, Kirby, & McQuarrie, 2004), and word and text reading fluency (Baker, Park, & Baker, 2012; Geva & Farnia, 2012) as predictors of English reading comprehension, in addition to word reading skills and measures of oral language proficiency.

An Extended View of the SVR Model

The Contribution of Cognitive Abilities to Reading Comprehension

As discussed above, the contribution of cognitive abilities such as PA and RAN to reading comprehension is not as clearly established as their contribution to word reading (Fuchs et al., 2012). Existing research suggests that early phonological processing skills such as PA and RAN are strong predictors of word recognition several years later in both EL1s (e.g., Adams, 1990; Bradley & Bryant, 1985; Kirby & Parrila, 1999; Lundberg, Olofsson, & Wall, 1980; MacDonald & Cornwall, 1995; Maclean, Bryant, & Bradley, 1987; Wagner, Torgesen, & Rashotte, 1994; Wagner et al., 1997) and ELLs (e.g., Gottardo, Yan, Siegel, & Wade-Woolley, 2001; Lindsey, Manis, & Bailey, 2003; Manis, Lindsey, & Bailey, 2004).

Longitudinal studies based on monolinguals have provided support for the inclusion of cognitive processing skills such as PA, RAN, and working memory in the SVR model (e.g., Johnston & Kirby, 2006; Kendeou, van den Broek, et al., 2009; Kirby, Parrila & Pfeiffer, 2003; Oakhill & Cain, 2012; Tilstra et al., 2009). Similarly, longitudinal studies with L2 learners have proposed the validity of an SVR model augmented with cognitive processes (e.g., Gottardo &
Mueller, 2009; Lesaux et al., 2007; Nakamoto et al., 2008; Verhoeven & van Leeuwe, 2012; Yaghoub Zadeh et al., 2012).

There is also wide consensus from L2 developmental research regarding the change in the nature of reading comprehension skills over time. This developmental change, consequently, would change the nature of the relationships between reading comprehension and its predictor skills (e.g., Farnia & Geva, 2013; Manis et al., 2004; Yaghoub Zadeh et al., 2012). For instance, Farnia and Geva (2013), in their longitudinal study with EL1s and ELLs, examined early (Grade 1) and late (Grade 6) predictors of growth in reading comprehension. Their findings provide additional support for the notion that early performance on PA and RAN can predict reading comprehension 4-5 years later, and that the contribution of Grade 4 PA and RAN to Grade 6 reading comprehension is mediated through word reading skills. On the whole, the contribution of PA and RAN to reading comprehension is not the same at different stages of development.

In another longitudinal study with ELLs (Grade 1-3) using a mediation modeling approach, Yaghoub Zadeh et al. (2012) demonstrated a more complex contribution of PA and RAN to subsequent reading outcomes (reading comprehension and reading fluency). They showed that the contribution of PA to reading comprehension and reading fluency was mediated through word reading. At the same time, RAN contributed to reading comprehension and reading fluency both directly and indirectly, through word reading.

Taken together, recent longitudinal research with ELL children suggests that cognitive processing skills such as PA and RAN play a distinct role in predicting word reading in the early stages of reading development, and that in turn, their contribution to subsequent reading comprehension skills is mediated through word reading skills.
The Contribution of Reading Fluency to Reading Comprehension

The National Reading Panel (2000) defines fluency as the “ability to read orally with speed, accuracy and proper expression” (p. 3-1). La Berge and Samuels (1974) define word reading fluency as the ability to convert letter-to-sound-to-words effortlessly and with ease. A fluent reader does not need to pay conscious attention to word decoding because this is an automatic process, which once in place enables readers to concentrate on the meaning and comprehension of the text.

Word reading fluency is an essential skill, bridging accurate word recognition and reading comprehension (NICHD, 2000). Automaticity theory (LaBerge & Samuels, 1974) and verbal efficiency theory (Perfetti, 1985) attribute the links between reading fluency and reading comprehension to a faster and automatic word recognition process, which eventually allows the valuable mental capacity required for decoding to be devoted to text comprehension.

While early versions of the SVR focussed on word reading accuracy, recently, researchers have highlighted the importance of word reading fluency in addition to word reading accuracy in the development of reading comprehension (e.g., Kirby & Savage, 2008). There are very few studies that attended to the relationship between reading fluency and reading comprehension in EL1s (Adlof, Catts, & Little, 2006; Silverman, Speece, & Harring, 2013) and in ELLs (e.g., Geva & Farnia, 2012; Yaghoub Zadeh et al., 2012). Most studies suggest that the SVR model is enhanced when reading fluency is taken into account, though the measurement and definition of reading fluency varies.

For example, Adlof et al. (2006), in their longitudinal study of second, fourth and eighth grade monolingual children with and without language impairment, used structural equation
modeling (SEM) and found that word and text reading fluency did not add unique variance to the SVR beyond decoding and language comprehension. In another study, Silverman et al. (2013) used the same statistical approach (SEM) to investigate the direct and indirect contributions of reading fluency to reading comprehension in a sample of typically developing Grade 4 white, Black, Asian, and biracial children for whom English was the primary language. These researchers defined reading fluency as a construct that includes the speed and accuracy of reading words, nonwords, and connected texts, as well as letter naming speed. Their model also included measures of decoding (word reading and PA) and linguistic comprehension (word-level semantics, sentence-level semantics and syntax, passage-level comprehension, and vocabulary) as independent variables, along with a robust latent construct of reading comprehension assessed with the Gates MacGinitie (MacGinitie, MacGinitie, Maria, & Dreyer, 2000) and Maze (Fuchs & Fuchs, 1992) tests as the outcome. Their findings showed that word and text reading fluency explain significant unique variance in reading comprehension beyond decoding and language comprehension. In fact, their SVR model that included the fluency construct explained 95.5% of the variance in reading comprehension. In this study, Silverman et al. also illustrated the mediating role of this complex reading fluency construct in the relationship between decoding and reading comprehension.

Also of relevance to the current study is a longitudinal study conducted by Geva and Farnia (2012). In line with Silverman et al., this study provides support for a more complex SVR model that includes word and text reading fluency and cognitive processing variables (e.g., PA, RAN, and working memory) in addition to the SVR variables. It involved EL1s and ELLs (from different home language backgrounds) and examined prediction from Grade 2 to Grade 5. The results also illustrated a change in the nature of the reading fluency construct - while word and
text reading fluency formed a single factor in Grade 2, they appeared to be two differentiated factors in Grade 5. This study underscores the importance of considering the construct of reading fluency from a developmental perspective, namely that with development, text reading fluency becomes more related to oral language skills such as syntactic skills and listening comprehension, whereas word reading fluency continues to rely on automatized word reading.

Another perspective is proposed by Yaghoub Zadeh et al. (2012) in regard to including reading fluency in the SVR model as an outcome variable instead of as a predictor. Yaghoub Zadeh et al. used an SEM approach and on the basis of their results, proposed an expanded SVR model that includes reading fluency (word and text) in addition to reading comprehension as an outcome for ELLs. The researchers concluded that at the elementary level, reading fluency and reading comprehension are two distinct constructs that may have common underlying processes, such as PA, RAN, word reading and language proficiency.

In sum, the available research has shown that reading fluency is an important contributor to reading comprehension in EL1s and ELLs. More recent research has added nuance by noting that the construct of reading fluency changes over time. While word reading fluency is tied to decoding skills in young readers, text reading fluency gradually becomes more related to language comprehension skills in higher grades (Fuchs, Fuchs, Hosp, & Jenkins, 2001; Geva & Farnia, 2012; Tilstra et al., 2009). An obvious next step is to examine the contribution of word reading fluency within the SVR model with ELLs coming from different L1s, especially those from alphabetic and non-alphabetic language backgrounds.
Theories of Language Transfer

The present study is linked to three theoretical frameworks that are pertinent to the cross-linguistic transfer of skills. The first framework is the “universal” or “central processing” hypothesis, articulated in the context of second language learning. According to this hypothesis, the same underlying processing cognitive skills (e.g., PA, RAN, and working memory) that are important for learning to read in monolingual children may also contribute to parallel L2 tasks as well (Geva & Ryan, 1993, Geva & Siegel, 2000). According to this framework, it is hypothesized that these underlying skills are not language specific and are expected to “transfer” or underlie correlations among similar L1 and L2 tasks (e.g., word reading, reading fluency; Genesee & Geva, 2006). The argument is that even though the two languages might be typologically different, they are supported by shared underlying cognitive and linguistic processes that contribute to reading processes such as word recognition, reading fluency, and reading comprehension. Therefore, once these underlying cognitive and linguistic processes are acquired in one language, they can be accessed across languages (for a review see Lesaux & Geva, 2006).

The second framework is Cummins’ (1976) threshold hypothesis. This framework suggests that a minimum threshold of language proficiency must be reached in both the L1 and L2 in order to be able to see the positive effects of bilingualism and to enable transfer of skills inter-lingually. The level of the learner’s development of literacy skills in both the L1 and L2 has an impact on the development of literacy skills in the L2 and the extent to which skills acquired in the L1 can be accessed in the L2 (Cummins, 1979, 1981).
The third framework is the typological differences framework, which suggests that transfer of skills may vary as a function of typological differences in features of the spoken or written form of languages (Frost, 1994; Katz & Frost, 1992). The influence of underlying cognitive skills is mediated by orthographic and spoken language differences between the L1 and L2 (Abu-Rabia, 1997; Dafontoura & Siegel, 1995; Gholamian & Geva, 1999). It appears that transfer from L1 can facilitate L2 learning when the two languages have similar features such as phonological forms. For example, L1 skills are expected to transfer from languages such as Spanish to English (e.g., Durgunoğlu, Nagy, & Hancin-Bhatt, 1993), but not from languages such as Chinese to English (e.g., Wang, Perfetti, & Liu, 2005).

**L1 Skills Predicting L2 Reading Comprehension**

The linguistic interdependence hypothesis, a general and early version of the language-universal theory, suggests that well-developed L1 language skills transfer to L2 language skills (Cummins, 1984), provided that a certain threshold has been passed in language proficiency skills. A complementary theory, the central processing hypothesis, proposes that basic specific cognitive and linguistic processes such as memory, RAN, and PA established in the child's L1 can be transferred to L2 and facilitate L2 acquisition (Durgunoglu, 2002; Geva, 2014; Geva & Siegel, 2000; Sparks, Patton, Ganschow, & Humbach, 2009).

Comprehension of written text involves the utilization of linguistic and metalinguistic knowledge (Durgunoglu & Hansin, 1992). L2 learners usually bring knowledge, strategies and processes from their L1 when learning a second language. Previous research has shown that individual differences in early L1 skills may play important roles in explaining individual differences in L2 skills a few years later (e.g., Sparks et al., 1998; Sparks et al., 2009).
Knowledge of the nature of cross-language transfer of skills will enable us to understand the notion of negative transfer (the conditions under which an L2 learner shows difficulty processing certain L2 elements because of interference from the L1) as well as positive transfer (the condition under which an L2 learner’s L1 facilitates processing L2; Geva, 2014). Research that can show the conditions for positive and negative transfer can be useful for tailoring instruction to aspects of the L1 that facilitate or interfere with L2 learning.

There is mixed evidence regarding the contributions of L1 decoding and oral language to L2 reading comprehension. Some studies have demonstrated non-significant relationships between tasks of decoding and oral language beyond the contributions of parallel L2 predictors (Gottardo & Muller, 2009; Manis et al., 2004; Nakamoto et al., 2008; Swanson et al., 2008). Other studies involving English-Spanish speaking children have shown significant contributions of L1 vocabulary to L2 reading comprehension after accounting for the same tasks in L2 (Carlisle et al., 1999; Lindsey et al., 2003; Proctor, August, Carlo, & Snow, 2006).

As an example, in their study involving 251 Spanish ELLs attending transitional bilingual program from kindergarten to Grade 2, Manis et al. (2004) found non-significant contributions of Spanish kindergarten print knowledge, PA, and expressive vocabulary to Grade 2 English reading comprehension (Passage Comprehension; Woodcock & Johnson, 1989) when parallel English variables were entered into the regression model. The researchers concluded that the contribution of L1 skills is small or non-significant when the within-language variables are in the model, and that the contribution of L1 skills seems to be mediated through parallel L2 skills. These results suggest that not much is gained from considering L1 skills such as PA and vocabulary, when the parallel L2 skills have already been included in the reading comprehension prediction model.
Similarly, Nakamoto et al. (2008), in their study with Spanish ELLs who participated in a transition bilingual curriculum, found a non-significant contribution of Spanish decoding and Spanish oral language to English reading comprehension (Passage Comprehension; Woodcock, McGrew, & Mather, 2001) beyond the effect of parallel skills assessed in English, the L2.

At the same time, Lindsey et al. (2003) examined the contribution of kindergarten and first grade L1 and L2 phonological processing skills and listening comprehension to first and second grade L2 reading comprehension in a sample of Spanish-speaking children who had early systematic educational instruction both in Spanish and English. The study showed that both L1 and L2 skills were unique predictors of L2 reading comprehension, measured with the Passage Comprehension test (Woodcock & Johnson, 1989).

Finally, it is important to mention a longitudinal study that involved Norwegian (the L2) and Urdu (the L1). Lervåg and Aukrust (2010) showed that L1 (Urdu) vocabulary made a small, yet marginally significant, contribution to initial L2 reading comprehension, measured by a Norwegian translation of the Neale Analysis of Reading Ability II (Neale, 1997). At the same time, L2 (Norwegian) decoding and vocabulary were significant predictors of initial levels of two L2 reading comprehension tests, the Neale Analysis of Reading Ability II (Neale, 1997) and the Woodcock Reading Mastery Test-R (Passage Comprehension; Woodcock, 1989). They also found that the predictive role of decoding and vocabulary is dependent on the reading comprehension measure. Specifically, short passage cloze tasks such as the Woodcock Passage Comprehension measure were more dependent on decoding skills than longer texts and open-ended comprehension measures such as the Neale Analysis of Reading Ability.
In sum, the notion of cross-language transfer of predictors and the extent to which L1 processes predict L2 reading comprehension has revealed inconsistent findings. Some studies show a significant direct relationship between L1 skills and English (L2) reading comprehension performance, while others show either non-significant or weak relationships between children’s L1 skills and their performance on reading comprehension in L2, once parallel measures in the L2 are taken into account. These seemingly discrepant results may be understood in terms of a number of complementary theoretical and measurement-related considerations.

First, the majority of these studies employed a correlational design, which does not provide much information regarding the causal nature of the relationships between the variables. For instance, although a significant positive correlation between L1 skill and L2 reading comprehension may be taken as evidence of transfer of skills, this is not sufficient because other possible factors such as cognitive abilities should also be taken into account and may be responsible for the apparent correlations (Genesee, Geva, Dressler, & Kamil, 2006). In fact, Genesee et al. (2006) suggest that transfer does not seem to occur across all skills. It is more likely to be noticed with regard to the cognitive and basic underlying skills such as PA and RAN, which are modularized.

The second explanation has to do with the notion that the same underlying skills are assessed, whether tested in the L1 or the L2. That is, if parallel L1 and L2 are highly correlated, it means that they share variance. Therefore, adding both L1 and L2 to the prediction model of L2 reading comprehension may be redundant, as individual differences on cognitive underlying processes that help to explain individual differences on reading comprehension are captured, whether assessed in the L1 or the L2, and there is no added value in assessing them in both languages.
Another, more theoretical, explanation has to do with the notion of threshold. Not all children under study attain the same level of proficiency in their L1. Moreover, as most of these children receive academic instruction in L2 after entering school, they typically lose academic L1 proficiency (Jia & Aaronson, 2003; Westernoff, 1991). Although some ELLs continue to be proficient in their L1, and may even attend heritage classes where L1 skills are strengthened, their language and literacy skills in the L1 may not develop at the same rate as those of their peers who live exclusively in an L1 environment, because they do not receive systematic and sustained academic instructions in their L1 anymore (Gottardo & Muller, 2009). It is possible that in certain contexts, children’s L1 skills are not found to predict L2 reading comprehension because their L1 skills are too low, and are below a threshold that would allow them to access these skills in the L1.

