

**Do Knowledge and Motivation Matter? The Role of General Knowledge and Reading  
Motivation in Reading Achievement in the Elementary Years**

by

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## **Dedication**

To my God, families, friends, teachers, and all who understand what a treasure it is to be able to communicate in more than one language

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## Abstract

Reading development in students who are second language learners (SLLs) has been a concern of many educators. It is important to understand reading development in students who are SLLs to effectively support their reading development. The dissertation consists of two studies, presented in two stand-alone manuscripts, that aimed to deepen our understanding in the role of general knowledge and reading motivation in reading development in students who are SLLs, along with students who are monolinguals (MLs). Students who were MLs were also included in the studies to explore how similar or different the role of general knowledge and reading motivation are in reading development of students who are SLLs and students who are MLs.

In the first study of this dissertation, I explored the contributions of kindergarten general knowledge and third-grade reading motivation to reading growth from first through fifth grade in U.S. students, using the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99. The longitudinal associations of the predictors with reading growth were examined because the findings can contribute to understanding reading difficulties emerging in later grades. The main statistical approaches included factor analysis to identify motivational constructs and multi-group latent growth modeling to examine how the two predictors simultaneously predict reading growth, while controlling for early decoding skills and demographic covariates. The results indicated that early general knowledge predicted reading growth to a similar extent between the two groups (approximately  $\beta = .20$  on a growth slope). In addition, third-grade reader self-

perception explained reading growth similarly in both groups (approximately  $\beta = .09$  on a growth slope), even after accounting for early general knowledge.

In the second study of this dissertation, I investigated the role of fourth-grade science knowledge (a proxy for general knowledge) and reading motivation in fourth-grade reading comprehension of informational and narrative texts. The study used three merged international datasets (PIRLS 2011, TIMSS 2011, and the combined dataset of TIMSS and PIRLS 2011). By using the international datasets, the study was able to investigate reading development in fourth-grade students from five countries. Factor analyses were used to identify motivational constructs for reading, and the associations of reading comprehension of each genre with science knowledge and reading motivation were examined with multi-group multilevel regression, controlling for demographic covariates. The results indicated that science knowledge, reader self-perception, and reading attitudes predicted informational and narrative reading comprehension to a similar extent between students who were SLLs and students who were MLs (approximately  $R^2 = .40$ ).

The concurrent and longitudinal association between general knowledge and reading development suggests that enhancing knowledge at the beginning of schooling and in the middle grades may support reading development in students who are SLLs as well as students who are MLs. However, policies related to reading development (e.g., the U.S. No Child Left Behind Act) have often focused on enhancing reading skills apart from knowledge development. It is important to convince policy makers that enhancing students' knowledge has the potential to support reading development not only in students who are MLs but also students who are SLLs. Additionally, the two studies revealed that reader self-perception significantly predicted reading development concurrently and longitudinally for both language groups. Professional

development for teachers to enhance reader self-perception of students may benefit students' reading development, regardless of language status.

## **Introduction**

The ability to read well is crucial for most academic and career development. Students who are second language learners (SLLs) have the asset of developing knowledge of more than one language, but they are also more likely than monolingual students to have difficulties in reading not only in the U.S. (National Center for Education Statistics, 2015), but around the world (Melby-Lervåg & Lervåg, 2014). As well, the number of students who are SLLs has increased around the world (McFarland et al., 2017; OECD, 2010). It is important to support reading development of students who are SLLs because reading difficulties would often translate to unequal access to content knowledge development, college education, and career opportunities. The question then becomes how can we effectively support reading development in students who are SLLs? This has been my central inquiry throughout my graduate studies.

Understanding the reading development of students who are SLLs is one of the prerequisites to effectively enhancing their reading competence. Our understanding can help us predict trajectories of reading growth and potential reading difficulties of students who are SLLs. In addition, our understanding can serve as a guide in making instructional, curricular, and policy decisions for supporting reading development (Duke & Carlisle, 2011). Among the variety of contributors to reading development (RAND Reading Study Group, 2002), two of the contributors that I have been particularly interested in have been prior knowledge and reading motivation.

Prior knowledge is a key component of reading comprehension according to theoretical grounding of comprehension. Readers leverage their prior knowledge to draw inferences about information the author may leave out and learn from reading by integrating prior knowledge and the textbase representation (Kintsch, 1994, 2004). Despite its theoretical importance, the role of prior knowledge in reading development in second language (L2) has not been studied extensively. For example, most L2 studies have focused on prior topic knowledge in relation to comprehending a text on that topic, whereas few studies have explored the role of domain or general knowledge.

Another factor that is theoretically and empirically important to reading comprehension but understudied among students who are SLLs is reading motivation. Some scholars caution that “we must be concerned with the will and thrill, not just the skill, of comprehension” (Duke, Pearson, Strachan, & Billman, 2011, p. 61). By “will and thrill,” Duke and colleagues (2011) mean the persistence and enjoyment students have to interact with the texts themselves, which are related students’ general motivation to read. Motivated readers are likely to engage in reading with persistence, which can further enhance their reading development (Guthrie et al., 2006). Fostering reading motivation in students may have the potential to support them to become life-long readers.

In a previous study, I explored how prior knowledge and reading motivation simultaneously contribute to first language (L1) and second language (L2) reading comprehension (Hwang & Duke, 2017). We included both as predictors in the study because reading comprehension is multifaceted in nature. We found that third-grade general knowledge and reading motivation positively predicted third-grade reading comprehension in students who were SLLs (also English learners; ELs) and students who were monolingual (MLs) in a

nationally representative sample of students in the U.S. General knowledge was observed with the strongest coefficient among the predictors and covariates, which included reading motivation, decoding skills, SES, school poverty, minoritized status, and gender, and the coefficient of reading motivation was similar to the coefficient of socioeconomic status. General knowledge was more strongly associated with reading comprehension in students who were ELs than students who were MLs.

From my previous study, I learned that cultivating general knowledge and reading motivation may have the potential to support reading comprehension, regardless of students' language status. I am also aware that, in the U.S., instructional time dedicated to supporting knowledge development in the primary grades is disproportionately small. In the year of 2007-2008, only 2.3 hours per week were spent on social studies and science each, whereas 11.7 hours were spent per week on English Language Arts (Blank, 2013). This neglect of knowledge-building in early schooling led me to wonder how early general knowledge, along with reading motivation, is associated with reading development in the later grades. In addition, I am aware that the number of students who are SLLs is increasing around the world, but previous studies on prior knowledge and reading motivation have been frequently conducted in one country, usually in North American and European countries. Thus, I became curious to know how the two predictors simultaneously explain reading comprehension in students who are SLLs living in different countries.