With the exception of Lervåg and Aukrust (2010), the other studies reviewed above involved English and Spanish, which are typologically related. One of the objectives of the present research is to compare the notion of transfer of underlying cognitive processes with two groups of ELLs who come from typologically different language backgrounds. The question addressed is whether transfer of underlying processes would be observed to the same extent with L2 learners with different L1 backgrounds – Spanish and Chinese. The question is whether typological similarities and differences would affect the cross-language transfer of cognitive and linguistic skills between L1 and L2 in the case of children whose L1 is typologically close to English, namely Spanish, and in the case of children whose L1 is typologically distant from English – namely Chinese. The next section provides an overview of key characteristics of the three writing systems involved – English, Chinese, and Spanish.
An Overview of the Writing Systems of English, Chinese, and Spanish

Reading in English: An alphabetic language

English is an alphabetic language with an opaque orthography. English words consist of regular and irregular spelling patterns, with phonemes being the smallest meaningful units. Regular words have a simple grapheme-phoneme correspondence (GPC; e.g., king / king), whereas irregular words do not follow the GPC rules, in other words, in irregular words, letters do not completely represent speech sounds (e.g., knee / nee; Wagner et al., 1997). In English, syllables have internal structures and can be divided into two parts: onset and rime (DeCara & Goswami, 2003). Furthermore, English is characterized as a language with a complex syllabic structure and unclear boundaries. These unclear boundaries might create more sensitivity to onset-rime segments (Alvarez, Carreiras, & Perea, 2001). It has been argued that the sensitivity to rime in the English language could facilitate decoding because the relationship between oral and written forms in units greater than phonemes is more consistent (e.g., the sequence of letters ight is pronounced similarly in light, right, sight, etc.; Jimenez-Gonzales, 1997). Furthermore, the English writing system is not only related to the sound of a word, but also reflects the word’s shared meaning. For instance, while the spelling is consistent, the pronunciations of the first part of words such as heal (hee) and health (he) is not the same; however, they are related by the root meaning (Wagner et al., 1997). There are also three types of morphemes: inflections, derivations, and compounds. English words consist mainly of inflection and derivation morphemes (Kuo & Anderson, 2006).

Reading in Chinese: A morpho-syllabic script

Compared to alphabetic scripts, Chinese characters have greater visual complexity due to the existence of semantic and phonological cues. In Chinese, word form construction depends
systematically on syllable units (Cheng, 1973; Kuo, 1994). Chinese words are constructed from single syllable morphemes (small, homophonic units with multiple free or bound morphemes; Packard, 2000). Over 80% of words in Chinese are compound and consist of two components, one semantic and the other phonetic. The semantic component is associated with meaning, whereas the phonetic component is associated with pronunciation and provides hints as to how to pronounce the word (Huang & Hanley, 1995). For example, in the character 蜻(qing), dragonfly, 虫(chóng), insect, is the semantic component that provides a cue to the meaning of the character (dragonfly is a kind of insect) and 青(qing), green, is the phonetic component that provides a cue to the pronunciation of the character. Although phonetic information is available in Chinese, it is not encoded at the phonemic level, unlike regular English words (Gottardo et al., 2001). It appears that when reading Chinese, entire syllable units are retrieved and used for phonological encoding, unlike English where segments of words or morphemes are retrieved and assembled (O’Séaghdha, Chen, & Chen, 2010). There are about 400 syllables in Chinese; most of them are of CV, CVV or CVC structure disregarding tone, but when tone is considered as well, there are about 1200 tonal syllables (O’Séaghdha et al., 2010).

Reading in Spanish: A regular orthography

Spanish is an alphabetic language very similar to English. Spanish is a language with a shallow or transparent orthography and consistent mapping between graphemes and phonemes (Cuetos & Labos, 2001; Jiménez-González, 1997). The syllabic structure of Spanish has easy-to-determine and consistent syllable boundaries and it is much simpler than that in English (Bradley, Sanchez-Casas, & Garcia-Albea, 1993). Therefore, unlike in English, decoding words in Spanish involves simply sounding out graphemes (e.g., vista/vista/in Spanish vs. sight/ sIt/ in English), and requires a minimal level of phonological awareness as well as familiarity with a
few context-dependent grapheme-phoneme rules (Jiménez-Gonzále, 1997). Unlike English, with some exceptions (e.g., “c” which before “e” or “I” sounds /s/; with all other letters sounds /k/), the majority of Spanish consonants have only one pronunciation and the five Spanish vowels (a, e, i, o, u) have only one grapheme-phoneme correspondence (GPC). Spanish orthography also has diagraphs (e.g., ll, ch, rr). Although some of these diagraphs (e.g., ch) are pronounced similarly in Spanish and English, others (e.g., ll, rr) have a unique pronunciation. In terms of morphological structure, similar to English, Spanish words are formed by derivations, inflections, and compounding. Spanish and English have many similar suffixes that stem from Latin (e.g., -itude in English vs. -itud in Spanish, -ation in English vs. ación in Spanish, -able in both English and Spanish) and Greek (e.g., -ocrat in English vs. ocrata in Spanish, -ism in English vs. -ismo in Spanish); therefore, they have many similarities in derivational morphology (Ramirez, Chen., Geva, & Luo, 2011).

**The Role of Rate of Growth in Predicting Reading Comprehension**

Most studies examining longitudinally the role of early cognitive and linguistic skills in predicting reading comprehension at some later point among ELLs have focused on the initial status (intercept) of these predictors (e.g., Gottardo & Muller, 2009; Lindsey et al., 2003; Nakamoto et al., 2007; Proctor et al., 2005). However, developmental research has shown that the nature of the predictors changes over time (e.g., Geva & Farnia, 2012; Verhoeven & van Leeuwe, 2012). To date, only very few studies have examined the influence of intercepts and rate of growth on different skills in predicting reading comprehension among ELL populations. For instance, Mancilla-Martinez and Lesaux (2010) in their study with low achieving Spanish-speaking children used latent growth analysis to investigate whether the initial status and rate of growth on L1 and L2 word reading and vocabulary between the ages of 4.5 years to 11 years
significantly predict reading comprehension achievement. They found that both English vocabulary and word reading intercepts and the slopes of these variables were positive significant predictors of later reading comprehension, with the English word reading intercept at age 4.5 being the strongest predictor. Those children whose word reading and vocabulary grew faster also showed better comprehension skills than the children whose word reading and vocabulary grew more slowly.

In another study with Spanish-speaking ELLs in Grades 1-3, Baker, Park and Baker (2012) examined whether initial scores and year-long growth in L1 and L2 reading fluency significantly predicted L1 and L2 reading comprehension within each grade. In this study, reading fluency was measured using pseudowords in Grade 1, and real words in connected texts in Grades 2 and 3, with speed and accuracy in both. It should be noted that children received reading instruction in both Spanish and English as part of the daily school program. The results from regression and path analyses showed that the rate of growth on reading fluency predicted reading comprehension, even when initial status was controlled for; this significant contribution of the rate of growth on fluency to reading comprehension was only evident within a language, but not across L1 and L2. The results further indicated that while the initial status of English fluency significantly explained 30-36% of the variance in English reading comprehension at the end of each grade, rate of growth on English reading fluency significantly explained an additional 4-7% of the variance in English reading comprehension.

These findings are intriguing, but they are all based on a sample of ELLs from a single L1 background (Spanish). Given the affinity between English and Spanish, it is not clear whether similar findings would be seen when the spoken and written L1 of children is less similar to English. An interesting question that has not been addressed so far is the extent to which the rate
of growth on early predictors contributes similarly to the development of reading comprehension skills in different L1 groups, nor is it known whether the growth trajectories of these predictors would be similar in ELLs with typologically different backgrounds such as Chinese and Spanish.

**The Present Study**

Building upon previous research (e.g., Farnia & Geva, 2013; Geva & Farnia, 2012), the present study was designed to examine the validity of an extended SVR model in two groups of ELLs coming from typologically different language backgrounds (Chinese and Spanish). This study aimed to highlight the importance of cognitive processing skills (PA, RAN) and word reading fluency as added components to the SVR model in order to provide a more accurate and comprehensive picture of reading comprehension development among ELLs. Examining the validity of this extended model with distinct languages should build support for the potential applicability of this model in explaining reading comprehension development in both alphabetic and non-alphabetic languages.

A shortcoming of ELL research is that a very few studies (e.g., Gottardo & Mueller, 2009; Gottardo et al., 2014) have examined the cross language transfer of L1 skills to L2 reading comprehension under the umbrella of the SVR model. While informative, the majority of these studies are limited to ELLs whose other language is a transparent language (Spanish). To my knowledge, there are no published studies that examine the relationships among L1 and L2 variables in predicting L2 reading comprehension in two distinct orthographies (Spanish and Chinese). The question to be addressed in the present study is whether transfer of underlying processes would be observed to the same extent with L2 learners with different L1 backgrounds — Chinese and Spanish. The present study was designed to examine whether typological similarities and differences would impact the contributions of L1 skills to L2 reading
comprehension across groups of students with different language backgrounds. Examining both L1 and L2 predictors of reading comprehension has theoretical and practical implications. On a theoretical level, including both L1 and L2 variables in the SVR model provides a more comprehensive picture of the relationships among skills in ELLs. On a practical level, this design provides a better picture for policy makers and educators, specifically in regards to whether L1 assessment should be part of the assessment for ELL populations.

The studies reviewed in the previous sections suggest that children’s performance on lower level literacy skills such as PA, RAN, word reading accuracy and fluency, and vocabulary are a major source of variance, and that each of these areas could contribute to poor reading comprehension in ELLs. These studies also show that at various points in development, variability on skills such as word reading (both accuracy and speed) and language skills predict later performance on reading comprehension. More specifically, the nature of the relationship between these lower level component literacy skills and reading comprehension seems to be changing over time. Although assessments of lower level component literacy skills at one or two points in time might be informative to confirm the level of achievement at that specific point, they do not provide a useful tool to monitor the patterns of growth on these skills, nor allow us to understand the influence of rate of growth in these skills on reading comprehension development. What is not clear is whether growth rates in these critical skills are a source of variability that can also contribute to later reading achievement (Kim, Petscher, Schatschneider, & Foorman, 2010). To my knowledge, only two studies (Baker et al., 2012; Mancilla-Martinez & Lesaux, 2010) have examined the influence of both initial status and rate of growth on predictors of reading comprehension in young ELLs with Spanish as their L1. Given the growing number of ELL students with various language backgrounds in the school systems, it is crucial
that developmental research not to be limited to one specific subgroup of ELLs. Therefore, the present study was designed to build on and advance previous research on ELLs to investigate the extent to which the skills that predict reading comprehension in early elementary grades continue their contribution over time, and whether they are consistent across ELLs coming from distinct L1 backgrounds (Chinese and Spanish).

First Objective – An Extended SVR Model in Young ELLs

The first objective of the research reported here was to examine whether an extended model of SVR that includes not only decoding and oral language skills (the two building blocks of SVR) but also cognitive processing skills (PA and RAN) and word reading fluency would provide a more comprehensive model of reading comprehension of ELLs with Chinese or Spanish language backgrounds than the original SVR model. The following two research questions were addressed with regard to the first objective:

Research Question 1.
Do the key processes of the SVR model (oral language and decoding) account for unique variance in the reading comprehension of Chinese and Spanish ELLs?

Research Question 2.
Does an extended SVR model of reading comprehension that also includes cognitive processing variables (PA, RAN) and word reading fluency provide a more comprehensive model of reading comprehension in ELL children than the original SVR components alone?

Hypothesis.

Given previous studies and using aspects of the SVR as a theoretical framework for the study, no language group differences in L2 predictor variables for reading comprehension were
expected. It was also hypothesized that individual differences in reading comprehension in ELLs in Grade 4 would be better understood when individual differences on cognitive skills and word reading fluency are added to the model.

**Second Objective: The Contribution of Cross-Linguistic Predictors to Reading Comprehension**

The second objective concerns cross-linguistic relationships between early L1 and L2 skills and subsequent English reading comprehension within each language group. The following research question was addressed:

**Research Question 3.**

To what extent do early L1 skills, assessed in Grade 1, contribute to reading comprehension in English in Grade 4, above and beyond the potential parallel early L2 skills in each language group? And are there differences between the two language groups in terms of the contributions of the early L1 skills to Grade 4 English reading comprehension?

**Hypothesis.**

Given previous studies and in accordance with the central processing, threshold, and typological differences hypotheses, it was expected that early cognitive skills (PA and RAN) assessed in the L1 would not contribute to English reading comprehension after taking into account the parallel L2 cognitive skills; however, early L1 oral language as well as decoding would contribute to English reading comprehension only in the Spanish ELL group and not in the Chinese ELL group. The rationale for this hypothesis was that PA and RAN are underlying cognitive processes that are assumed to be relevant across languages and do not need to be acquired separately for each language; once they have been acquired they can be transferred
from one language to another (Lesaux & Geva 2006). However, oral language and reading skills are more language-specific and, according to the typological differences framework (Frost, 1994; Katz & Frost, 1992), they are expected to transfer from one language to another if the two languages have similar features (e.g., phonological forms) such as Spanish to English (e.g., Durgunoğlu et al., 1993) but not from Chinese to English (e.g., Wang et al., 2005).

**Third Objective: The Contribution of Rate of Growth in Predictors to Reading Comprehension**

The effects of individual differences in the growth processes of basic cognitive and linguistic skills on reading comprehension has not been yet investigated systematically. Part three was aimed to determine whether variability in individual slopes (rate of growth) on early cognitive and linguistic predictors of reading comprehension in English can be explained by L1 status: whether the slopes are the same for Spanish and Chinese ELL groups. This part, furthermore, investigated the extent to which the rate of growth (slope from Grade 1 to Grade 4) on English cognitive, SVR, and word reading fluency skills, in addition to their initial status (intercept in Grade 1), explain variation in English reading comprehension in Grade 4. The following two research questions were addressed:

**Research Question 4.**

Are the growth trajectories of English PA, RAN, vocabulary, and word reading (accuracy and fluency) different in ELLs with Chinese and Spanish language backgrounds?

**Hypothesis.**

Given that ELL students from both language backgrounds had similar exposure to English literacy instruction, their cognitive-linguistic skills were expected to develop in a similar way. That is, no group differences were anticipated for developmental trajectories (Grade 1 to
Grade 4) of early predictors of fourth-grade reading comprehension in English between Chinese ELLs and Spanish ELLs. Additionally, recent developmental research (e.g., Singer & Willett, 2003) suggests that the rate of growth over an extended period of time is not constant or linear, and that development may decelerate as children develop their cognitive and linguistic skills. Therefore it was expected that the individual developmental trajectories of the predictor variables would be non-linear in nature.

**Research Question 5.**

Notwithstanding individual differences on initial status in Grade 1, to what extent do the rates of growth (slope from Grade 1 to Grade 4) on early predictors explain variation in English reading comprehension in Grade 4?