### **Overview of the Dissertation**

The dissertation studies aimed to address my questions about how general knowledge and reading motivation predict reading development concurrently and longitudinally in students who are SLLs living in different countries. I used large-scale U.S. national and international datasets

for the studies. I selected large-scale datasets because using representative samples can enhance generalizability of findings. In addition, studies using large-scale datasets have informed educational reform (Mullis, Martin, Goh, & Cotter, 2016), been included in resources for policy makers (e.g., Klein & Knitzer, 2007; Lovejoy et al., 2013), and received interest from media (e.g., Gewertz, 2012; Resmovits, 2012). The findings from the analyses of large-scale datasets regarding prior knowledge and reading motivation may inform the discourse for supporting reading development. Based on previous studies, including my own, prior knowledge and reading motivation need to receive more attention from educators and policy makers than before.

An alternative format was selected for the dissertation: two journal-length manuscripts ready to be submitted for publication. An alternative format has the potential to communicate results of studies with a wider audience of educational field more quickly than a traditionally format of dissertation, thus increasing the likelihood of impacting research and practice in a timely fashion (Duke & Beck, 1999). Each manuscript has been written for researchers and discusses the rationale of the study and conceptual framework; summarizes previous research; reviews method of the current study (i.e., datasets, samples, variables, and analytic approaches); explains and interprets the results; and discusses the implications, limitations, and contributions of the study.

In the first study, I explored the relationship of reading growth from first through fifth grade with kindergarten general knowledge and third-grade reading motivation in students who were SLLs (also English learners; ELs) and students who were MLs in the U.S. The study addressed the following research questions: First, does general knowledge measured in the fall of kindergarten predict reading growth between the spring of first grade through the spring of fifth grade for students who were ELs and students who were MLs in the U.S? Second, to what extent

does reading motivation in the winter of third grade explain reading growth between the spring of first grade through the spring of fifth grade for students who were ELs and students who were MLs in the U.S., over and above general knowledge measured in the fall of kindergarten?

The study used the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K; Tourangeau, Nord, Lê, Sorongon, & Najarian, 2009). The sample was a cohort of students who entered kindergarten, representative of U.S. children in the academic year of 1998-99. Fifteen percent of students were learning English as their second language, whereas the rest of the children were MLs. The results of analyses of multi-group latent growth models indicated that early general knowledge in the beginning of schooling predicted reading growth throughout the elementary years to a similar extent between students who were ELs and students who were MLs (approximately  $beta = .25$  on a growth intercept; approximately  $beta = .20$  on a growth slope), controlling for decoding skills in the beginning of schooling and demographic covariates. Reading motivation explained additional variance in reading growth, controlling for early general knowledge and decoding skills in the beginning of schooling and demographic covariates; students with more positive reader self-perception were likely to show greater growth in reading than those with less positive reader self-perception (approximately  $beta = .09$  on a growth slope), regardless of language status. The findings of the study suggest that cultivating general knowledge from the beginning of schooling and fostering positive reader self-perception may have the potential to bolster reading growth in students who are ELs and students who are MLs in the elementary years.

In the second study, I focused on the concurrent relationship of reading comprehension with general knowledge and reading motivation. Informational and narrative genres were examined separately in relation to general knowledge and reading motivation. Data from more

than one country were used because the findings would be more applicable to different countries than a single-country study would be. The specific research question asked was: In five countries (Australia, Canada [Quebec], Germany, Hong Kong, and Singapore), how are fourth-grade reading motivation and science knowledge (a proxy for general knowledge) related to informational and narrative reading comprehension in students who are SLLs and students who are MLs?

The study used three international datasets, collected and provided by the International Association for the Evaluation of Educational Achievement (IEA). The five countries were chosen because the immigration rates of these countries were higher than the rest of the countries that participated in the research conducted by the IEA (United Nations, 2016). Based on the results from multi-group multilevel regression analyses, the study showed that, general knowledge and reading motivation (reading attitudes and reader self-perception) positively predicted informational and narrative reading comprehension in students who were SLLs and students who were MLs across the five countries, controlling for gender and home resources for learning as student-level covariates and school averages of home resources for learning and dummy variables for countries as school-level covariates. The magnitude of the relationships between the predictors and reading comprehension for each genre was similar between the language groups. General knowledge was the strongest contributor in both groups of students (approximately  $beta = .40$  for each genre), followed by reader self-perception (approximately  $beta = .20$  for the informational; approximately  $beta = .30$  for narrative) and reading attitudes (approximately  $beta = .08$  for the informational; approximately  $beta = .05$  for narrative). The findings of this study suggest that: (1) general knowledge can facilitate reading comprehension of informational and narrative texts, regardless of language status, and (2) supporting students'

reading motivation may strengthen reading comprehension of both genres in students who are SLLs and students who are MLs.

In summary, the dissertation studies have potential implications for general knowledge and reading motivation in relation to reading development in students who are SLLs, as well as students who are MLs, in the elementary years. For example, the findings of the studies suggest that it may not be advisable to pull students who are SLLs out of content area instruction to teach basic reading/language skills. The studies also extend previous research into how a broader form of prior knowledge (rather than topic knowledge) and reading motivation simultaneously predict reading development in young elementary-aged readers (rather than secondary and post-secondary students) who are SLLs living in different countries.

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**Chapter 1: Manuscript 1: The Role of Early General Knowledge and Reading Motivation  
in First- and Second-language Reading Growth: A Longitudinal Study from First through  
Fifth Grade**

**Abstract**

This study investigated the role of early general knowledge and reading motivation in reading growth of elementary school students in the U.S who were English learners (ELs) and students who were monolinguals (MLs). Using nationally representative longitudinal data, the analyses of latent growth models showed consistent pattern in both groups: Controlling for demographic background and early decoding skills, early general knowledge in kindergarten predicted reading growth from first through fifth grade, and reader self-perception in third grade accounted for a specific portion of the variance in the growth. The findings of the study suggest that fostering knowledge development in the beginning of schooling and cultivating reader self-perception have the potential to support reading growth, regardless of language status.

*Keywords:* reading growth, English learners, prior knowledge, reading motivation, longitudinal analysis

## Introduction

Reading comprehension is necessary to function as an independent member of society. In the modern world, most routines in everyday life and in professional contexts require proficiency in reading a variety of texts. However, students who are English learners (ELs) are more likely to have difficulty with reading. Mancilla-Martinez and Lesaux (2010) reported that fourth-grade students who were ELs in the U.S. showed, on average, a second-grade level of reading ability based on the national norms of a test used in their study. Nakamoto, Lindsey, and Manis (2007) observed that students who were ELs started to lag behind the normative sample of students who were monolinguals (MLs) in reading achievement as of third grade. The results of a national assessment of reading also showed a gap in reading development between the two language groups (Polat, Zarecky-Hodge, & Schreiber, 2016). Only eight percent of fourth-grade students who are ELs achieved the ‘proficient’ level of reading, while 39 percent of fourth-grade students who are MLs achieved the same level. Moreover, the number of students who are ELs in the U.S. has been increasing: approximately 10 percent of students are learning English as their second language (McFarland et al., 2017).