**Hypothesis.**

On the basis of strong evidence in the literature regarding the developmental change in the nature of predictors of reading comprehension (e.g., Geva & Farnia, 2012; Silverman et al., 2013; Storch & Whitehurst 2002) and based on the limited research that has examined the influence of intercepts and growth rates in predicting L2 reading comprehension, both intercepts and rate of growth on early predictors were expected to contribute to English reading comprehension in Grade 4.
Chapter Three:  
Methodology  

Participants  
As part of a cross-sequential, longitudinal project, which began in 2003, 120 ELL students from four successive cohorts were recruited and followed from Grade 1 to Grade 4. The participants for the present study were Spanish-English (n=53; 22 males; 31 females) and Chinese-English ELLs, both Mandarin speaking (n=20; 9 males; 11 females) and Cantonese speaking (n=47; 25 males; 22 females), enrolled in 15 schools in 4 school boards in southern Ontario. The breakdown by cohort was as follows: 16 children started in 2003, 51 children started in 2004, 51 children started in 2005, and 2 children started in 2006. 

Students’ English skills were assessed in the winter/spring of each successive year. Students’ L1 skills were only assessed in Grade 1. Participants were recruited via a letter sent home to all students in each of the classrooms. The letter contained detailed information about the process and objectives of the research project. Consent forms in English and in the students’ home languages were distributed in each of the participating classrooms. Only children with parental consent participated. In addition, verbal assents were obtained from children at the beginning of testing sessions. 

The data of children with specific sensory or developmental disabilities were excluded. Information regarding children’s ELL status was gathered from their school files. We also asked teachers to identify students in their classrooms who spoke a language other than English at home. This information was verified through parental consent forms and child questionnaires. At

1 See Appendix A for a comparison of Cantonese and Mandarin ELLs’ performance on different measures.
the initial level (Grade 1), the mean age of the Chinese group was 81 months with a standard deviation of 3.62, and the mean age of the Spanish group was 80.61 months, with a standard deviation of 4.40.

Attrition is unavoidable in longitudinal studies. The attrition rate for the present study was moderate (23% from Grade 1 to Grade 4). The most common reason for attrition was that a child had moved out of the area served by the school boards that had given permission for the study to take place. Each year the children remaining in the sample were compared statistically to those who left; none of these differences were statistically significant. Analyses using the data from the 120 remaining participants who were tested on at least 3 time points are reported here.

Demographic Information

A family questionnaire was sent to each participant’s family in order to identify home literacy practices and provide demographic information. The available demographic information gathered from the returned questionnaires is summarized in Table 1. The questionnaires were translated into Chinese and Spanish.
Table 1

Demographic Characteristics of Participants by Language Group

<table>
<thead>
<tr>
<th>Demographic variable</th>
<th>N</th>
<th>Chinese Group</th>
<th>N</th>
<th>Spanish Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country of Birth: Canada (%)</td>
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<td>82.35</td>
<td>33</td>
<td>94.70</td>
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<td>Age of arrival if not born in Canada</td>
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<td>33</td>
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<td>33</td>
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<td>68.29</td>
<td>33</td>
<td>81.82</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• High school diploma</td>
<td></td>
<td>68.29</td>
<td></td>
<td>81.82</td>
</tr>
<tr>
<td>• College Degree</td>
<td></td>
<td>7.32</td>
<td></td>
<td>3.03</td>
</tr>
<tr>
<td>• University Degree</td>
<td></td>
<td>24.39</td>
<td></td>
<td>15.15</td>
</tr>
</tbody>
</table>

Tasks Assessing Language and Literacy Skills

A combination of non-standardized and standardized tasks was administered in the children’s first language as well as English. When available, commercial original versions of the test in the children’s first language were used.

SVR Factors

Word-Level Reading Skills

A composite score\(^2\) of standardized measures of word and pseudoword reading was used. English word reading was measured using the Word Identification (WI) subtest of the Woodcock Reading Mastery Test Revised (WRMT-R, Woodcock, 1998). English pseudoword reading was

\(^2\) Correlations between WI and WA ranged from .80 to .86 from Grade 1 to Grade 4 (\(p < .001\)).
measured using the Word Attack (WA) subtest of the Woodcock Reading Mastery Test Revised (WRMT-R, Woodcock, 1998). In these tasks, children are required to read aloud words or non-words that increase in level of difficulty. Each task comprises 45 items, and testing is discontinued after 6 consecutive errors that end with the last item within a set. The Cronbach α coefficients are .90 for Word Identification and .92 for Word Attack for the sample used in this study.

For Chinese children, an experimental word recognition task (adapted from Chan & Siegel, 2001; see Appendix B) consisting of 100 items was administered. The discontinue criterion for both sections was 6 consecutive errors. The Cronbach α coefficient is .83 for the sample used in this study.

To test Spanish word reading ability, the Identificación de letras y palabras subtest of the Batería III Woodcock- Muñoz (Woodcock & Muñoz-Sandoval, 1995) was used. In this task, children are asked to read aloud a series of letters and then words of increasing difficulty. The task contains 58 items and testing is discontinued after 6 consecutive errors. The Cronbach’s α coefficient is .81 for the sample used in this study.

**Oral Language: Receptive Vocabulary**

The Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981) is a task of receptive vocabulary in English and verbal comprehension. In this task, children hear a word presented with four pictures, and are asked to point to the picture that matches the word heard. This task consists of 168 items including nouns, verbs, and adjectives, and it is discontinued after 8 errors within a 10-item set. The Cronbach’s α coefficient is .73 for the sample used in this study. It is considered a good task to assess L2 oral language proficiency (Farnia & Geva, 2011).
The Spanish version of this task, the Test de Vocabulario en Imagenes Peabody (TVIP; Dunn, Padilla, Lugo, & Dunn, 1986) was administered to children coming from a Spanish language background. This task consists of 125 items, and it is discontinued after 6 consecutive errors. The Cronbach’s α coefficient is .93 for the sample used in this study.

Chinese children were administered the Chinese version of the PPVT-R (Lu & Lui, 1998). This task contains 175 items and is discontinued after 8 errors within a 10-item set. The Cronbach’s α coefficient is .98 for the sample used in this study.

Beyond SVR - Cognitive Tasks:

Non-Verbal Ability

The Matrix Analogies Test (MAT-Expanded Form; Naglieri, 1989) was administered to assess children’s nonverbal reasoning and problem solving abilities. This test involves four subtests. The first is Pattern Completion, whereby children are asked to choose from one of the six pictures below in order to complete pattern. The other three subtests are: Reasoning by Analogy, Serial Reasoning, and Spatial Visualization, which involves similar procedures to the first subtest and also involves reasoning about visual patterns. The Cronbach’s α coefficient is .92 for the sample used in this study. The task, used as a general control variable, was administered when children were in Grade 2.

Phonological Awareness (PA)

Phonological awareness was tested in English as well as in the children’s L1. L1 phonological awareness tasks varied somewhat based on the types of phonological tasks that are plausible for each language.
The phoneme deletion section of an English experimental task of phonological awareness (PAT) was used to test children’s phonological awareness (Jared, Cormier, Levy, & Wade-Woolley, 2011; see Appendix C). This section involves deleting phonemes within an onset or rime (e.g., say “bip” without the /p/) and consists of 12 items. Each correct answer scores one point. The Cronbach’s α coefficient is .70 for the sample used in this study.

For Chinese children, an experimental tone detection task (Gottardo et al., 2001; see Appendix D) was used. This is a task of linguistic processing at a syllabic level and it is crucial for comprehending Chinese by contrasting meaning in Chinese words that have the same segmental phonemes (Schirmer, Tang, Penney, Gunter, & Chen, 2005) but different tones. In Chinese, use of tone to comprehend utterances is acquired in infancy, beginning at 10 months and being complete before two years of age (Tse, 1978). This task consists of 15 items. All 15 test items (as well as two training items) were presented orally, once, to the participants by the examiner who was native speaker of Chinese. Children were asked to indicate whether the first, second, or third word had a different tone from the other two items. Requesting a numerical response rather than production of the stimulus item avoided any possibility that errors could be attributed to difficulties in tone production rather than tone perception. The Cronbach’s α coefficient is .76 for the sample used in this study.

Spanish phonological awareness was tested by the initial and final sound matching tasks of the Test of Phonological Processing in Spanish (TOPPS; Francis et al., 2001). The TOPPS was developed as the Spanish version of the Comprehensive Test of Phonological Processing (CTOPP), originally developed by Wagner, Torgesen, and Rashotte (1999). In this task, children are asked to identify the word that has the same first or last sound as the prompt word. For example, children see pictures of a piano (prompt), hourglass, field, feet (choices), and the tester
then asks: ¿Qué palabra empieza con el sonido /p/ como piano? ¿hora, suelo, o pies?, and the target sound is the “pies”. The test consists of 20 items and is discontinued after three consecutive incorrect responses. The Cronbach’s α coefficient is .83 for the sample used in this study.

**Rapid Naming Speed (RAN)**

Rapid Automatized Naming (RAN; Wagner et al., 1999), a subtest of the Comprehensive Test of Phonological Processing (CTOPP), was used. This task taps basic cognitive processes by estimating the speed with which children access the names of highly automatized printed symbols (Bowers, Golden, Kennedy, & Young, 1994; Wolf, Pfeil, Lotz, & Biddle, 1994). The digit subtest was used in the present study. Children are asked to name, as fast as they can, a list of 6 randomly alternating digits, presented in rows. There are two trials, and the total time taken to read each trial is recorded in seconds. The Cronbach’s α coefficient is .81 for the sample used in this study.

The same task was administered in Chinese and Spanish to assess L1 RAN. The administration procedure in Chinese/Spanish is the same as in English - children are asked to name the digits in their L1 as fast as they can. The Cranach’s α coefficient is .81 for the Chinese ELLs and .84 for the Spanish ELLs in the present sample.

**Beyond SVR - Word Reading Fluency**

The Sight Word Efficiency (SWE) subtest of the Test of Word Reading Efficiency (TOWRE, Torgesen, Wagner, & Rashotte, 1999) was used to assess children’s word-level reading fluency in English. The TOWRE is a timed test that was designed to measure children’s ability to read sight words with accuracy and speed. In the subtest used, children are shown a list
of words that progress in difficulty and are asked to read aloud as many words as possible within a 45-second period. This subtest is scored in terms of the total number of words read correctly within the 45-second time frame. The Cronbach’s $\alpha$ coefficient is .87 for the sample used in this study. This task was not administered in Chinese or in Spanish.

**Dependent Variable**

**English Reading Comprehension**

Neale Analysis of Reading Ability (Neale, 1989): In this test, children are asked to read aloud short stories. Any decoding errors that are made are corrected by the tester on the spot, and the time taken to read the story is noted. Children progress through stories of increasing difficulty until they make 16 or more reading errors on any one story. Comprehension questions are asked after each story if no more than 16 errors are made on that story. Some questions may be answered using literal reference to the text, while others require inferences to be made. The number of questions answered correctly yields the comprehension score. The Cronbach’s $\alpha$ coefficient is .83 for the sample used in this study. This measure was administered in Grade 4.

**Testing Procedures**

Students were tested on a large battery of tests, administered across four testing sessions; each session lasted approximately 30 minutes. The assessment of a variety of cognitive, language and literacy skills took place once a year. In Grade 1 to Grade 2, participants were assessed in both their L1 and L2. However, in Grades 3 and 4, testing occurred only in English because data analysis indicated no improvement in the L1 skills. Testing took place once a year at each of the participating schools in a quiet room designated by each of the schools. The participants were first tested in senior kindergarten and followed up every year afterwards up to Grade 4. Participants were tested individually or in small groups, depending on the task. All testing
sessions were arranged with the participants' classroom teachers. Tasks were administered by fully trained graduate students and research assistants. Graduate or undergraduate students who are native speakers of Spanish or Chinese administered the tests in these languages.
Chapter Four:

Analyses and Results

Data management and manipulation

With the exception of nonverbal ability, all data from standardized tasks were not converted to percentiles or standardized scores, in order to avoid bias associated with using norms standardized on EL1 populations; analyses were based on raw scores. Before undertaking data analyses, all variables were examined for data entry error, missing values, outliers, and normality of distributions.

In order to minimize changes to the data and to maximize the use of the data (sample size), outliers (n=45; 20 in Chinese group; 25 in Spanish group across the four grades) were not omitted. Instead, a Winsorizing technique was used to modify the extreme values, setting them at the value of the lowest (or highest) included value within the normal distribution.

Because of sample size constraints, and due to the high correlations between word and pseudoword reading (ranging from .80 to .86 across grades, \( p < .001 \)), a composite score was created from the Word Identification and Word Attack tests scores at each time point. Also, the RAN variable was reverse coded to aid interpretation of the results, because, unlike the rest of the variables, lower scores (i.e., less time) represented better performance.

Descriptive Analyses

The means and standard deviations for all English variables are displayed in Table 2. The results of descriptive analyses also revealed a substantial change in achievement over time on all
tasks across both language groups. In order to avoid increasing the Type I error by conducting multiple t-tests to examine the same hypothesis, a set of multivariate analyses of variance (MANOVA) was conducted to compare the performance of Chinese and Spanish ELLs on each English task across the 4 grades.

As shown in Table 2, there were no significant differences in the performance of the Spanish and Chinese groups on PA and RAN tasks across all 4 grades. However, Chinese ELLs performed significantly better than Spanish ELLs on the non-verbal ability task, $F(1, 118) = 15.84, p < .001$, on the reading comprehension task in Grade 4, $F(1, 118) = 13.51, p < .001$, on the receptive vocabulary task in Grade 1, $F(1, 118) = 4.29, p \leq .05$, in Grade 2, $F(1, 118) = 8.11, p \leq .01$, in Grade 3, $F(1, 118) = 11.38, p \leq .001$, and in Grade 4, $F(1, 118) = 17.52, p \leq .001$, on word reading task in Grade 1, $F(1, 118) = 17.47, p \leq .001$, in Grade 2, $F(1, 118) = 13.47, p \leq .001$; in Grade 3, $F(1, 118) = 5.91, p \leq .05$, and in Grade 4, $F(1, 118) = 9.25, p \leq .01$, as well as on word reading fluency tasks in all grades (Grade 1, $F(1, 118) = 27.62, p \leq .001$; Grade 2, $F(1, 118) = 13.47, p \leq .001$; Grade 3, $F(1, 118) = 15.20, p \leq .001$; and Grade 4, $F(1, 118) = 12.94, p \leq .001$).
### Table 2

*Means and Standard Deviations of Age in Months, Reading Comprehension, and English Independent Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chinese (M) (SD)</td>
<td>Spanish (M) (SD)</td>
<td>Chinese (M) (SD)</td>
<td>Spanish (M) (SD)</td>
</tr>
<tr>
<td><strong>Age (in months)</strong></td>
<td>81 (3.62)</td>
<td>80.61 (4.40)</td>
<td>92.40 (3.96)</td>
<td>92.02 (4.31)</td>
</tr>
<tr>
<td><strong>MAT (SS)</strong></td>
<td>-</td>
<td>108.94 (11.46)</td>
<td>-</td>
<td>15.84**</td>
</tr>
<tr>
<td><strong>PPVT</strong></td>
<td>86.66 (18.75)</td>
<td>78.09 (18.24)</td>
<td>105.55 (21.27)</td>
<td>117.55 (17.18)</td>
</tr>
<tr>
<td><strong>WR Composite</strong></td>
<td>32.53 (12.99)</td>
<td>19.40 (10.53)</td>
<td>41.15 (10.53)</td>
<td>57.83 (9.87)</td>
</tr>
<tr>
<td><strong>PA</strong></td>
<td>3.81 (2.68)</td>
<td>2.94 (2.32)</td>
<td>5.62 (3.44)</td>
<td>3.81 (2.32)</td>
</tr>
<tr>
<td><strong>RAN</strong></td>
<td>53.85 (12.10)</td>
<td>49.63 (13.13)</td>
<td>41.09 (8.97)</td>
<td>38.53 (9.87)</td>
</tr>
<tr>
<td><strong>WR Fluency</strong></td>
<td>45.26 (18.40)</td>
<td>24.31 (17.07)</td>
<td>57.83 (13.07)</td>
<td>66.28 (13.07)</td>
</tr>
</tbody>
</table>

|                        | Chinese (M) (SD) | Spanish (M) (SD) | Chinese (M) (SD) | Spanish (M) (SD) |
| **F**                  | -                | -                | -                | -                |
| **η²**                 | -                | -                | -                | -                |

*Numerical values in parenthesis.*

Note. Standard deviations are reported in parenthesis, MAT = Nonverbal ability; RC = Reading comprehension (NEALE); PPVT = Peabody Picture Vocabulary; WR Composite = Word reading composite (WI, WA); PA = Phonological awareness (PAT); RAN = Rapid naming speed digit; WR Fluency = Word reading fluency (TOWRE).

*** p ≤ .001, ** p ≤ .01, *p ≤ .05
**Part One: Extended SVR Model in Young ELLs**

In this section, of main interest was how English reading comprehension in Grade 4 was related longitudinally to English SVR skills (receptive vocabulary and decoding) and to underlying cognitive skills (PA and RAN) and word reading fluency, all assessed in Grade 1. Correlation coefficients were computed to examine the patterns of relationships between the dependent and independent variables, controlling for non-verbal ability (Tables 3 and 4 for Chinese and Spanish, respectively).

As shown in Tables 3 and 4, similar correlation patterns appeared in both language groups with respect to the relationships of L2 predictor measures with English reading comprehension. Within each language group, reading comprehension correlated significantly with L2 receptive vocabulary, word reading composite, cognitive variables, and word reading fluency.

Slightly different patterns of correlations emerged for the Chinese ELL and Spanish ELL groups, and it was therefore important to examine whether the covariance matrices of the two language groups actually differed. In order to test the homogeneity of the two covariance matrices, a Box’s M analysis was conducted. Results indicated that there was no statistically significant difference between the correlational patterns of the two groups, \( F(28, 43367.41) = 1.02, \text{ns} \). Therefore, there was no statistical justification for analyzing the data separately for the two language groups, and they were amalgamated to increase power in subsequent analyses.
Table 3

Partial Correlations among Grade 1 L2 Predictor Variables and Grade 4 Reading Comprehension for Chinese ELLs (Controlling for Nonverbal Ability, N = 67)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- RC</td>
<td>1.00</td>
<td>.42*</td>
<td>.64**</td>
<td>.34*</td>
<td>.43**</td>
<td>.68**</td>
</tr>
<tr>
<td>2- PPVT</td>
<td>1.00</td>
<td>.49**</td>
<td>.18</td>
<td>.38**</td>
<td>.53**</td>
<td></td>
</tr>
<tr>
<td>3- WR Composite</td>
<td>1.00</td>
<td>.41*</td>
<td>.45**</td>
<td>.90**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4- PA</td>
<td>1.00</td>
<td>.13</td>
<td>.44**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5- RAN</td>
<td></td>
<td>1.00</td>
<td>.61**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6- WR Fluency</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. RC = Reading comprehension (NEALE); PPVT = Peabody Picture Vocabulary; WR composite = Word reading composite (WI, WA); PA = Phonological Awareness (PAT); RAN = Rapid naming speed digit; WR Fluency = Word reading fluency (TOWRE)

** p ≤ .001, * p ≤ .01
Table 4

Partial Correlations among Grade 1 L2 Predictor Variables and Grade 4 Reading Comprehension for Spanish ELLs (Controlling for Nonverbal Ability, N = 53)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- RC</td>
<td>1.00</td>
<td>.41*</td>
<td>.52**</td>
<td>.29*</td>
<td>.40**</td>
<td>.61**</td>
</tr>
<tr>
<td>2- PPVT</td>
<td>1.00</td>
<td>.40*</td>
<td>.20</td>
<td>.25</td>
<td>.35</td>
<td></td>
</tr>
<tr>
<td>3- WR Composite</td>
<td>1.00</td>
<td>.49**</td>
<td>.55**</td>
<td>.90**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4- PA</td>
<td>1.00</td>
<td>.40*</td>
<td>.42*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5- RAN</td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>.59**</td>
<td></td>
</tr>
<tr>
<td>6- WR Fluency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note. RC = Reading comprehension (NEALE); PPVT = Peabody Picture Vocabulary; WR composite = Word reading composite (WI, WA); PA = Phonological Awareness (PAT); RAN = Rapid naming speed digit; WR Fluency = Word reading fluency (TOWRE)

** p ≤ .001, * p ≤ .01

To further explore the relationships between the predictors and reading comprehension, a multicollinearity diagnosis analysis was conducted. A multicollinearity diagnosis can help to ensure the regression model estimates of the coefficients are stable and the standard errors for the coefficients are not inflated. As can be seen in Table 5, the Variance Inflection Factors and Tolerance values were within the acceptable range (below 10, and above .10, respectively), thus none of the variables was redundant.
Table 5

*Multicollinearity Diagnosis*

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Collinearity Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tolerance</td>
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<tr>
<td>PPVT</td>
<td>.71</td>
</tr>
<tr>
<td>WR Composite</td>
<td>.18</td>
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<tr>
<td>PA</td>
<td>.78</td>
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<tr>
<td>RAN</td>
<td>.58</td>
</tr>
<tr>
<td>WR Fluency</td>
<td>.18</td>
</tr>
</tbody>
</table>

*Note.* PPVT = Peabody Picture Vocabulary; WR Composite = Word reading composite (WI, WA); PA = Phonological awareness (PAT); RAN = Rapid naming speed digit; WR Fluency = Word reading fluency (TOWRE).

To investigate the significant contributions of early SVR skills to reading comprehension in Grade 4, a set of hierarchical linear regression models were investigated. As indicated, nonverbal ability was entered in the model first as a control variable, followed by the SVR cluster (receptive vocabulary and word reading composite), assessed in Grade 1. As shown in Table 6, the SVR variables jointly contributed 35% to the total of 48% of variance accounted for in the model. Nonverbal ability, receptive vocabulary and word reading composite were significant longitudinal predictors of reading comprehension.
Table 6

The Role of Early SVR Variables in Predicting Grade 4 English Reading Comprehension – A 3-step Hierarchical Linear Regression Model Summary Table (combined sample: N=120)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F_\Delta (df_1, df_2)$</th>
<th>$\beta^a$</th>
<th>$\beta^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAT</td>
<td>.13</td>
<td>.13</td>
<td>17.86*** (1,118)</td>
<td>.36***</td>
<td>.05</td>
</tr>
<tr>
<td>2</td>
<td>PPVT</td>
<td>.48</td>
<td>.35</td>
<td>38.95*** (2,116)</td>
<td>.18*</td>
<td>.18*</td>
</tr>
<tr>
<td></td>
<td>WR Composite</td>
<td></td>
<td></td>
<td></td>
<td>.56***</td>
<td>.56***</td>
</tr>
</tbody>
</table>

Note. MAT= Nonverbal ability; PPVT= Peabody Picture Vocabulary; WR Composite= Word reading composite (WI, WA).

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

$^a$Standardized beta coefficient for the step at which the predictor first entered the model

$^b$Standardized beta coefficient for the predictor in the final step of the model

To further address the question of which of the early variables contributed to English reading comprehension in addition to the SVR variables, another set of hierarchical linear regressions was conducted, with English reading comprehension in Grade 4 as the dependent variable. In all of these regression analyses, nonverbal ability was entered first as a control variable, followed by cognitive variables (PA and RAN) as one cluster and the SVR variables (receptive vocabulary and word reading composite) as another cluster, followed by word reading fluency.
Table 7

The Role of Early Cognitive Variables, SVR Variables, and Word Reading Fluency in Predicting English Reading Comprehension – A 4 Step Hierarchical Linear Regression Model Summary Table (combined sample: N=120)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F_\Delta (df_1, df_2)$</th>
<th>$\beta^a$</th>
<th>$\beta^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAT</td>
<td>.13</td>
<td>.13</td>
<td>17.86*** (1,118)</td>
<td>.36***</td>
<td>.05</td>
</tr>
<tr>
<td>2</td>
<td>PA</td>
<td>.33</td>
<td>.19</td>
<td>16.65*** (2,116)</td>
<td>.20*</td>
<td>.05</td>
</tr>
<tr>
<td></td>
<td>RAN</td>
<td></td>
<td></td>
<td></td>
<td>.37***</td>
<td>.03</td>
</tr>
<tr>
<td>3</td>
<td>PPVT</td>
<td>.49</td>
<td>.17</td>
<td>19.04*** (2,114)</td>
<td>.16*</td>
<td>.14</td>
</tr>
<tr>
<td></td>
<td>WR Composite</td>
<td></td>
<td></td>
<td></td>
<td>.48***</td>
<td>.07</td>
</tr>
<tr>
<td>4</td>
<td>WR Fluency</td>
<td>.54</td>
<td>.05</td>
<td>11.50*** (1,113)</td>
<td>.53***</td>
<td>.53***</td>
</tr>
</tbody>
</table>

Note. MAT= Nonverbal ability; RC = Reading comprehension (NEALE); PA= Phonological awareness (PAT); RAN = Rapid naming speed digit; PPVT= Peabody Picture Vocabulary; WR Composite= Word reading composite (WI, WA); WR Fluency= Word reading fluency (TOWRE). ***$p < .001$, **$p < .01$, *$p < .05$

$^a$Standardized beta coefficient for the step at which the predictor first entered the model

$^b$Standardized beta coefficient for the predictor in the final step of the model

The results, summarized in Table 7 (above), indicate that the English cognitive cluster that included PA and RAN, assessed in Grade 1, explained 19% of the shared variance in Grade 4 English reading comprehension ($p < .001$) after controlling for nonverbal ability. The two English SVR variables (receptive vocabulary and word reading composite) contributed an additional 17% to the explained variance ($p < .001$) when entered after PA and RAN (also measured in Grade 1). English word reading fluency was entered in the final step and accounted for an additional unique 5% of the variance. Examination of the beta weights in the final step of the model suggested that word reading fluency was in fact the most important predictor in the
model. Altogether, 54% of the variance in reading comprehension performance in Grade 4 was explained by nonverbal ability, underlying cognitive variables (PA and RAN), SVR (receptive vocabulary and word reading composite), and by word reading fluency. Although nonverbal ability, cognitive and SVR clusters played an important role in the model before the presence of word reading fluency, their contributions were less evident when the contribution of word reading fluency was included in the model.

**Part Two: The Contribution of Cross-Linguistic Predictors to Reading Comprehension**

Table 8 shows the minimum, maximum, and mean percentage of correct answers (mean and standard deviation for RAN), and total number of items for each task. It is important to caution that a direct comparison of performance of the two language groups on the L1 tasks is not possible because the parallel tasks do not use the same scales.

Correlation coefficients were computed to examine the patterns of relationships between English reading comprehension (the dependent variable) and L1 and L2 cognitive and linguistic variables in Grade 1 (the predictors). Results revealed different correlation patterns for each language group (Tables 9 & 10). While there were significant high correlations between reading comprehension and all English measures in Grade 1 for both language groups, the magnitude of correlations between the dependent variable and L1 measures was not as high.

For the Chinese group, only Chinese word reading and PA (assessed in Grade 1) were correlated significantly with English reading comprehension in Grade 4. The correlations between parallel L1 and L2 measures of word reading and RAN were also moderate and significant. Furthermore, the correlations between English word reading and Chinese PA and RAN were moderately significant.
Table 6

Descriptive Statistics Summary for L1 Tasks in Grade 1

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Total number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Percentage Correct</td>
<td></td>
</tr>
<tr>
<td>Chinese Group (N=67)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1 PPVT</td>
<td>9</td>
<td>91</td>
<td>22</td>
<td>175</td>
</tr>
<tr>
<td>L1 WR</td>
<td>0</td>
<td>18</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>L1 PA</td>
<td>0</td>
<td>14</td>
<td>52</td>
<td>15</td>
</tr>
<tr>
<td>L1 RAN</td>
<td>59</td>
<td>175</td>
<td>109.84 (27.01)*</td>
<td>72</td>
</tr>
<tr>
<td>Spanish Group (N=53)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1 PPVT</td>
<td>5</td>
<td>74</td>
<td>32</td>
<td>125</td>
</tr>
<tr>
<td>L1 WR</td>
<td>4</td>
<td>31</td>
<td>22</td>
<td>58</td>
</tr>
<tr>
<td>L1 PA</td>
<td>2</td>
<td>10</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>L1 RAN</td>
<td>13</td>
<td>134</td>
<td>92.94 (29.33)*</td>
<td>72</td>
</tr>
</tbody>
</table>

Note. L1 PPVT= First language Peabody Picture Vocabulary Task; L1 WR= First language word recognition task; L1 PA= First language phonological awareness task; L1 RAN = First language rapid naming speed digit. *Mean score (Standard Deviation) reported for L1 RAN Digit.

As for the Spanish group, there was a significant correlation between English reading comprehension in Grade 4 and Spanish PA in Grade 1. Also, significant correlations between parallel L1 and L2 word reading and PA measures were evident. L1 PA was moderately correlated with L2 word reading composite. Furthermore, the correlation between L2 receptive vocabulary and L1 PA was moderately significant. L2 RAN was also moderately correlated with L1 word reading and L1 PA. L1 receptive vocabulary, L1 word reading, and L1 RAN did not correlate with Grade 4 English reading comprehension.
Different patterns of correlations appeared to emerge within the Chinese ELL and Spanish ELL groups, and it was therefore important to examine whether the covariance matrices actually differed in the two groups. In order to test the homogeneity of the two covariance matrices, a Box’s M analysis was conducted. Results indicated that there was a statistically significant difference in the correlational patterns in the two groups with regard to L1 measures, $F(10, 58894.24) = 3.21, p = .000$ (even though this was not the case for L2 predictors; see Part One).