In an effort to support students’ reading development, major U.S. literacy policies and programs have focused on supporting students’ reading skills (e.g., No Child Left Behind, Reading First, some state policies associated with the reading-by-third-grade movement). Although supporting reading skills of students can bolster their reading development, previous research has also indicated that supporting prior knowledge and reading motivation may have the potential to support reading development. For example, having prior knowledge related to a topic of a text can be helpful in generating inferences (Fincher-Kiefer, 1992; Pearson, Hansen, & Gordon, 1979) and creating coherent representation of the text (McNamara & Kintsch, 1996).

Miller and Keenan (2009) found that the gap between poor and good decoders in recall of information central to the text was reduced when poor readers had prior topic knowledge. The authors argued that the finding supported the hypothesis that prior knowledge can compensate for low decoding skills. As well, developing students' knowledge in social studies and science was observed to improve oral and reading comprehension skills of children in primary grades (Connor et al., 2017). Regarding motivation for reading, Guthrie et al. (2006) showed that supporting reading motivation of third-grade students improved their reading comprehension even after their initial level of reading comprehension was statistically controlled. Cartwright, Marshall, and Wray (2015) showed that reading motivation can predict reading comprehension beyond decoding skills, verbal ability, and executive function in first- and second-grade students. However, these previous studies only included students who were MLs, not students who were ELs. We need more evidence regarding whether and to what extent prior knowledge and reading motivation can facilitate reading development in students who are ELs.

Recently, Hwang and Duke (2017) examined the role of third-grade science knowledge and reading motivation in third-grade reading comprehension in students who were ELs and students who were MLs. They found that both predictors explained reading comprehension regardless of language status. However, their study did not examine the role of prior knowledge and reading motivation in reading growth (i.e., gains over time). Exploring the longitudinal relationships between each of the two predictors and reading development is important to understanding reading difficulties emerging in later grades, particularly for students who are ELs. Therefore, the current study was conducted to investigate whether and to what extent prior knowledge and reading motivation in earlier grades explain reading growth throughout the elementary years in students who were ELs and students who were MLs, using a national

longitudinal dataset (ECLS-K). Many previous studies have controlled for language status to fit data from the two language groups in one reading model. However, it would be flawed to assume that the trajectory of language and literacy development is the same between students who are ELs and students who are MLs (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014). Thus, the present study examined the role of the predictors in reading growth for each language group separately and tested coefficients of the predictors on reading growth for significant differences between the two language groups.

### **Conceptual Framework**

The conceptualization of reading comprehension according to the Construction-Integration Model (Kintsch, 1998, 2013) is discussed first. Then, knowledge and reading motivation are explained as factors in reading development. Specifically, different types of knowledge and operational concepts of knowledge in reading research are outlined and different constructs of reading motivation recurring in reading research are explained. I also discuss why general knowledge and reading motivation may jointly predict reading development.

### **Reading Comprehension**

Reading comprehension can be defined as a process in which a reader constructs a textbase and a situation model of a text (Kintsch, 1998, 2013). The textbase representation is derived by constructing the microstructure and macrostructure of the text. The situation model is constructed when the reader integrates the textbase with prior knowledge. Reading comprehension is influenced by multiple factors and the interplay among them, including text factors (e.g., text structure), reader factors (e.g., language proficiency), and the context in which reading activities occur. Thus, how factors contribute to reading development individually and

jointly is likely to vary among readers (Duke & Carlisle, 2011). For example, Riddle Buly and Valencia (2002) observed six profiles of readers who have different weaknesses and strengths in decoding, fluency, and meaning construction even though the readers displayed the similarly low levels of reading comprehension ability. In this line of thought, predictors might explain reading development in students who are ELs differently from reading development in students who are MLs. For example, due to still-developing second language proficiency, we hypothesize that students who are ELs might depend on their prior knowledge more to comprehend texts than students who are MLs (Hwang & Duke, 2017). It is necessary, then, to examine a reading model separately for each language group, rather than assuming one reading model can fit for both groups.

Among many potential contributors to reading comprehension, this study focused on two reader characteristics, prior knowledge and reading motivation of readers, to examine reading development in students who were ELs and students who were MLs.

### **Knowledge**

Knowledge can be defined as information and the organization of information stored in long-term memory (Anderson & Pearson, 1984; Cook & Gueraud, 2005), and three dimensions of knowledge are regarded to influence comprehension processes: lexical knowledge (e.g., the meaning of “tree”), featural knowledge (e.g., the characteristics of a tree such as colors and height), and script/scenario knowledge (e.g., experience of planting a tree). In reading research, the term *prior knowledge* has been frequently used as an umbrella term to refer to existing knowledge readers have in relation to the information in a text (e.g., Mason, Tornatora, & Pluchino, 2013; Soalt, 2005) and interchangeably with *background knowledge* (e.g., Coiro, 2011; Droop & Verhoeven, 1998). Researchers have used knowledge measures or questionnaires that

assessed different types of knowledge, including topic, domain, and general/world knowledge (Cervetti & Wright, in press). Topic knowledge accounts for knowledge specifically related to a topic of text, whereas domain knowledge is a body of knowledge related to a field of study or discipline. In school contexts, it often means subject matter knowledge (e.g., Anmarkrud & Bråten, 2009; Lin & Yang, 2007). General/world knowledge can be defined as knowledge in more than one domain (e.g., Best, Floyd, & McNamara, 2008; Kozminsky & Kozminsky, 2001). Measures for general/world knowledge often assess broad knowledge on school-type topics (Cervetti & Wright, in press).

### **Reading Motivation**

Motivation refers to a mechanism or a process that determines activation, intensity, and persistence of behavior (Bandura, 1977; Boekaerts, 2001), and reading motivation can be defined as a relatively stable readiness or willingness of a person to engage in reading (Wigfield & Guthrie, 1997). Reading motivation consists of multiple constructs. Four recurring constructs in the reading motivation literature are reading attitudes, intrinsic motivation, reading self-efficacy, and reading self-concept. Reading attitudes can be defined as “a system of feelings related to reading which causes the learner to approach or avoid a reading situation” (Alexander & Filler, 1976, p. 1). Mathewson's (1994) conceptualization extends reading attitudes beyond feelings about reading by including readiness to engage in reading and beliefs about reading. Reading attitudes and intrinsic motivation are conceptually related to each other (Schiefele et al., 2012), which can be defined as “the enjoyment of reading activities that are performed for their own sake” (Guthrie & Wigfield, 2000, p. 268).