Table 7

*Partial Correlations among Grade 1 L1 and L2 Predictor Variables and Grade 4 Reading Comprehension for Chinese ELLs (Controlling for Nonverbal Ability, N= 67)*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Eng RC</td>
<td>1.00</td>
<td>.42***</td>
<td>.64***</td>
<td>.34**</td>
<td>.43***</td>
<td>.07</td>
<td>.34***</td>
<td>.29*</td>
<td>.21</td>
</tr>
<tr>
<td>2- Eng PPVT</td>
<td>1.00</td>
<td>.49***</td>
<td>.18</td>
<td>.38***</td>
<td>-.17</td>
<td>.04</td>
<td>.18</td>
<td>.03</td>
<td></td>
</tr>
<tr>
<td>3- Eng WR composite</td>
<td>1.00</td>
<td>.41***</td>
<td>.45***</td>
<td>.06</td>
<td>.26*</td>
<td>.42***</td>
<td>.26*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4- Eng PA</td>
<td>1.00</td>
<td>.13</td>
<td>.29*</td>
<td>.39***</td>
<td>.22</td>
<td>.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5- Eng RAN</td>
<td>1.00</td>
<td>-.15</td>
<td>.17</td>
<td>.28*</td>
<td>.38*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6- L1 PPVT</td>
<td>1.00</td>
<td>.27*</td>
<td>.14</td>
<td>.12</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7- L1 WR</td>
<td>1.00</td>
<td>.19</td>
<td>.28*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8- L1 PA</td>
<td>1.00</td>
<td>.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9- L1 RAN</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Eng RC = English reading comprehension (NEALE); Eng PPVT = English Peabody Picture Vocabulary; Eng WR composite = English word reading composite (WI, WA); Eng PA = English Phonological Awareness (PAT); Eng RAN = English rapid naming speed digit; Eng WR Fluency = English word reading fluency (TOWRE); L1 PPVT = First language Peabody Picture Vocabulary Task; L1 WR = First language word recognition task; L1 PA = First language phonological awareness task; L1 RAN = First language rapid naming speed digit ***, $p < .001$, ** $p < .01$, * $p < .05$*
**Table 8**

Partial Correlations among Grade 1 L1 and L2 Predictor Variables and Grade 4 Reading Comprehension for Spanish ELLs (Controlling for Nonverbal Ability, N= 53)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Eng RC</td>
<td>1.00</td>
<td>.41**</td>
<td>.52***</td>
<td>.29*</td>
<td>.40**</td>
<td>.05</td>
<td>.23</td>
<td>.42*</td>
<td>-.12</td>
</tr>
<tr>
<td>2- Eng PPVT</td>
<td>1.00</td>
<td>.40**</td>
<td>.20</td>
<td>.25</td>
<td>.01</td>
<td>.02</td>
<td>.48***</td>
<td>-.09</td>
<td></td>
</tr>
<tr>
<td>3- Eng WR composite</td>
<td>1.00</td>
<td>.49***</td>
<td>.55***</td>
<td>-.11</td>
<td>.44**</td>
<td>.54***</td>
<td>-.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4- Eng PA</td>
<td>1.00</td>
<td>.40**</td>
<td>-.20</td>
<td>.19</td>
<td>.30*</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5- Eng RAN</td>
<td>1.00</td>
<td>.03</td>
<td>.37**</td>
<td>.28*</td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6- L1 PPVT</td>
<td>1.00</td>
<td>.45***</td>
<td>.11</td>
<td>.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7- L1 WR</td>
<td>1.00</td>
<td>.39**</td>
<td>.29*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8- L1 PA</td>
<td>1.00</td>
<td>-.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9- L1 RAN</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Eng RC = English reading comprehension (NEALE); Eng PPVT= English Peabody Picture Vocabulary; Eng WR composite= English word reading composite (WI, WA); Eng PA= English Phonological Awareness (PAT); Eng RAN = English rapid naming speed digit; Eng WR Fluency= English word reading fluency (TOWRE); L1 PPVT= First language Peabody Picture Vocabulary Task; L1 WR= First language word recognition task; L1 PA= First language phonological awareness task; L1 RAN = First language rapid naming speed digit.

***p < .001, **p < .01, *p < .05

First a model with L1 variables only was examined within each language group in order to identify early L1 predictors of Grade 4 English reading comprehension. In the first set of hierarchical linear regressions, English nonverbal ability was entered as a control variable, followed by the L1 cognitive cluster (PA and RAN) and the L1 SVR cluster (receptive vocabulary and word reading). The results are summarized in Tables 11 and 12 for the Chinese and Spanish groups, respectively.
As shown in Table 11, for the Chinese ELLs, the model that included both the L1 cognitive cluster and L1 SVR cluster was not significant in explaining English reading comprehension three years later. However, the model with nonverbal ability and the L1 cognitive cluster (PA and RAN) significantly explained 18% of the shared variability in English reading comprehension in Grade 4 ($p < .05$). The L1 SVR cluster (receptive vocabulary and word reading) did not play a significant role in predicting English reading comprehension, and therefore, it was removed from subsequent analyses.

As can be seen in Table 12, similar to the Chinese ELL groups, for the Spanish group, the model with all the L1 cognitive and SVR variables was not significant. However, the model with nonverbal ability and the L1 cognitive cluster (PA and RAN) significantly explained 24% of the shared variance in English reading comprehension ($p < .01$). Examination of the beta weights suggests that Spanish PA is the most important variable in the model. The L1 SVR cluster (receptive vocabulary and word reading) did not play a significant additional role in predicting English reading comprehension; therefore, it was removed from the following analyses.
### Table 9

*The Role of Early L1 Variables in Predicting English Reading Comprehension in the Chinese Group – A 3-Step Hierarchical Linear Regression Summary Table (N=67)*

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F (df_1, df_2)$</th>
<th>$\beta^a$</th>
<th>$\beta^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAT</td>
<td>.09</td>
<td>.09</td>
<td>6.12* (1,65)</td>
<td>.29*</td>
<td>.18</td>
</tr>
<tr>
<td>2</td>
<td>L1 PA</td>
<td>.18</td>
<td>.10</td>
<td>3.77* (2,63)</td>
<td>.26*</td>
<td>.23</td>
</tr>
<tr>
<td></td>
<td>L1 RAN</td>
<td></td>
<td></td>
<td></td>
<td>.14</td>
<td>.08</td>
</tr>
<tr>
<td>3</td>
<td>L1 PPVT</td>
<td>.25</td>
<td>.07</td>
<td>2.68 (2,61)</td>
<td>-.04</td>
<td>-.04</td>
</tr>
<tr>
<td></td>
<td>L1 WR</td>
<td></td>
<td></td>
<td></td>
<td>.28</td>
<td>.28</td>
</tr>
</tbody>
</table>

*Note.* MAT = Nonverbal ability; L1 PA = First language phonological Awareness; L1 PPVT = First language Peabody Picture Vocabulary Task; L1 WR = First language word recognition task; L1 PA = First language phonological awareness task; L1 RAN = First language rapid naming speed digit... *p < .05

$a$Standardized beta coefficient for the step at which the predictor first entered the model  
$b$Standardized beta coefficient for the predictor in the final step of the model

### Table 10

*The Role of Early L1 Variables in Predicting English Reading Comprehension in the Spanish Group – A 3-Step Hierarchical Linear Regression Summary Table (N=53)*

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F (df_1, df_2)$</th>
<th>$\beta^a$</th>
<th>$\beta^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAT</td>
<td>.07</td>
<td>.07</td>
<td>3.98* (1,51)</td>
<td>.27*</td>
<td>.18</td>
</tr>
<tr>
<td>2</td>
<td>L1 PA</td>
<td>.24</td>
<td>.17</td>
<td>5.44* (2,49)</td>
<td>.41**</td>
<td>.36*</td>
</tr>
<tr>
<td></td>
<td>L1 RAN</td>
<td></td>
<td></td>
<td></td>
<td>-.07</td>
<td>-.11</td>
</tr>
<tr>
<td>3</td>
<td>L1 PPVT</td>
<td>.25</td>
<td>.01</td>
<td>.31 (2,47)</td>
<td>-.03</td>
<td>-.03</td>
</tr>
<tr>
<td></td>
<td>L1 WR</td>
<td></td>
<td></td>
<td></td>
<td>.13</td>
<td>.13</td>
</tr>
</tbody>
</table>

*Note.* MAT = Nonverbal ability; L1 PA = First language phonological Awareness; L1 PPVT = First language Peabody Picture Vocabulary Task; L1 WR = First language word recognition task; L1 PA = First language phonological awareness task; L1 RAN = First language rapid naming speed digit... *p < .01, *p < .05

$a$Standardized beta coefficient for the step at which the predictor first entered the model  
$b$Standardized beta coefficient for the predictor in the final step of the model
The next set of hierarchical linear regression analyses was conducted for each language group by entering the English cognitive cluster first, and the parallel L1 cognitive cluster next, followed by the English SVR cluster. The results are summarized in Tables 13 and 14 for Chinese and Spanish groups, respectively. As shown in Table 13, nonverbal ability made a significant contribution of 9% to English reading comprehension in Grade 4. Furthermore, the English cognitive cluster (PA and RAN) significantly explained an additional 24% of the variance in English reading comprehension three years later. The contribution of the Chinese cognitive cluster (PA and RAN) did not remain significant in the presence of the parallel English variables. The English SVR cluster (receptive vocabulary and word reading) significantly explained an additional 16% of the variance in Grade 4 English reading comprehension.

As indicated in Table 14, nonverbal ability made a significant contribution of 7% to English reading comprehension in Grade 4. English and Spanish cognitive clusters (PA and RAN) both explained an additional, significant, 17% and 10% of the shared variance in English reading comprehension in Grade 4, respectively. However, The English SVR cluster did not contribute significantly when entered into the model after the L1 and L2 cognitive clusters.

In summary, the groups were similar in some ways and different in others. Contrary to expectations, in both language groups, the L1 SVR cluster in Grade 1 did not predict English reading comprehension three years later. In addition, the L1 cognitive cluster (PA and RAN) significantly predicted L2 reading comprehension in the Spanish group only, even when the contributions of the parallel variables in the L2 were accounted for.
Table 11

The Role of Early L1 and L2 Variables in Predicting Grade 4 English Reading Comprehension in the Chinese Group – A4-Step Hierarchical Linear Regression Summary Table (N=67)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F_\Delta (df_1, df_2)$</th>
<th>$\beta^a$</th>
<th>$\beta^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAT</td>
<td>.09</td>
<td>.09</td>
<td>6.12* (1,65)</td>
<td>.29*</td>
<td>-.02</td>
</tr>
<tr>
<td>2</td>
<td>L2 PA</td>
<td>.33</td>
<td>.24</td>
<td>11.17*** (2,63)</td>
<td>.29*</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>L2 RAN</td>
<td></td>
<td></td>
<td></td>
<td>.40**</td>
<td>.16</td>
</tr>
<tr>
<td>3</td>
<td>L1 PA</td>
<td>.34</td>
<td>.02</td>
<td>.72 (2,61)</td>
<td>.14</td>
<td>.00</td>
</tr>
<tr>
<td></td>
<td>L1 RAN</td>
<td></td>
<td></td>
<td></td>
<td>.02</td>
<td>.01</td>
</tr>
<tr>
<td>4</td>
<td>L2 PPVT</td>
<td>.50</td>
<td>.16</td>
<td>9.43*** (2,59)</td>
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<td>.11</td>
</tr>
<tr>
<td></td>
<td>L2 WR composite</td>
<td></td>
<td></td>
<td></td>
<td>.49**</td>
<td>.49**</td>
</tr>
</tbody>
</table>

Note. MAT= Nonverbal ability; L2 PA= English Phonological Awareness (PAT); L2 RAN= English rapid naming speed digit; L1 PA= First language phonological Awareness; L1 RAN = First language rapid naming speed digit; L2 PPVT= English Peabody Picture Vocabulary; L1 WR composite= English word reading composite (WI, WA)

**p < .001, *p < .01, *p < .05

$^a$Standardized beta coefficient for the step at which the predictor first entered the model

$^b$Standardized beta coefficient for the predictor in the final step of the model.
Table 12

The Role of Early L1 and L2 Variables in Predicting Grade 4 English Reading Comprehension in the Spanish Group – A 4-Step Hierarchical Linear Regression Summary Table (N=53)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F_\Delta (df_1, df_2)$</th>
<th>$\beta^a$</th>
<th>$\beta^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAT</td>
<td>.07</td>
<td>.07</td>
<td>3.98* (1,51)</td>
<td>.27*</td>
<td>.06</td>
</tr>
<tr>
<td>2</td>
<td>L2 PA</td>
<td>.24</td>
<td>.17</td>
<td>5.34** (2, 49)</td>
<td>.16</td>
<td>.052</td>
</tr>
<tr>
<td></td>
<td>L2 RAN</td>
<td></td>
<td></td>
<td></td>
<td>.32*</td>
<td>.16</td>
</tr>
<tr>
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<td>L1 PA</td>
<td>.33</td>
<td>.10</td>
<td>3.34* (2,47)</td>
<td>.30*</td>
<td>.12</td>
</tr>
<tr>
<td></td>
<td>L1 RAN</td>
<td></td>
<td></td>
<td></td>
<td>-.11</td>
<td>-.06</td>
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<tr>
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<td>L2 PPVT</td>
<td>.40</td>
<td>.07</td>
<td>2.50 (2,45)</td>
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<td>.20</td>
</tr>
<tr>
<td></td>
<td>L2 WR composite</td>
<td></td>
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<td>.28</td>
<td>.28</td>
</tr>
</tbody>
</table>

Note. MAT= Nonverbal ability; L2 PA= English Phonological Awareness (PAT); L2 RAN = English rapid naming speed digit; L1 PA= First language phonological Awareness; L1 RAN = First language rapid naming speed digit; L2 PPVT= English Peabody Picture Vocabulary; L1 WR composite= English word reading composite (WI, WA)

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

$^a$Standardized beta coefficient for the step at which the predictor first entered the model

$^b$Standardized beta coefficient for the predictor in the final step of the model

Part Three: The Contribution of Rate of Growth on Predictors to Reading Comprehension

Whereas the previous sections focused on an examination of longitudinal predictions between two measurement points, the emphasis here addressed the developmental trajectories of the early predictor variables. Of specific interest was the relationship between growth on each predictor variable over time (level-1 outcome variable) and the language group (level-2 predictor variable). Hierarchical linear modeling (HLM6, Raudenbusch, Bryk, Cheong, & Congdon, 2004) analyses were conducted, examining a random effects model with 2 levels. It is important to note
that each early language, literacy, and cognitive variable was treated as an outcome variable in
the HLM analyses in order to obtain the rate of growth (slopes) on these early variables.\(^3\)

HLM is a statistical technique that enables the modeling of individual growth while
considering the longitudinal nature of the data. The assumption was that the individual
developmental trajectories of the variables of interest would be non-linear in nature (i.e.,
quadratic) because the data for the present study was collected over a long period of time with
multiple testing waves. Therefore, the rate of growth on these variables was not expected to
remain constant (i.e., linear).

In all models, the intercept was centred around the mid-point (around the mean age in
Grade 2, i.e., 92 months) for several reasons: to model the mean growth of each outcome
variable, to define the trajectories as the average trajectories during the data collection, and to
stabilize the “estimation procedure” by reducing the correlation between the linear and non-
linear growth (Raudenbusch & Bryk, 2002, p. 182). Taking this approach, the intercept reported
in the results represents the estimated child’s outcome at Grade 2. First, an intercept-only model
was fitted, then a linear model, and finally a quadratic model. The intercept-only model was used
to obtain the relative slope values for each outcome variable. The relative fit of each model was
assessed using the chi-square test of deviance (Bryk & Raudenbusch, 1992). To illustrate, the
outcome variable \(Y_{it}\) is written as a function of an intercept \(\beta_{0i}\) plus a multiplication of a slope
parameter \(\beta_{1i}\) plus a residual \(r_{it}\):

\(^3\) The contributions of rate of growth on predictors to reading comprehension was not examined by HLM analysis because there
was no longitudinal data available for reading comprehension as the outcome variable.
Level-1 model:

\[ Y_{ti} = \beta_0 + \beta_{1i} \times (\text{Age}_c) + r_{ti} \quad \text{with} \quad r_{ti} \sim N(0, \sigma^2) \]

The level-1 analysis provides information regarding the growth trajectories (slopes) for the sample as a whole and indicates whether there is significant variability in these trajectories across children.

In the level-2 model, the level-1 coefficient (\(\beta_{1i}\)) becomes a level-2 outcome variable to be predicted by language group membership (Chinese or Spanish).