Reading self-efficacy accounts for “the belief that one can be successful at reading” (Wigfield & Guthrie, 1997, p. 422). Schiefele et al. (2012) argued that reading self-efficacy

indicates readers' evaluation of their own reading ability, whereas reading self-concept includes not only self-evaluation of reading ability but also feedback from others and comparison to others (e.g., peers, teachers, parents). Many reading motivation surveys include both items for reading self-efficacy and for reading self-concept to capture perceived competence in reading (e.g., Chapman & Tunmer, 1995; Wigfield & Guthrie, 1997). Reader self-perception, defined as how readers feel about themselves as readers (Henk & Melnick, 1995), is related to both reading self-efficacy and reading self-concept in that it also involves readers' appraisal of themselves as readers. Items of the instrument for reader self-perception were designed to "prompt children to think about their reading ability" (Henk & Melnick, 1995, p. 473).

### **The Role of General Knowledge and Reading Motivation in Jointly Relating to Reading Development**

In order to construct a coherent representation of a text, readers need to integrate propositions of a text and make inferences about information not explicitly stated in a text. Cook and O'Brien (2014) postulated that when readers make connections among the propositions, readers evaluate coherence among them against their general knowledge. In addition, Cain, Oakhill, Barnes, and Bryant (2001) posited that readers leverage their general knowledge when they make inferences about what was not explicitly stated in a text and that the ability to generate inferences may partially stem from general knowledge.

Despite the postulations about the mechanism of how general knowledge can facilitate reading comprehension, few studies have actually measured general knowledge of readers to understand its role in reading development. Empirical evidence of how prior knowledge can support reading development has been documented mostly by previous studies that used topic-knowledge measures. Nevertheless, the findings from studies using topic-knowledge measures

can be applied to understanding how general knowledge can facilitate reading development because knowledge of multiple topics in more than one discipline is considered general knowledge. High general knowledge might have similar advantages that topic knowledge would bring to reading development, with higher probability of encountering texts about familiar topics, such as making inferences about information not explicitly stated in texts (Fincher-Kiefer, 1992) and about meanings of unknown words (Cervetti, Wright, & Hwang, 2016), partially compensating for low reading ability (Recht & Leslie, 1988) and verbal ability (Schneider, Körkel, & Weinert, 1989). Additionally, having strong general knowledge might indicate that readers not only have developed knowledge of different topics but also the relationships among and structures within them in more than one discipline. Complicated networks among different knowledge units can facilitate activation of relevant knowledge to a text (Bereiter, 1991).

General knowledge may play an important role in maintaining coherence of text representation, but it is also conceivable that reading motivation is likely to determine the quality and characteristics of the coherence. Readers might adopt different standards of the coherence according to their motivation to read (van den Broek, Bohn-Gettler, Kendeous, Carlson, & White, 2011). Readers who believe that they can be successful at reading (i.e., positive reader self-perception) may be inclined to have more stringent standards for the coherence and to put more effort to maintain coherence than readers with less positive reader self-perception. Readers with positive attitudes toward reading might show frequent readiness to engage in reading and might display strong persistence to maintain coherence of a text representation even when they encounter challenges during reading.

Hypothetically, it is possible that readers with strong reading motivation but low general knowledge may approach reading more strategically to remedy the difficulties due to insufficient

general knowledge than readers with low reading motivation and general knowledge.

Additionally, readers with strong general knowledge but low reading motivation may have fewer difficulties in building the coherence of their text representation compared to readers with low general knowledge. However, when they encounter challenges in reading (e.g., reading texts with technical vocabulary and/or ill-structured texts), they may be less engaged in constructing a coherent text representation (e.g., skimming a text) than those readers who have high reading motivation. From this perspective, it can be postulated that general knowledge and reading motivation can predict reading achievement simultaneously to some degree.

## **Previous Research**

### **The Role of Prior Knowledge in L1 and L2/FL Reading Development**

Previous L1 reading research has shown that having knowledge related to a topic of a text can facilitate reading comprehension of that text (Fincher-Kiefer, 1992; McNamara & Kintsch, 1996; Priebe, Keenan, & Miller, 2012; Wiley, 2005). Readers with rich knowledge on a topic of a text have been observed to recall more of the text than readers with low knowledge related to the topic of the text (Priebe et al., 2012; Wiley, 2005). In addition, having prior knowledge on a topic of a text can be advantageous in making inferences about information not explicitly stated in the text (Fincher-Kiefer, 1992) and in comprehending low-coherence passages about that topic (McNamara & Kintsch, 1996).

Some researchers have postulated that having topic knowledge compensates to some degree for general low reading ability and other literacy-related skills. Recht and Leslie (1988) compared poor readers with high knowledge of baseball with good readers with low knowledge of baseball on recalling and summarizing a text about baseball (fifth and seventh grade). They found that poor readers with high knowledge about baseball reenacted the action of baseball

players described in a text better and produced a better retelling of a baseball game described in the text than good readers with low knowledge baseball did. The authors argued that having knowledge on a topic related to a text facilitates the comprehension process that is otherwise impaired by low reading ability. Similarly, Adams, Bell, and Perfetti (1995) observed that readers with high knowledge of football but with low reading skills comprehended a text about football as well as did readers with high reading skills but with low knowledge of football (fourth and seventh grade). Taylor (1979) showed a significantly larger gap in performance on recall between reading the familiar and unfamiliar topic in poor readers (fifth graders who read a third-fourth grade level) than good readers (third graders at a third-fourth grade level). The author concluded that poor readers' reading would be more compromised than good readers when the use of prior knowledge is restricted. Taken the findings together, it appears that prior knowledge is supportive of poor readers' comprehension and perhaps, based on Taylor (1979), more so than for good readers.

It has been argued more specifically that prior topic knowledge facilitates reading due to compensation for low decoding skills. Priebe et al. (2012) as well as Taft and Leslie (1985) have reported that poor decoders made more decoding errors that were semantically congruent with meaning of a text when they had prior knowledge related to the topic of a text, and did better on reading comprehension measures, compared to when they read a passage about a topic that they did not know well. The authors of both studies speculated that prior topic knowledge can help readers rely more on semantic cues than graphic cues in decoding a text about that topic.

Moreover, knowledge on a topic of a text might compensate for low verbal ability when reading a text about that topic. For example, Schneider et al. (1989) observed that students in third, fifth, and seventh grades who knew a lot about soccer but had low verbal ability (as

measured by vocabulary knowledge, word classifications, and sentence completion) performed better on three reading comprehension measures for soccer-related texts (identifying text details, drawing inferences, and detecting contradictions in the text) than students in third, fifth, and seventh grades who knew little about soccer but had high verbal ability. The study did not examine reading comprehension in L2, but their finding provides a reason to think that prior topic knowledge (as opposed to general knowledge, which is discussed later in this section) might compensate for still-developing L2 proficiency of students who are ELs in comprehending L2 texts about that topic.

Fewer studies have been conducted to examine the relationship between L2 reading development and prior knowledge. Most studies have reported the positive role of prior knowledge in L2 and foreign-language (FL) reading development. For example, Rydland, Aukrust, and Fulland (2012) studied reading development of fifth-grade students in Norway who spoke Turkish or Urdu as their L1 and Norwegian as their L2. Their study showed that prior topic knowledge significantly predicted performance on the reading measure of passages about that topic. Prior topic knowledge explained reading comprehension more than L2 decoding, whereas L2 vocabulary was not significant. In addition, a significant interaction between L2 depth of vocabulary and prior topic knowledge was observed, suggesting that students with high vocabulary knowledge might have benefited more from prior topic knowledge than students with low vocabulary knowledge. Burgoyne, Whiteley, and Hutchinson (2013) found that students who were ELs could leverage prior topic knowledge in drawing inferences to comprehend a text about that topic. In a standardized reading comprehension assessment, students who were MLs outperformed students who were ELs. However, with topic knowledge instruction, students who were ELs did as well as students who were MLs did on inferential questions about a text on that

topic, even though students who were MLs still did better on explicit literal questions about the text than students who were ELs.

Moreover, some research has indicated that the extent to which prior topic knowledge facilitates L2 reading comprehension of a text on that topic might rely on complexity of a text. For example, Barry and Lazarte (1995) examined L2 reading development in high school students who spoke English as L1 and were learning Spanish as second or foreign language. The students were grouped into high-knowledge and low-knowledge readers according to their knowledge on topics of passages and read three levels of the passages that differed by syntactic complexity. The quality of recall of the texts in all levels showed the advantage of prior topic knowledge: high-knowledge readers generated better recall of the texts compared to low-knowledge readers' recall. However, the quality of high-knowledge readers' recall of the most complicated text was more compromised than their recall of the easiest and intermediate levels of texts. The authors argued that the complicated syntax of the most difficult passages overrode the advantage of knowing the topics of the passages.

In addition, Droop and Verhoeven (1998) examined how comprehension of texts is influenced by readers' knowledge about topics of the texts and linguistic complexity of the texts (e.g., length of sentences and syllables). They included third-grade Dutch students who were MLs and Turkish and Moroccan students who were second language learners (SLLs) of Dutch. They found that for simple texts, the advantage of topic knowledge was evident: students who were SLLs outperformed students who were MLs on reading measures when both groups read texts about cultures familiar to students who were SLLs. However, for complicated texts, students who were MLs outperformed students who were SLLs, even when both groups read texts about cultures familiar to students who were SLLs. The authors postulated that due to

limited L2 proficiency, students who were SLLs could not benefit from their topic knowledge when they read complicated texts.

L2 proficiency has been hypothesized to influence the role of topic knowledge in comprehending a text on that topic. Carrell (1983) claimed that advanced L2 learners whose L2 proficiency is above the upper end of threshold would rely less on prior knowledge than intermediate L2 learners. Al-Shumaimeri (2006) argued that high L2 proficiency would enable L2 learners to rely more on reading strategies and skills than prior knowledge. As well, Hudson (1982) suggested that poor L2 proficiency below the low end of the threshold would prevent L2 readers from making use of prior knowledge. The empirical evidence for the hypothesis of L2-proficiency threshold has been inconsistent. Carrell's study (1983) supported the upper-end-threshold hypothesis. There was no significant association found between topic familiarity and text comprehension on that topic in advanced and high-intermediate learners of English, whereas a significant relationship was found in students who were MLs. Ridgway (1997) supported the lower-end-threshold hypothesis. He divided the sample of Turkish students who were ELs into high and low groups of L2 proficiency and found a significant relationship between topic familiarity and text comprehension on that topic only in high L2 proficiency group, but not the low L2 proficiency group.

The empirical findings that prior topic knowledge did not predict L2 reading comprehension of a text on that topic for certain levels of L2 proficiency need to be interpreted cautiously. First, most studies have not measured topic knowledge directly. Rather, ratings of topic familiarity were used. Second, criteria to divide students according to their L2 proficiency have been vague and have differed across studies. However, given the findings of previous studies, it would be interesting to examine whether the longitudinal relationship between prior

knowledge and L2 reading development may or may not change as students who are ELs progress to later grades given that it is likely that their L2 proficiency would be better in later grades than earlier grades.

Most studies on the relationship between prior knowledge and L2/FL reading development have included secondary or postsecondary students (e.g., Al-Shumaimeri, 2006; Carrell, 1983; Ridgway, 1997). Malik (1990), Fang (1994), and Hammadou (2000) reported the positive role of prior topic knowledge in comprehending a text about that topic in a target foreign language among college students. Malik (1990) also reported that students made more semantically and syntactically acceptable decoding errors when they read culturally familiar text than unfamiliar text. More L2/FL studies are necessary that include students in the elementary years to extend our understanding of the role of prior knowledge in L2/FL reading development in the elementary years.

In both L1 and L2/FL studies, it seems that prior knowledge has been predominantly operationalized as knowledge related to a topic of a text, and few studies have examined prior knowledge beyond specific topic knowledge. Exceptionally, Tarchi (2010) and Anmarkrud and Bråten (2009) have explored the role of domain knowledge (which, as noted earlier, is a body of knowledge related to a field of study or discipline) in reading comprehension in L1 reading. Both studies have shown that domain knowledge predicted reading comprehension of a text in that domain. However, Anmarkrud and Bråten (2009) also reported that domain knowledge was no longer a significant predictor when prior topic knowledge was inserted in a regression model for reading comprehension. General knowledge (which, as explained earlier, is knowledge in more than one domain) has been rarely examined, either. McNamara, Ozuru, and Floyd (2011) showed the positive association of general knowledge (including knowledge of biology, physical science,

social sciences, and the humanities) with L1 narrative and informational text comprehension in fourth graders. Moreover, a study conducted by Grissmer, Grimm, Aiyer, Murrah, and Steele (2010) revealed that a general-knowledge measure in the beginning of kindergarten was the strongest predictor of L1 reading achievement in fifth grade. However, their statistical approach could not show the growth rate of reading development over time because they only included two repeated reading measures. Statistical approaches to analyze growth rate such as latent growth modeling and mixed models require at least three repeated measures. Thus, the study did not precisely analyze how the relationship between early knowledge and reading achievement in a later grade changes throughout the elementary years.