Level-2 model

\[ B_{0i} = \gamma_{00} + \gamma_{01} \times (\text{Language Group}) + u_{00} \quad \text{with} \quad u_{00} \sim N(0, \tau_{00}) \]

\[ \beta_{1i} = \gamma_{10} + \gamma_{11} \times (\text{Language Group}) + u_{11} \quad \text{with} \quad u_{11} \sim N(0, \tau_{11}) \]

A level-2 model including a quadratic component would be written as:

\[ B_{0i} = \gamma_{00} + \gamma_{01} \times (\text{Language Group}) + u_{00} \quad \text{with} \quad u_{00} \sim N(0, \tau_{00}) \]

\[ \beta_{1i} = \gamma_{10} + \gamma_{11} \times (\text{Language Group}) + u_{11} \quad \text{with} \quad u_{11} \sim N(0, \tau_{11}) \]

\[ \beta_{2i} = \gamma_{21} + \gamma_{22} \times (\text{Language}) + u_{21} \quad \text{with} \quad u_{21} \sim N(0, \tau_{22}) \]

In each of the following sections, a comparison was first conducted between linear and quadratic models. For a quadratic model, the intercept, the slope, and the acceleration were examined. For a linear model, only the intercept and the slope were examined. As noted above, the intercept here was the Grade 2 scores for each variable.
**Growth in English Receptive Vocabulary.**

For English receptive vocabulary, a comparison of the quadratic with the linear growth model indicated a significantly improved fit for the linear growth model (Chinese = 1.77, \( p = .00 \); Spanish = -1.80, \( p = .01 \)). Therefore, the linear model was retained (Figure 1). The results of HLM analysis (summarized in Table 15) indicated that there was a significant variation in individual receptive vocabulary growth rates, with a significantly higher average growth rate of 1.80 units per month (\( t (354)=-2.56, p = .00 \)) for Chinese ELLs compared to Spanish ELLs.

![Figure 1. Estimated individual growth curves for English receptive vocabulary.](image)

**Growth in English Word Reading (Composite).**

For English word reading, a comparison of the quadratic with the linear growth model indicated a significantly improved fit for the linear growth model (Chinese = 1.26, \( p = .00 \); Spanish = -1.19, \( p < .05 \)). Therefore, the linear model was retained (Figure 2). The results of HLM analysis (summarized in Table 16) indicated that there is a significant variation in individual word reading growth rates, with a significantly higher average growth rate of 1.19 units per month (\( t (354)=-2.543, p < .05 \)) for Chinese ELLs compared to Spanish ELLs.
**Figure 2.** Estimated individual growth curves for English word reading composite.

**Growth in English Phonological Awareness.**

For English PA, a comparison of the quadratic with the linear growth model indicated a significant linear trend (Chinese = .26, p = .00; Spanish = -.28, p < .05). Therefore, the linear model was retained (Figure 3). The results of the HLM analysis (summarized in Table 17) indicated that the average growth rate in PA was significantly higher by .28 units per month ($t$ (354) = -2.25, $p < .01$) for Chinese ELLs compared to that of the Spanish ELLs.

**Figure 3.** Estimated individual growth curves for English phonological awareness.
**Growth in English Rapid Naming Speed (Digit).**

For English RAN, a comparison of the quadratic with the linear growth model indicated that neither model was significant ($p=ns$) (Figure 4). The results of HLM (summarized in Table 18) indicated that none of the groups had significant growth (i.e., faster naming) over time. This might indicate a ceiling effect. Also, children’s group membership did not affect their performance on the RAN digit task, $t (354) =-.34, p=ns$.

![Figure 4: Estimated individual growth curves for English rapid naming speed.](image)

**Growth in English Word Reading Fluency.**

For English word reading fluency, a comparison of the quadratic with the linear growth model indicated a significantly improved fit for the linear growth model (Chinese = 1.37, $p= .00$; Spanish = -1.07, $p=ns$). Therefore, the linear model was retained (Figure 5). The results of the HLM analysis (summarized in Table 19) indicated that children’s group membership did not affect their performance on English WR fluency. There was no significant difference in the average growth rate between Chinese and Spanish ELLs, $t (354) =-1.85, p= ns$. 
To summarize, contrary to expectations, a linear growth model was the best fit for describing the development of all the cognitive, language and literacy tasks except for the English RAN (where there was no significant growth). Also, overall, the growth rate was significantly higher for the Chinese ELL group on receptive vocabulary, word reading and PA tasks. However, children’s rate of growth on English word reading fluency did not differ across the language groups. In regards to RAN, neither group showed significant growth (improvement) from Grade 2 to Grade 4, a result that might reflect a ceiling effect.

*Figure 5. Estimated individual growth curves for English word reading fluency.*
Table 13

**HLM Results for English Receptive Vocabulary**

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Table 14

*HLM Results for English Word Reading Composite*

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### Table 15

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Table 16 HLM

*Results for English Rapid Naming Speed*

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Table 17

*HLM Results for English Word Reading Fluency*

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To explore the contribution of the rates of growth on cognitive and linguistic predictors to later English reading comprehension, the slopes for individual children (obtained from the HLM analyses carried out on each variable) were entered into the SPSS program and used in subsequent regression analyses. The individual slope from the linear model was the amount of growth per month for a given task.

Correlation coefficients were computed to examine the patterns of relationships between English reading comprehension, the dependent variable, and the rate of growth on each predictor (Tables 20 & 21 for Chinese and Spanish ELL groups, respectively). Similar patterns appear in both language groups with respect to relationships among dependent variables and the slopes of the predictors. The results of these correlation analyses revealed that while there were significant relationships between Grade 4 reading comprehension and the slopes of word reading, PA and word reading fluency, the growth in receptive vocabulary was not correlated with reading comprehension in Grade 4 in either language group. Examining the relationships among the slopes indicated significant relationships only between the slopes of word reading, PA, and word reading fluency in both language groups. Given the importance of the SVR variables for the present study and the established role of oral language skills in reading comprehension development of ELLs by previous research (e.g., Carlisle et al., 1999; Farnia & Geva, 2013; Geva & Farnia, 2012; Yaghoub Zadeh et al., 2012), the slope of receptive vocabulary was retained in subsequent statistical analyses. As the results of the HLM analysis also indicated, RAN did not show any significant growth over time for either language group, suggesting a ceiling effect; this variable was not included in subsequent analyses.

While similar patterns of correlations appeared to emerge for the Chinese ELL and Spanish ELL groups, it was important to examine whether the covariance matrices were actually
the same in the two groups. In order to test the homogeneity of the two covariance matrices, a Box’s M analysis was conducted. Results indicated that there was no statistically significant difference between the correlational patterns within the two groups, and the two groups could be amalgamated for subsequent analyses, $F(21, 43220.31) = 1.01, ns$.

Table 18

*Partial Correlations among Slopes of Predictor Variables and Grade 4 Reading Comprehension for Chinese ELLs (Controlling for Nonverbal Ability, N= 67)*

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Note. RC = English reading comprehension (NEALE); PPVT Slope= English Peabody Picture Vocabulary rate of growth; WR composite Slope= English word reading composite (WI, WA) rate of growth; PA Slope = English Phonological Awareness rate of growth; WR Fluency Slope= English word reading fluency (TOWRE) rate of growth, ***$p< .001$; **$p< .01$; *$p< .01$
Table 19

Partial Correlations among Slopes of Predictor Variables and Grade 4 Reading Comprehension for Spanish ELLs (Controlling for Nonverbal Ability, N= 53)

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Note. RC = English reading comprehension (NEALE); PPVT Slope= English Peabody Picture Vocabulary rate of growth; WR composite Slope= English word reading composite (WI, WA) rate of growth; PA Slope = English Phonological Awareness rate of growth; WR Fluency Slope= English word reading fluency (TOWRE) rate of growth; ***p < .001; **p < .01; *p < .01

A set of hierarchical regression analyses including both the early predictors and their slopes was run (Table 22). The results indicated that nonverbal ability in Grade 2 explained 14% of the shared variance in English reading comprehension in Grade 4. The English cognitive PA slope did not predict the variation in reading comprehension when the intercepts of the cognitive cluster (PA and RAN) were already in the model. While the PA intercept and RAN intercept jointly explain 19% of the shared variance in Grade 4 English reading comprehension (p < .001) after controlling for nonverbal ability, the intercepts of the English SVR cluster (receptive vocabulary and word reading composite) contributed an additional 17% to the shared variance (p < .001) when entered into the model after the cognitive variables. The contribution of the slopes
of the SVR cluster was 4% above and beyond the intercepts of the SVR cluster \((p < .01)\). The intercept of English word reading fluency was entered next and explained an additional 3% of the shared variation in reading comprehension in Grade 4 \((p < .01)\). The slope of English reading fluency was entered last in the model and did not add any significant contribution to the model. Examination of this model resulted in removing the slopes of English PA and English word reading fluency from the model, as these two slope-related variables did not make significant contributions to the outcome variable.

The final model (Table 23) was obtained using hierarchical regression analysis and consisted of nonverbal ability (as the control variable), the intercepts of English cognitive cluster followed by the intercepts of the SVR cluster, the slopes of the SVR cluster, and the intercept of word reading fluency. This final model explained 59% of the shared variability in Grade 4 English reading comprehension. Examination of the beta weights in the final step of the model suggested that the slope of the word reading composite and the intercept of word reading fluency were the most important predictors in the model.
Table 20

The Role of Early Predictor Variables and Their Slopes in Predicting Grade 4 English Reading Comprehension – A 7-step Hierarchical Linear Regression Model Summary Table (combined sample: N=120)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F$ (df$_1$, df$_2$)</th>
<th>$\beta^a$</th>
<th>$\beta^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAT</td>
<td>.14</td>
<td>.14</td>
<td>17.77*** (1,112)</td>
<td>.37***</td>
<td>.01</td>
</tr>
<tr>
<td>2</td>
<td>PA</td>
<td>.32</td>
<td>.19</td>
<td>15.11*** (2,110)</td>
<td>.22*</td>
<td>.07</td>
</tr>
<tr>
<td></td>
<td>RAN Digit</td>
<td></td>
<td></td>
<td></td>
<td>.34***</td>
<td>-.04</td>
</tr>
<tr>
<td>3</td>
<td>PA Slope</td>
<td>.34</td>
<td>.02</td>
<td>2.60 (1,109)</td>
<td>.17</td>
<td>-.04</td>
</tr>
<tr>
<td>4</td>
<td>PPVT</td>
<td>.51</td>
<td>.17</td>
<td>18.81*** (2,107)</td>
<td>.12</td>
<td>.09</td>
</tr>
<tr>
<td></td>
<td>WR Composite</td>
<td></td>
<td></td>
<td></td>
<td>.53***</td>
<td>.02</td>
</tr>
<tr>
<td>5</td>
<td>PPVT Slope</td>
<td>.55</td>
<td>.04</td>
<td>4.88 ** (2,105)</td>
<td>.09</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>WR Composite Slope</td>
<td></td>
<td></td>
<td></td>
<td>.47**</td>
<td>.24</td>
</tr>
<tr>
<td>6</td>
<td>WR Fluency</td>
<td>.58</td>
<td>.03</td>
<td>7.69** (1,104)</td>
<td>.46**</td>
<td>.26</td>
</tr>
<tr>
<td>7</td>
<td>WR Fluency Slope</td>
<td>.59</td>
<td>.01</td>
<td>1.38 (1,103)</td>
<td>.25</td>
<td>.25</td>
</tr>
</tbody>
</table>

Note. MAT = Nonverbal Ability; PA = English Phonological Awareness (PAT) intercept; RAN Digit = English Rapid Naming Speed Digit intercept; PA Slope = English Phonological Awareness rate of growth; PPVT = English Peabody Picture Vocabulary intercept; WR composite = English word reading composite (WI, WA) intercept; PPVT Slope = English Peabody Picture Vocabulary rate of growth; WR composite Slope = English word reading composite (WI, WA) rate of growth; WR Fluency = English word reading fluency (TOWRE) intercept; WR Fluency Slope = English word reading fluency (TOWRE) rate of growth

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

$^a$Standardized beta coefficient for the step at which the predictor first entered the model

$^b$Standardized beta coefficient for the predictor in the final step of the model
Table 21

Final Model, The Role of Early SVR Predictors and Their Slopes in Predicting Grade 4 English Reading Comprehension – A 6-step Hierarchical Linear Regression Model Summary Table (combined sample: N=120)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F_\Delta (df_1, df_2)$</th>
<th>$\beta^a$</th>
<th>$\beta^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAT</td>
<td>.13</td>
<td>.13</td>
<td>17.86**(1,118)</td>
<td>.36***</td>
<td>.02</td>
</tr>
<tr>
<td>2</td>
<td>PA</td>
<td>.33</td>
<td>.19</td>
<td>16.65**(2,116)</td>
<td>.20*</td>
<td>.01</td>
</tr>
<tr>
<td></td>
<td>RAN Digit</td>
<td></td>
<td></td>
<td></td>
<td>.37***</td>
<td>-.01</td>
</tr>
<tr>
<td>3</td>
<td>PPVT</td>
<td>.49</td>
<td>.17</td>
<td>19.04**(2,114)</td>
<td>.16*</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>WR Composite</td>
<td></td>
<td></td>
<td></td>
<td>.48***</td>
<td>-.19</td>
</tr>
<tr>
<td>4</td>
<td>PPVT Slope</td>
<td>.54</td>
<td>.04</td>
<td>5.21**(2,112)</td>
<td>.09</td>
<td>.09</td>
</tr>
<tr>
<td></td>
<td>WR Composite Slope</td>
<td></td>
<td></td>
<td></td>
<td>.38**</td>
<td>.38**</td>
</tr>
<tr>
<td>5</td>
<td>WR Fluency</td>
<td>.59</td>
<td>.05</td>
<td>12.69**(1,111)</td>
<td>.53**</td>
<td>.53**</td>
</tr>
</tbody>
</table>

Note. MAT= Nonverbal Ability; PA= English Phonological Awareness (PAT) intercept; RAN Digit= English Rapid Naming Speed Digit intercept; PPVT= English Peabody Picture Vocabulary intercept; WR composite = English word reading composite (WI, WA) intercept; PPVT Slope= English Peabody Picture Vocabulary rate of growth; WR composite Slope= English word reading composite (WI, WA) rate of growth; WR Fluency = English word reading fluency (TOWRE) intercept

***$p < .001$, **$p < .01$

$^a$Standardized beta coefficient for the step at which the predictor first entered the model

$^b$Standardized beta coefficient for the predictor in the final step of the model

In sum, two specific observations can be drawn from the results pertaining to the analysis of the slopes. First, in order to model English reading comprehension in ELLs, both the intercepts and the rate of the growth on predictors should be considered. Second, while nonverbal ability and the intercepts of English cognitive and SVR clusters explained a significant 49% of the shared variance in Grade 4 English reading comprehension, the rate of growth on the
word reading composite and the intercept of word reading fluency were the strongest unique predictors of later English reading comprehension in the presence of all the other variables. These results are consistent with the notion of change in the nature of the predictor variables.
Chapter Five: Discussion

The overall goal of the present study was to examine the validity of an extended version of the SVR framework in explaining reading comprehension development in two groups of elementary school ELLs coming from typologically different L1 backgrounds – Chinese and Spanish. This study also explored the contribution of L1 cognitive and linguistic skills as well as the rate of growth on early L2 predictors. These objectives were explored in three parts using descriptive, regression and hierarchical linear modeling analyses.

Part one sought to examine whether an extended model of SVR that includes not only decoding and oral language variables, but also cognitive processing variables (PA and RAN that are known predictors of word reading) as well as word reading fluency would provide a more comprehensive model of reading comprehension in ELLs with Chinese or Spanish language backgrounds. Part two explored the cross-language relationships between early L1 and L2 skills and English reading comprehension within each language group. Lastly, part three investigated the effects of individual differences in growth processes of basic cognitive and linguistic skills on reading comprehension. This part was designed to determine whether variability in individual slopes (rate of growth) in early cognitive and linguistic predictors of reading comprehension in English can be explained by L1 status.