Regarding L2 reading research, almost no research has been conducted to investigate the role of domain or general knowledge in L2 reading development, except for Hwang and Duke (2017). They investigated the association of third-grade L1 and L2 reading development with third-grade measure for knowledge in earth and space science, physical science, and life science (a proxy for general knowledge) and showed that the knowledge measure predicted L1 and L2 reading comprehension positively, even after controlling for third-grade decoding skills, early decoding skills, reading motivation, and demographic covariates. Interestingly, the relationship between science knowledge and reading comprehension was stronger for students who were ELs than students who were MLs. Based on their findings, it seems to reasonable to compare the coefficients of prior knowledge on reading development between the two language groups rather than to assume that they are equivalent. Notably, the authors did not examine the longitudinal association between general knowledge and reading development. The relationship between early general knowledge and reading development may become weaker over time as students develop language proficiency and/or reading strategies or may not become weaker in students

who are ELs and/or in students who are MLs. Thus, it is interesting in this research context to examine and compare the role of general knowledge in reading growth over time in students who are ELs and students who are MLs.

## **The Role of Reading Attitudes and Intrinsic Motivation in L1 and L2/FL Reading**

### **Development**

L1 reading research has shown that intrinsic motivation to read and reading attitudes are positively related to reading development. Mucherah and Yoder (2008) and Park (2011) have reported that intrinsic motivation to read, along with reading self-efficacy/self-concept, explained performance on reading measures. Some previous studies have examined intrinsic reading motivation with literacy-related variables. For example, Retelsdorf, Köller, and Möller (2011) found that intrinsic motivation predicted reading growth from fifth through eighth grade, controlling for decoding speed and number of books at home. In terms of reading attitudes, Petscher (2010) conducted a multilevel meta-analysis of 32 studies on the relationship between reading achievement and reading attitudes (conceptualization by Mathewson, [1994]) and found a moderately strong positive relationship ( $Z = 0.32$ ). The relationship was stronger among elementary students ( $Z = 0.44$ ) than among middle school students ( $Z = 0.24$ ). In addition, intrinsic motivation and reading attitudes can explain reading achievement even after the initial level of reading achievement was controlled for (Guthrie et al., 2006 for intrinsic motivation; Kush, Watkins, & Brookhart, 2005; Martínez, Aricak, & Jewell, 2008 for reading attitudes). Furthermore, the relationship between reading achievement and reading attitudes or intrinsic motivation to read has been observed to be mediated by the amount of reading (Becker, McElvany, & Kortenbruck, 2010; Schaffner, Schiefele, & Ulferts, 2013 for intrinsic motivation;

McKenna, Conradi, Lawrence, Jang, & Meyer, 2012; McKenna, Kear, & Ellsworth, 1995 for reading attitudes).

Fewer L2 reading studies have examined intrinsic motivation for reading or reading attitudes in relation to reading achievement. Dhanapala and Hirakawa (2016) showed that intrinsic motivation predicted L2 reading achievement positively among college students whose L1 is Sinhala and L2 is English. Positive reading attitudes have been observed to be related with better reading achievement in L2/FL. For example, Sani and Zain (2011) found that reading attitudes, along with reading self-efficacy, predicted reading development in English (L2) in middle school students whose L1 was Bahasa Malaysia. Their survey for reading attitudes asked about feelings about reading in English (“I like to have time to read English in class”), beliefs about reading (“Reading in English is almost always boring”), and willingness to engage in reading (“I like to read in English before I go to bed”). In EFL settings, Kim (2016) administered a survey of reading attitudes to college students in South Korea, created by Yamashita (2004). The survey for reading attitudes asked students to rate positive feelings (*comfort*; e.g., “I feel relaxed if I read in English”), negative feelings (*anxiety*; e.g., “I feel anxious if I don’t know all the words,” and *discomfort*; e.g., “I feel pressure when I read in English”), and *evaluative beliefs* about reading.<sup>1</sup> The study found that only discomfort had a significant (negative) relationship to reading achievement in English, whereas *comfort*, *anxiety* and *evaluative beliefs* did not. Students who felt less discomfort when reading in English were likely to perform better on a reading measure in English than those who felt more discomfort. Despite the findings of previous studies, few studies have explored reading development in the elementary years in

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<sup>1</sup> The items about feelings are related to reading attitudes (Mathewson, 1994), however, the items about evaluative beliefs (consisting of linguistic value, utility value, and practical value) appear to be more related to the value of reading, that is, the perception of what can be gained by engaging in reading (Wigfield & Eccles, 2000), rather than reading attitudes.

relation to reading attitudes or intrinsic motivation to read. More studies on the relationship between reading attitudes and L2 reading in the elementary years are needed.

### **The Role of Reading Self-efficacy and Self-concept in L1 and L2 Reading Development**

Previous L1 reading studies have shown that reading self-efficacy predicts reading achievement among elementary (De Naeghel, Van Keer, Vansteenkiste, & Rosseel, 2012) and secondary students (Mucherah & Yoder, 2008; Retelsdorf et al., 2011). In addition, studies have examined reading self-concept to understand L1 reading achievement. McGeown, Duncan, Griffiths, and Stothard (2015) showed that reading self-concept (e.g., “I am: a poor reader; an OK reader; a good reader; a very good reader,” p. 554) was related to reading achievement, as well as the value of reading, even after controlling for word reading (marginal significance for reading self-concept,  $p < .06$ ). Anmarkrud and Bråten (2009) found that reading self-concept (e.g., “compared with the others in my class, I have a good understanding of books that I read,” p. 256) was not significantly related to reading achievement, whereas the value of reading predicted reading achievement positively in a study with variables for reading self-concept, prior topic knowledge, prior achievement of social studies (i.e., domain knowledge), value of reading, and reading strategies.

Fewer studies have been conducted to examine the role of reading self-efficacy or self-concept in L2 reading development. Sani and Zain (2011) reported positive associations of L2 reading achievement with reading self-efficacy (“I believe that I am a poor reader in English,” p. 248) and reading attitudes among secondary students whose L1 is Bahasa Malaysia and L2 is English. Taboada Barber et al. (2015) investigated the relationship of reading self-efficacy (“I can understand the main idea of a story,” p. 48) with L1 and L2 reading comprehension in middle school students. The authors found that reading self-efficacy contributed to the reading

measure significantly in students who were ELs but not in students who were MLs, controlling for a previous reading measure. Based on their finding, reading self-efficacy might not contribute to reading development to the same degree in students who were ELs and students who were MLs. Thus, a study is needed to include both language groups and examine the relationship between reading self-efficacy and reading development for each group separately. Also, more studies that include elementary students who are ELs are needed to understand the role of reading self-efficacy.

**Reading motivation and prior knowledge.** In both L1 and L2 reading research, few studies have been conducted to examine how reading motivation and prior knowledge simultaneously predict reading development. Baldwin, Peleg-Bruckner, and McClintock (1985) and Stahl, Jacobson, Davis, and Davis (1989) have examined topic interest rather than motivational constructs for reading. Baldwin et al. (1985) demonstrated that prior topic knowledge and topic interest were positively related to comprehension of a text on that topic in L1 among secondary students. However, Stahl et al. (1989) found a significant relationship only between prior topic knowledge and reading comprehension of a text on that topic in L1, but not between topic interest and reading comprehension. Anmarkrud and Bråten (2009) investigated the role of topic knowledge, domain knowledge in social studies, value of reading, reading self-efficacy, and the use of reading strategies in comprehending a text on that topic in L1. They reported that reading self-efficacy, domain knowledge, and the use of reading strategies were not significant predictors, whereas topic knowledge and the value of reading were. In sum, results of studies that examined both reading motivation and prior knowledge in L1 readers have shown that prior knowledge contributed to reading development, whereas the contribution of reading motivation to reading development has not consistently been found.

Only a small number of studies have been conducted to examine how prior knowledge and reading motivation jointly explain reading development in students who are ELs with the exception of Hwang and Duke (2017). The findings of their study showed the important role of general knowledge and reading motivation in both language groups, but still there is a gap in our knowledge on whether and to what extent general knowledge and reading motivation in earlier grades predict growth in reading in L1 and L2. Moreover, their study used a composite variable for reading motivation rather than exploring different motivational constructs for reading. Thus, in examining the longitudinal relationships of general knowledge and reading motivation, a study that explores the roles of different motivational constructs for reading and general knowledge in reading growth can deepen our understanding on L1 and L2 reading development.

### **Present Study**

The present study was conducted to examine reading growth in students who were ELs and students who were MLs in the elementary years. Using six years of longitudinal data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K; Tourangeau, Nord, Lê, Sorongon, & Najarian, 2009), the study seeks to extend the existing research by investigating how general knowledge, reading attitudes, and reader self-perception jointly predict reading growth between first and fifth grade in a nationally representative sample of U.S. students, including both students who were ELs and students who were MLs. Specifically, general knowledge was measured in the fall of kindergarten, and a survey about reading motivation was administered in the winter of third grade. The study explored the extent to which the predictor variables explained variance in growth of reading when early decoding skills measured in the fall of kindergarten and demographic information (SES, gender, and minority status) were controlled. In addition, the trajectory of reading development and the role of the

predictors to reading growth were systematically compared between the two language groups. The study provides information about to what extent general knowledge at the beginning of schooling can predict reading growth and to what extent the motivational constructs can predict reading growth for each language group in the elementary years beyond general knowledge. The specific research questions were:

1. Does general knowledge measured in the fall of kindergarten predict reading growth between the spring of first grade through the spring of fifth grade for students who were ELs and students who were MLs in the U.S?

2. To what extent does reading motivation in the winter of third grade explain reading growth between the spring of first grade through the spring of fifth grade for students who were ELs and students who were MLs in the U.S., over and above general knowledge measured in the fall of kindergarten?

## **Method**

### **Dataset**

This study used data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K; Tourangeau et al., 2009), a study conducted by the National Center for Education Statistics (NCES). The purpose of the ECLS was to provide comprehensive and reliable data to understand children's development and experiences from kindergarten through elementary and middle school grades, as well as relationships of early experiences to their later development. The NCES collected information from a nationally representative sample of children, their parents, teachers, and schools across the U.S. by using a multistage probability sampling design. Therefore, the ECLS-K data includes children from diverse socioeconomic, racial, and linguistic backgrounds who attended a variety of public, private, and parochial

schools. The study began with a cohort of students entering kindergarten in the academic year of 1998-99 and followed this cohort through eighth grade. Information on children's cognitive, socioemotional, physical development as well as information on their home, classroom, and school environment was obtained from the children, their families, and their schools through direct assessments or surveys. Information including reading achievement was collected at seven time points: the fall and the spring of kindergarten (1998-99), the fall of first grade (for a random sub-sample of students) and spring of first grade (1999-2000), the spring of third-grade (2002), the spring of fifth-grade (2004), and the spring of eighth-grade (2007).

As the current study focused on reading in the elementary years, data obtained in eighth grade were not used. Of the 16,143 fifth-grade students originally selected for the ECLS-K study, 11,820 students responded to questionnaires and/or participated in direct assessments (unweighted frequency). The analytic sample includes 10,589 students who had a fifth-grade reading score. Of 10,589 students, information about 10,116 students' home language is present in the dataset. Among them, approximately 15 percent of students' parents ( $n = 1,432$ ) reported they spoke a non-English language at home as a primary language, while the rest of them ( $n = 8,296$ ) spoke mainly English at home.

### **Measures and variables**

**Language status.** Language status was determined by a composite variable about the primary language at home, created by ECLS-K researchers. Children whose parents reported that their primary home language was not English were considered students who were ELs. The children were considered students who were MLs when their parents reported that their primary home language was English. The home language, rather than language proficiency, was used as a criterion to determine language status because a test of language proficiency was not

administered to every grade. In addition, home language is arguably a better criterion for language status than a test of language proficiency for a national sample because the distinction between limited versus proficient English proficiency varies across school districts and states (Lesaux & Harris, 2015).

The ECLS-K manual reported that the composite variable was formed from two items of the parents survey administered in the fall of kindergarten: “Is any language other than English spoken in your home?” and “What is the primary language spoken in your home?” (Tourangeau et al., 2009). If the first question was left blank, then the case was coded as missing on the composite variable. Cases were coded as English (i.e., home language is English) on the composite variable: 1) when an answer to the first question was “no,” or 2) when an answer to the first question was “yes” (another language spoken at home), and at the same time, an answer to the second question was “English language” (primary language is English) (Although it is possible that students in case 2) were not entirely monolingual, that seems the best characterization for the purposes of this study given that their primary home language is English and their primary school language is presumably English.). Cases were coded as non-English (i.e., home language is non-English) when an answer to the first question was “yes” and an answer to the second question was “non-English language.” The questions about language at home were asked when the children were kindergarteners and first graders. In the current study, the parents’ response when children were in kindergarten was used because the longitudinal analysis included kindergarten as the starting time point.

**General knowledge.** The ECLS-K administered knowledge measures, named as *general knowledge*, to kindergarteners and first graders, which assessed knowledge and skills in natural

science and social studies in children. The numbers of items for natural science and social studies were approximately equal (Rock, Pollack, Educational Testing Service, & Hausken, 2002).

Overall, the framework of science measures was similar to the 1996 National Assessment of Educational Progress (NAEP) Science Framework (Pollack, Atkins-Burnett, Rock, & Weiss, 2005; Rock et al., 2002) that was based on local, state, and international science curricula (National Assessment Governing Board, 1996). Science knowledge measures were designed to assess children's conceptual knowledge in, and their competence of scientific investigation in three science fields: earth and space (e.g., earth's composition and events in environment, and relationship between earth and other bodies in space), physical (e.g., matter, energy, and motion of things) and life science (e.g., living things, health, and human body). Conceptual-knowledge items assessed knowledge about discrete scientific facts and understanding of why things happen in the way they do. Items regarding scientific investigation assessed children's knowledge of doing science such as how to formulate questions about nature, how to answer them by using available tools and referring to evidence, and how to communicate scientific inquiries. The coverage of three science fields was equally distributed in science measures at each grade level, based on the recommendation of the American Association for the Advancement of Science and National Academy of Science.