Part One

An Extended SVR Framework in Young ELLs

The first objective of the research was to investigate whether the key processes of the SVR model (oral language and decoding) each account for unique variance in Chinese and
Spanish ELL children’s reading comprehension in English. The second objective was to examine whether an SVR model of reading comprehension, supplemented with cognitive processing variables (PA, RAN) and word reading fluency, would provide a more comprehensive model of reading comprehension in ELLs.

It was hypothesized that since the Chinese and Spanish languages are different in respect to their orthographic systems, different patterns of association among predictors might emerge. However, in the case of the Chinese and Spanish ELLs in the present sample, language background did not distinguish early L2 predictors of L2 reading comprehension a few years later, and the same early L2 cognitive and linguistic skills contributed to individual differences in L2 reading comprehension in both groups. In fact, the preliminary descriptive and correlational analyses indicated that despite some significant differences between the performance of the Chinese and Spanish ELLs on the outcome variable (reading comprehension in Grade 4), and some of the predictors such as English receptive vocabulary, English word reading composite, and English word reading fluency, the patterns of the inter-relationships among variables were similar in both groups; on the whole, the same predictors of reading comprehension operate in both. These results led us to combine the two groups so that they were treated as one single ELL group.

The findings confirmed that oral language and decoding are critical skills for ELLs, and individual differences in Grade 1 on these skills can predict reading comprehension three years later. Altogether, about 35% of the variance in reading comprehension was accounted for by the simple SVR model. This is a replication of other studies with regard to EL1s (e.g., Joshi & Aaron, 2000; Kendeou, Van Den Broek et al., 2009; Paris & Paris, 2003; Tilstra et al., 2009) as well as with regard to ELLs (e.g., Geva & Farnia, 2012; Gottardo & Muller, 2009; Hoover &
The second hypothesis was confirmed as well. It turns out that individual differences on additional skills assessed in Grade 1, aside from the SVR components, augment the SVR, and account for a significant additional 37% of the variance in subsequent performance on reading comprehension in ELLs. Consistent with previous research involving ELLs (Farnia & Geva, 2013; Yaghoub Zadeh et al., 2012), over and above the significant role of accurate word reading and breadth of vocabulary knowledge, two additional underlying cognitive processes, PA and RAN, play a significant role in explaining subsequent reading comprehension of ELLs in Grade 4.

It has been shown in previous research that regardless of language status, cognitive skills such as PA and RAN are crucial skills for developing decoding in EL1 and ELLs alike (Geva, 2006; Nation, Clarke, Marshall, & Durand, 2004). However, the relationships among such underlying cognitive processes and reading comprehension are not that simple. Although the current research provides additional support for the significant contribution of PA and RAN to reading comprehension, the role of these cognitive variables in explaining unique variation in reading comprehension diminishes when SVR variables are added to the model. It is possible to predict subsequent reading comprehension on the basis of early performance on PA and RAN in Grade 1, but the prediction is more accurate if information about word reading and vocabulary is available. This observation does not minimize the importance of early cognitive skills, which are important for developing accurate and fluent word reading skills (e.g., Wolf & Bowers, 1999). Instead, they underscore their indirect effects through word reading. This indirect longitudinal association of PA and RAN with subsequent reading comprehension is in line with previous
studies that proposed the mediating role of word reading in the relationship among cognitive skills and reading comprehension (e.g., Gottardo & Mueller, 2009; Johnston, & Kirby, 2006; Tunmer & Nesdale, 1985; Yaghoub Zadeh et al., 2012). More specifically, these indirect relationships should be considered in light of (a) the consistently significant correlations between cognitive variables and word reading; (b) the significant correlations between these cognitive variables and reading comprehension; and (c) the considerable percent of variance (19%) in reading comprehension explained by individual differences on PA and RAN, even before the effects of word reading (and vocabulary) are taken into account (see Appendix E). Both PA and RAN are considered as prerequisites of word reading, and when entered into the model along with the word reading, their effects are already included within the word reading (decoding) aspect of the model (Geva, 2006; Johnson & Kirby, 2006; Nation et al., 2004).

The findings from the present study also provide new insight regarding the role of word reading fluency in ELLs’ reading comprehension development. Although the D term in the SVR model has been considered as “decoding accuracy” in numerous studies, and has been measured accordingly, it has been argued (Kirby & Savage, 2008) that decoding fluency should also be considered within the SVR model for EL1s and ELLs alike. In the present study, the role of English word reading fluency was explicit and salient, and it explained an additional 5% of the unique variance in reading comprehension above and beyond the contributions of all the other variables. Individual differences in accurate decoding tell only part of the story. As Kirby and Savage (2008) explained, accurate but slow decoding is not sufficient to support reading comprehension in English. In line with Baker et al. (2012) and Yaghoub Zadeh et al. (2010), the results demonstrate the significant role of word reading fluency in enhancing reading comprehension of ELLs and clarifies that this conclusion is valid whether the home language is
Chinese or Spanish. The current study underscores the importance of developing fluent word reading in ELLs coming from different language backgrounds, even when their oral language skills are still developing. It shows that already in Grade 1, slow and inaccurate decoding skills can foretell whether ELLs may struggle or thrive when they are expected to comprehend what they read in subsequent years.

While both Baker et al. (2012) and the current study were each longitudinal, Baker and his colleagues assessed different age groups of Spanish speaking ELLs three times over one year. The current study evaluated development of the participants whose home language is Chinese or Spanish, less intensely but over a longer time span. The longitudinal design of the current study shows that performance on certain cognitive and linguistic skills in Grade 1 can predict individual differences in reading comprehension three years later. Baker et al. indicated that overall, 30-36% of the variance in reading comprehension (at the end of each grade) was explained by the initial score of reading fluency (assessed at the beginning of each grade). On the other hand, in the present study, the total significant variance of Grade 4 reading comprehension explained uniquely by Grade 1 word reading fluency was 5%. These different results may be due to the fact that Baker et al. only included measures of word and text reading fluency (both initial level and growth) in their model. In the present study, however, the significant role of Grade 1 word reading fluency in Grade 4 reading comprehension was demonstrated in the presence of other predictors such as PA, RAN, receptive vocabulary and accurate decoding skills.

Of relevance to the present study is a longitudinal study (Grades 2 to 5) conducted by Geva and Farnia (2012), who provide support for the validity of a more complex, “augmented” SVR model that includes word and text reading fluency in addition to the SVR variables (oral language and word reading). Taken together, despite their methodological differences, recent
longitudinal studies of ELLs have shown consistently that reading fluency is an important component of reading comprehension, to be considered in terms of instruction in general, and adapting instruction to various learner profiles more specifically.

In sum, the findings of the present study support the relevance of the SVR framework for ELL children coming from Chinese and Spanish home language backgrounds. They further suggest that variables beyond decoding and oral language exert influence on reading comprehension and that the SVR can and should be augmented by considering the influence of individual differences in early cognitive skills and word reading fluency when studying the development of skills that matter for later reading comprehension.

The fact that none of the cognitive and SVR variables maintained their unique contributions to reading comprehension after word reading fluency was added to the model, and the positive moderate to high correlations among these variables and word reading fluency, suggest that all the variables in the model share a substantial amount of variance with word reading fluency in explaining the variability in reading comprehension. An interesting observation that supports this possibility was the fact that in every step of the modeling, each variable showed a significant unique contribution to reading comprehension before the next set of the variables was added to the model. This observation provides support for the past research in respect to the role of early cognitive skills as the prerequisites for early SVR skills, as well as the significant role of early SVR skills in the development of word reading fluency. Therefore, it is not surprising that all the early cognitive and SVR variables in the model predict later reading comprehension through word reading fluency. The results further suggest that regardless of home language, an important focus of any literacy intervention program should be on developing the fundamental skills involved in word reading accuracy and fluency, as well as oral language
skills. The question to address in future research is whether targeted instruction to ELLs might change the nature of the development of these skills and in turn facilitate further the development of language and reading comprehension. After all, one would want to believe that the relationships between individual differences on cognitive, language and literacy skills in Grade 1 and Grade 4 should not be that easily predictable because good teaching practice should alter the course of development.

**Part Two.**

*The Contribution of Cross-Linguistic Predictors to Reading Comprehension*

The discussion shifts now to an examination of the cross-language relationships between early L1 and L2 skills and English reading comprehension in the Chinese and Spanish as L1 groups. The main objective was to find out to what extent individual differences on L1 skills assessed early (i.e., in Grade 1) would contribute to reading comprehension in English above and beyond early L2 skills. It was hypothesized that early L1 cognitive skills (PA and RAN) would not contribute to English reading comprehension after the parallel L2 cognitive skills have been considered, the logic being that PA and RAN are underlying cognitive processes that are relevant across languages and do not need to be acquired separately for each language; once they have been acquired they can transfer from one language to another (Genesee et al., 2006). Taking typological differences in the spoken and written language into account, it was also expected that early L1 oral language skills as well as L1 decoding would contribute to English reading comprehension in the Spanish group but not in the Chinese group. The rationale for these predictions was that the structures of the spoken and written Spanish and English languages are more similar than Chinese and English. Also, Spanish and English are both alphabetic languages and share word patterns (e.g., root words, derivations) whereas Chinese is a morpho-syllabic
language with a more complex visual pattern compared to English. Previous research showed mixed results with respect to the question of whether and the extent to which L1 processes might predict L2 reading comprehension.

The present study revealed several interesting findings in respect to the cross-linguistic transfer from L1 to L2. First, contrary to expectations, there was a significant contribution of early Spanish cognitive skills (PA and RAN) to Grade 4 English reading comprehension above and beyond the contributions of the L2 parallel skills. In fact, Spanish cognitive skills explained 10% of the variance in English reading comprehension three years later. But this was not the case with regard to Chinese ELLs: Chinese L1 early cognitive skills did not maintain their significant and unique contributions to Grade 4 L2 reading comprehension in the presence of the parallel L2 measures. The cross-linguistic transfer of cognitive skills to English reading comprehension was only evident in the Spanish ELL group and not in the Chinese group. These results underscore the importance of considering home language, typological differences, and the possibility that certain skills such as Chinese PA may not be strongly related to English. In fact, the results of the analyses revealed different correlational patterns among L1 and L2 variables in the two language groups. On the basis of the current results, there is no consistent support for a generalizable, language-universal theory that argues that underlying cognitive processing skills can “transfer” cross-linguistically and are not language specific. Instead, it appears that one needs to consider a “script dependent” typological framework as complementary (Geva, 2014).

These findings seem to extend our understanding of the typological differences in features of the spoken or written form of languages (Katz & Frost, 1992; Frost, 1994). Languages vary in terms of their orthographies and/or their writing systems (scripts). In languages with shallow orthography, such as German, Spanish, and Italian, there is a relatively
simple letter-sound correspondence; therefore, the influence of underlying cognitive skills is mediated by orthographic differences between L1 and L2 (Abu-Rabia, 1997; Dafontoura & Siegel, 1995; Gholamian & Geva, 1999). In the case of the present study, Spanish and English are typologically similar and share more structural features both in terms of the spoken language and in terms of the writing system. By contrast, compared to alphabetic scripts, Chinese characters have greater visual complexity due to the existence of both semantic and phonological cues. Chinese words are constructed from single syllable morphemes (small, homophonic units with multiple free or bound morphemes; Packard, 2000). When reading Chinese, entire syllable units are retrieved and used for phonological encoding, unlike English where segments of words or morphemes are retrieved (O’Sieaghdha et al., 2010). These differences between the structural features of the languages under study might explain the differences in the nature of cross-language transfer of PA between these two groups of ELLs.

As suggested by Manis et al. (2004) and Nakamoto et al. (2008) in their longitudinal study with elementary Spanish ELLs attending a transitional bilingual program, the contribution of L1 skills to L2 may be mediated by parallel L2 skills. Mancilla-Martinez and Lesaux (2010) also found that Spanish word reading and Spanish vocabulary skills were not accounting for unique variance in later English reading comprehension among their low-achieving Spanish-speaking sample. These findings were attributed to the fact that the children did not receive formal Spanish instruction and were also using more English at home.

Furthermore, unlike the Lindsey et al. (2003) study, the present study does not reveal any evidence for cross-linguistic transfer of early L1 decoding and oral language skills to later English reading comprehension. It is important to note that participants in the Lindsey et al. (2003) study were educated in a bilingual context. The children in the present study attended
schools with English as the language of instruction; therefore it is not surprising that L2 reading comprehension, which is highly related to oral language proficiency, is strongly related to L2 skills.

The ELLs in the present study did not receive any formal instruction in their L1 and may have shifted toward speaking more English than their L1 at home. Cross-language transfer should be expected when children are given formal academic instruction in both L1 and L2, and a minimum age-appropriate threshold of language proficiency is reached in both languages (Cummins, 1976). In the present study, while there is evidence for cross-linguistic transfer of Spanish underlying cognitive skills such as PA and RAN to English reading comprehension, there is no evidence of transfer with regard to the SVR component skills, language and decoding. The fact that receptive vocabulary and word reading in L1 do not predict reading comprehension in English may be attributed to the low proficiency of the participants in the current study in their first language. Support for this argument comes from the preliminary analyses and the percentage of correct responses on L1 measures.4

Another explanation is that children who receive academic instruction in their L2 eventually lose their proficiency in L1, or in fact may never develop it adequately (Jia & Aaronson, 2003; Westernoff, 1991). The children in the present study had not attained an academic L1 and were developing their English L2 at school and on the playground. As can be seen from their vocabulary knowledge, their performance on the vocabulary measure in Grade 1

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4 According to this report, the mean percent of correct responses on the L1 word reading measure was 6% and 22%, in the Chinese and Spanish ELL groups, respectively. The reported mean percent of correct responses to the receptive vocabulary measure in L1 was 22% and 32% in the Chinese and Spanish ELLs, respectively. However, means are misleading here. Altogether, only 3 of the children in the Chinese ELL group were able to respond correctly to at least half of the questions on the L1 receptive vocabulary and L1 word reading measures. In the Spanish ELL group, none of the children was able to respond to at least half of the questions on the two above-mentioned measures.
was equivalent to an English vocabulary level of below kindergarten\textsuperscript{5}. Therefore, these children cannot be considered as monolingual English but ELLs. Although some ELLs continue to develop their L1 skills, either through the heritage programs they attend, typically once a week, or through language use at home, their language and literacy skills in the L1 may not develop at the same rate as their peers who live exclusively in Spanish or Chinese environments and receive systematic, sustained and frequent academic instruction in their L1 (Gottardo & Muller, 2009). Based on the available demographic information, the majority of children in the present study are Canadian-born, and only 50\% were attending a heritage program. Clearly they were not fluent in their L1, but the results also show that on the basis of the language of school instruction, English, it is possible to reliably predict reading comprehension.

All in all, the results of the current study suggest that basic cognitive skills (e.g., PA and RAN), regardless of L1 proficiency level, may transfer from L1 to L2, especially if the two languages are typologically similar (English and Spanish in case of the present study). Furthermore, higher level language and literacy skills such as receptive vocabulary and word reading should reach a certain proficiency level in the L1 in order to be transferred to an L2. However, these results require replication and the use of ELL samples with different levels of exposure to oral and written L1 at home.

Part Three

The Contribution of Rate of Growth on Predictors of Reading Comprehension

A key interest in the present study is examining the relative role of initial status and growth rates in L2 cognitive and linguistic skills in predicting later reading comprehension

\textsuperscript{5} Note: The grade equivalent for the mean performance on the Grade 1 English receptive vocabulary (PPVT) task was below kindergarten level for both the Chinese and Spanish ELLs in the present sample (Dunn & Dunn, 1981).
achievement. In particular, the focus is on individual differences in the developmental trajectories of L2 cognitive and linguistic skills, and the potential unique contribution of these trajectories to English reading comprehension in Grade 4 of Spanish and Chinese ELLs.

Given that ELL children from both language backgrounds had similar exposure to English literacy instruction, it was hypothesized that their cognitive-linguistic skills would develop at a similar rate. Although no group differences between Spanish ELLs and Chinese ELLs were anticipated for developmental trajectories (Grade 1 to Grade 4) of predictors, different patterns of growth were observed in the two language groups with regard to English receptive vocabulary, word reading composite, and PA. Contrary to expectations, both ELL groups showed significant linear growth over time from Grade 1 to Grade 4 on these measures. In addition, the findings show that the average growth rates in receptive vocabulary, word reading composite, and PA were significantly higher in the Chinese ELL group than the Spanish ELL group. However, group membership did not affect the rate of growth on RAN and word reading fluency. Furthermore, while both language groups showed significant linear growth over time in word reading fluency, there was no evidence of significant growth in RAN. The non-significant growth in this cognitive skill can be attributed to the ceiling effect on this measure. RAN is a hard-wired cognitive ability and when it is acquired there is no further development expected.

The analyses revealed several interesting results regarding the patterns of relationships among the predictor variables, their slopes, and Grade 4 reading comprehension. First, the slope associated with PA did not predict the variation in reading comprehension when the initial status on this variable was already in the model. Second, the slopes associated with receptive vocabulary and the word reading composite (i.e., the SVR components) explained an additional
4% of the shared variance in Grade 4 reading comprehension after taking into account the contribution of their respective initial status. Third, after the contribution of English word reading fluency initial status was taken into account, the slope associated with word reading fluency did not make any additional contributions to reading comprehension.

The final model consists of the initial status of underlying cognitive variables (PA and RAN), the initial status of the SVR variables (receptive vocabulary and word reading composite), and the initial status of word reading fluency, as well as the slopes of the SVR variables. This model explained 59% of the shared variability in reading comprehension three years later, with the slope associated with the word reading composite and the initial status of word reading fluency making unique contributions to the model.

The results are in line with those of Mancilla-Martinez and Lesaux (2010), who demonstrated the significant role of both the initial status and the slopes of vocabulary and word reading in predicting reading comprehension. The present study does not replicate the findings of Baker et al. (2012), who found that both initial status and the slope of word reading fluency made a significant contribution to ELL reading comprehension. However, the fact that the slope of word reading composite and the initial status of the word reading fluency variable, and not the slope of word reading fluency, were shown to have the most significant and unique contributions to Grade 4 reading comprehension in the present study support the notion of developmental change in the nature of these variables proposed by Geva and Farnia (2012). These researchers showed that developmental change in the nature of the reading fluency construct occur with development. They argued that word and text reading fluency form a single factor that relies more on basic word-level reading skills (e.g., orthographic, phonological, and morphological processes) at the early stages of reading acquisition.
The findings of the present study underscore the importance of considering the rate of growth on early predictors of reading comprehension. In addition to ELL children’s skills level at the beginning of schooling, it may be important to monitor the growth of these skills and the developmental changes in the nature of the variables, particularly in the elementary grades. This may be useful in identifying children who may be at risk for future problems in reading comprehension and who may require early intensive instruction and/or intervention with building blocks of reading comprehension such as vocabulary knowledge and word reading.

**Summary, General Discussion, and Implications**

The results of the research reported in this dissertation confirm and expand our understanding of the complex nature of reading comprehension development in ELL groups. This dissertation provides support for a more complex model of reading comprehension development in ELLs, which includes cognitive variables (PA and RAN) as well as word reading fluency in the SVR model for Chinese and Spanish ELLs alike.

The findings support the notion that beyond being a simple descriptive model, SVR can help to identify how the influence of these skills may change as children develop. The findings also suggest that additional components, and in particular cognitive skills (e.g., PA and RAN) and word reading fluency, should be added to the SVR to enhance our understanding of factors contributing to reading comprehension of ELLs in the lower school grades.

The current study extends the findings of previous studies related to SVR in several respects. First, the present study is based on a longitudinal design, following individual children from Grade 1 to Grade 4, rather than a cross-sectional design. The longitudinal nature of this study provides a better understanding of the developmental change in the nature of the variables
as children move from lower elementary levels to the upper levels. For instance, reading skills
(both accuracy and fluency) begin to develop early in children’s lives, at first entangled but
gradually developing independently, with each having considerable and stable contributions to
reading comprehension over time (from Grade 1 to Grade 4). Second, previous studies have used
either pseudoword reading or word identification as a measure of decoding skill. In the present
study, decoding is measured by creating composite scores based on pseudoword and word
identification scores. The word reading composite score better represents different aspects of
decoding processes in children. Including both the pseudoword and real word reading scores may
explain the indirect contribution of PA and RAN to reading comprehension through the word
reading composite measure. Pseudoword reading relies more on PA (e.g., sounding out smaller
units), while RAN is more important for learning larger units (e.g., whole word). Therefore, it
seems as though the effects of both cognitive skills are already included within the composite
decoding measure. Third, the inclusion of both L1 and L2 variables in the SVR model is
important to determine whether assessing ELL children in their L1, with or without similarities
to their L2, would provide a better understanding of the nature of their reading comprehension
development in L2. However, the ELLs in the present study did not seem to have adequate
proficiency in their L1, because they did not receive formal instructions in these languages. It
should be noted that underscoring the importance of L1 skills does not necessarily mean that we
need to teach ELLs in their L1 to help them acquire English. Rather, understanding the
relationship between ELLs’ L1 and L2 skills facilitates monitoring their progress in school and
identifying their sources of difficulties when learning English.

Given that the present findings validated an extended SVR model as a relevant model of
reading comprehension in ELL children, policy makers should consider this model as a guiding
theory to design effective teaching and intervention with struggling ELL readers (Kirby & Savage, 2008).

**Instructional Implications**

From a practical point of view, these findings could guide literacy assessment, instruction, and intervention. First, they showed that early assessment of cognitive and literacy skills is valuable in predicting later reading comprehension performance. Second, with regard to instruction, the findings suggested that improvement and development of literacy and cognitive skills in the early years may lead to better comprehension of texts later on. Third, the importance of both initial levels and rate of growth on early predictors has direct instructional implications, as it provides a conceptual framework for designing appropriate teaching practices that targets not only the initial skill but the rate of development of early literacy skills at the elementary level for ELL children. It seems as though the risk of comprehension difficulties is low when early intensive instruction is provided, which may change the nature of the development of the early skills. Decoding and oral language as well as reading fluency development should be part of the ELLs’ curriculum, and teachers should frequently monitor growth in order to accommodate ELLs’ changing needs. Moreover, understanding the importance of the growth rate in critical predictors (e.g., word reading, oral language, fluency) of later reading comprehension facilitates screening and identifying ELLs who may become struggling readers few years later.

**Implications for Future Research**

Although this study validates the importance of cognitive and word reading fluency skills within the SVR framework in a unique way that has not been investigated in young ELL children, there are still many other aspects of the SVR model that need to be empirically investigated in this population. For instance, because the study was an analysis of existing
datasets, it was not possible to include text reading fluency and other measures of oral language skills. Also, the findings of the study might have been different if a measure of reading comprehension in Grade 1 could have been included as an auto-regressor. Furthermore, the outcome measure used in this study is relies highly on decoding ability. Replicating the study by adding other measures of reading comprehension that tap into different underlying skills such as vocabulary, listening comprehension and prior knowledge should provide a more comprehensive and generalizable picture of the relationships between the predictors and the outcome.

A major limitation confronting this study is the lack of sufficient demographic data. There are many studies suggesting the importance of individual differences due to demographic characteristic such as SES, home literacy experience, and parental education (Goldenberg, Rueda, & August, 2006; Yaghoub Zadeh, Farnia, & Ungerleider, 2010). Unfortunately, there was insufficient data to allow for any conclusions in this regard to be drawn. However, this study provides a rich set of findings about the relationships among early cognitive and literacy skills and later reading comprehension achievement in ELLs. The analyses carried out in this study confirmed previous empirical research and revealed new findings to be taken into account in future research.
References


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Appendix A

**Descriptive Statistics: Age in Months, Reading Comprehension, and English Independent Variables in Cantonese and Mandarin ELL Groups**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cantonese</th>
<th>Mandarin</th>
<th>F</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in month) (G1)</td>
<td>81.43</td>
<td>80.00</td>
<td>.23</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>(3.40)</td>
<td>(4.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAT (SS) (G2)</td>
<td>109.98</td>
<td>106.50</td>
<td>1.30</td>
<td>.02</td>
</tr>
<tr>
<td></td>
<td>(11.19)</td>
<td>(12.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC (G4)</td>
<td>26.04</td>
<td>23.90</td>
<td>1.19</td>
<td>.02</td>
</tr>
<tr>
<td></td>
<td>(6.74)</td>
<td>(8.64)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPVT (G1)</td>
<td>87.38</td>
<td>76.60</td>
<td>4.11*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(19.97)</td>
<td>(19.86)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WR Composite (G1)</td>
<td>31.60</td>
<td>29.86</td>
<td>.27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(13.53)</td>
<td>(14.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA (G1)</td>
<td>3.62</td>
<td>3.45</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.82)</td>
<td>(2.86)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAN (G1)</td>
<td>54.91</td>
<td>50.00</td>
<td>2.33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(11.51)</td>
<td>(13.24)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WR Fluency (G1)</td>
<td>44.62</td>
<td>40.30</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(18.73)</td>
<td>(19.98)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Standard deviations are reported in parenthesis, MAT= Non-verbal ability; RC = English reading comprehension (NEALE); PPVT= English Peabody Picture Vocabulary; WR Composite= English word reading composite (WI, WA); PA= English phonological awareness (PAT); RAN = English rapid naming speed digit; WR Fluency= English word reading fluency (TOWRE).*  

*p< .05*
Appendix B
Chinese Word Recognition Task

Word Recognition
(adapted from Chan & Siegel, by Gu et Gottardo)

Ceiling: Stop after examinee misses 6 test items in a row.

Section A:

十大
上
山
天

好
红
妈
明
眼

足
看
声
果
黄

海
狗
脸
树
脚

Section B:

物
空
形
计
放
地
但
到
她
法

定
活
苦
合
叫
明
利
开
论
想

新
当
运
学
么
路
称
都
会
像

说
战
过
道
电
种
样
奸
防
邻

吻
咳
澡
帕
攻
吝
怯
汁
匠
帆

抄
泣
刻
舒
构
构
译
闭
缰

造
劲
讼
指
嘴
需
涤
慈
碑
糕

器
毯
勇
寄
勤
街
旗
裤
集
赐
Appendix C
English Sound Deletion Task (PAT)

Sound Deletion Test (part II)

Instructions for the practice trials for the onset-rime and phonemic awareness sub-tests

1. Say ZICK. Now say ZICK without saying Z (response: ICK)
   a) If the child says ICK say “Good, that’s right. ZICK without saying Z is ICK”.
   b) If incorrect say “That’s not quite right. ZICK without saying Z is ICK”.
2. Say TANE. Now say TANE without saying T (response: ANE). Give the same feedback as before for this and subsequent practice items.
5. Say FEEG. Now say FEEG without saying F (response: EEG).

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
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<th></th>
<th></th>
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<th></th>
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<tbody>
<tr>
<td>13. vock</td>
<td>v</td>
<td>ock</td>
<td>(sock)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>14. mez</td>
<td>m</td>
<td>ez</td>
<td>(Egra)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>15. blap</td>
<td>b</td>
<td>ap</td>
<td>(map)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>16. gope</td>
<td>g</td>
<td>ope</td>
<td>(rope)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>17. spoid</td>
<td>sp</td>
<td>oid</td>
<td>(void)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>18. dreek</td>
<td>dr</td>
<td>eek</td>
<td>(week)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>19. loof</td>
<td>l</td>
<td>oof</td>
<td>(roof)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>20. file</td>
<td>f</td>
<td>like</td>
<td>(like)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>21. troag</td>
<td>tr</td>
<td>oag</td>
<td>(vogue)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>22. bloss</td>
<td>bl</td>
<td>oss</td>
<td>(gloss)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>23. staib</td>
<td>st</td>
<td>aib</td>
<td>(babe)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>24. teeg</td>
<td>t</td>
<td>eeg</td>
<td>(league)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. bip</td>
<td>p</td>
<td>bi</td>
<td>(bit)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>26. zaiv</td>
<td>v</td>
<td>zai</td>
<td>(zany)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>27. kleeb</td>
<td>k</td>
<td>leeb</td>
<td>(leek)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>28. dreep</td>
<td>d</td>
<td>rep</td>
<td>(step)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>29. fawb</td>
<td>b</td>
<td>faw</td>
<td>(fox)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>30. smaif</td>
<td>s</td>
<td>maif</td>
<td>(safe)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>31. fize</td>
<td>z</td>
<td>fie</td>
<td>(tie)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>32. kem</td>
<td>m</td>
<td>ke</td>
<td>(keg)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>33. ploke</td>
<td>p</td>
<td>loke</td>
<td>(cloak)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>34. skov</td>
<td>s</td>
<td>kov</td>
<td>(cob)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>35. daf</td>
<td>f</td>
<td>da</td>
<td>(dad)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
<tr>
<td>36. griss</td>
<td>g</td>
<td>ris</td>
<td>(risk)</td>
<td>C</td>
<td>R</td>
<td>NR</td>
</tr>
</tbody>
</table>

Onset-Rime Awareness /12 correct

Phoneme Awareness /12 correct

Examiner’s initials ____________
Appendix D
Chinese Tone Discrimination Task

TONE DISCRIMINATION
(Adapted from So & Siegel, by Pan, Gu & Gottardo)

Instructions: I am going to read some words. Each time after I have read 3 words, (you say them back to me) and then tell me which word has a different tone, the first, the second or the third?

要求：我念念一些字，每次念三个。请你先跟我念，然后告诉我哪个字与其它两个字声调不同。

练习： (1) 拔4 喊3 汉4
(2) 方1 劳1 放4

测验： (1) 园4 昆1 坤1 YES
(2) 厮4 母3 目4 YES
(3) 莲2 怜2 锻4 YES
(4) 妈1 麻2 哭1 YES
(5) 今3 金1 YES
(6) 路4 陆4 庐2 YES
(7) 船1 传2 YES
(8) 油2 友3 YES
(9) 也1 持2 迟2 YES
(10) 物4 错4 YES
(11) 林1 还2 YES
(12) 烹2 肯1 阔2 YES
(13) 级2 机1 集2 YES
(14) 亮4 靓2 凉2 YES
(15) 韵4 盘2 盤4 YES
## Appendix E

The Role of Early Cognitive Variables in Predicting Grade 4 English Reading Comprehension – A 2-step Hierarchical Linear Regression Model Summary Table (combined sample: N=120)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F$ ($df_1, df_2$)</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAT</td>
<td>.13</td>
<td>.13</td>
<td>17.86*** (1,118)</td>
<td>.19*</td>
</tr>
<tr>
<td>2</td>
<td>PA</td>
<td>.33</td>
<td>.19</td>
<td>16.65*** (2,116)</td>
<td>.20*</td>
</tr>
<tr>
<td></td>
<td>RAN</td>
<td></td>
<td></td>
<td></td>
<td>.37***</td>
</tr>
</tbody>
</table>

**Note.** MAT = Nonverbal ability; RC = English reading comprehension (NEALE); PA = English phonological awareness (PAT); RAN = English rapid naming speed digit

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

$\beta$: Standardized beta coefficient for the predictor in the final step of the model.