The ECLS-K framed social studies as systematic inquiries that different disciplines are collaboratively engaged in to promote civic competence in a democratic society, as informed by the National Council for the Social Studies (NCSS). The social studies items in the ECLS-K reflect thematic strands in the 1994 *Curriculum Standards of Social Studies* (NCSS, 1994). Five disciplines—history (e.g., distinguishing between present and past in historical and familial events), government (e.g., purposes of government, individual rights and responsibilities),

culture (e.g., everyday objects and their uses, and social roles), geography (e.g., location, using maps and the globe, and different types of lands and water), and economics (e.g., needs vs. wants, different jobs, price in relation to supply and demand)—were included as items for social studies in general knowledge measures. Fifty percent of testing time was used for items in the culture category (questions such as “What do trains and planes have in common?” and “What does a fireman do.”) (Rock et al., 2002, pp. 2–17), twenty percent for geography, and ten percent for history, government, and economics. Items in each of the five strands were also classified into two types, *knowledge* and *analysis/interpretation*. In kindergarten, eighty percent of testing time was assigned for knowledge items and twenty percent for analysis/interpretation, while seventy percent of testing time was used for knowledge and thirty for application/interpretation in first grade. It is important to note that the ECLS-K knowledge measures were based on national curriculum and assessment standards; immigrant children’s knowledge of their cultural heritage and intercultural competence were less likely to be captured with the ECLS-K knowledge measures.

The ECLS-K knowledge measures appear to assess lexical, featural, and script/scenario knowledge (Cook & Gueraud, 2005). For example, in order to answer correctly, students need to understand vocabulary used in grade-level science and social studies (lexical knowledge). Students need to understand features of objects or categories to answer correctly, for example, what common characteristics that objects or categories share (featural knowledge). Script/scenario knowledge seems to be related to the scientific-investigation items because having knowledge of doing science indicates that one understands how to proceed with scientific inquiry in different situations. In addition, knowledge measures in the ECLS-K can be regarded as general/world knowledge in reading research because the measures assessed knowledge from

more than one domain (science and social studies, or life and physical science) (Best et al., 2008; Kozminsky & Kozminsky, 2001). In the current study, the Item Response Theory (IRT) score for general knowledge in the fall of kindergarten was used. The Cronbach alpha reliability of general knowledge in the fall of kindergarten was .88 (Rock et al., 2002).

**Reading measures.** Reading was assessed with a two-stage reading test individually administered by a trained assessor. The assessment included items from published standardized tests from the NAEP and from the NCES (Najarian, Pollack, & Sorongon, 2009). The first test was comprised of items showing a broad range of difficulty and the score of the first test was used to determine the difficulty level of the second-stage test. The two-stage assessment was used to measure reading ability with a set of items most appropriate for children's achievement level and minimize possible ceiling and floor effects.

From kindergarten through eighth grade, the reading assessment was designed to measure basic literacy skills, comprehension of vocabulary-in-context, and passage comprehension. The assessment in kindergarten (fall and spring semester) and first grade (fall and spring semester) emphasized basic skills more, whereas more emphasis was placed on reading comprehension in the reading assessments for third, fifth, and eighth grades (spring semesters for each grade). The results of the reading assessment were reported as a total score (routing test number-correct scores, the IRT scale scores, standardized scores [T-scores]), and as scores pertinent to particular skills (item cluster number correct and criterion-referenced proficiency scores). In the current study, IRT reading scores were used for reading achievement (primarily measured reading comprehension) in the spring of first, third, and fifth grade. The Cronbach alpha reliabilities of reading measures from the fall of kindergarten through the spring of fifth grade were higher than .90 (Rock et al., 2002).

**Early decoding skills.** The criterion-referenced reading proficiency score in the fall of kindergarten, described in the previous paragraph, was used as a measure of early decoding skills. The original variable for the criterion-referenced reading proficiency score in the fall of kindergarten, provided by the ECLS-K, has 8 values for each level: level 0 (non-mastery of the lowest proficiency level), level 1 (letter recognition), level 2 (associating letters with sounds at the beginning of words), level 3 (associating letters with sounds at the end of words), level 4 (recognizing common words by sight), level 5 (comprehension of words in context), level 6 (literal inference), and level 7 (extrapolation). The levels from 4 through 7 were recoded as the attainment of level 4 because the highest proficiency for achieving decoding skills was level 4, and levels from 5 through 7 do not tap into decoding skills but rather reading comprehension skills. Thus, the variable for early decoding skills in the current study has five values (0 ~ 4).

**Vocabulary knowledge.** The Oral Language Development Scales (OLDS), a language assessment with items drawn from the PreLas 2000 (Duncan & DeAvila, 1998), was administered to “children who were identified by school records or teachers as having a non-English language background” (Rock et al., 2002, p. 7-1). It is important to note that home language was not used as a criterion to determine the administration of the OLDS. Nonetheless, the OLDS was administered to most students whose primary home language was not English. The OLDS consisted of three subtests for measuring listening comprehension of simple directives, productive language (retelling stories), and expressive vocabulary (naming pictures) in English. In the current study, the subscore for the vocabulary measure was used to examine the role of vocabulary knowledge in addition to the role of general knowledge in explaining reading growth among subsample of students who were ELs. The Split-half reliability for the

OLDS was .97 and the Cronbach alpha reliability for the vocabulary measure was over mid .80 (Rock et al., 2002).

**Motivation for reading.** The Self-Description Questionnaire-I (SDQ-I; Marsh, 1990) was adapted and used to measure how children feel about themselves both academically and socially in the spring of third grade. Among 42 items, 8 items asked about their experiences related to reading (Tourangeau et al., 2009): “I get good grades in reading,” “I like reading,” “Work in reading is easy for me,” “I am interested in reading,” “I cannot wait to read each day,” “I am good at reading,” “I like reading long chapter books,” “I enjoy doing work in reading.” The items for reading in the SDQ-I asked students to “rate their ability, enjoyment, and interest in reading” (Marsh, 1990; Marsh, Barnes, Cairns, & Tidman, 1984, p. 945).

The ECLS-K reported that the 4-point scale was used for the SDQ-I because it yielded appropriate variance when it was field-tested (Pollack et al., 2005). The four scales included: not-all-true, a-little-bit-true, mostly-true, and very-true. Assessors read the SDQ questions to each child in order to prevent children’s responses from being influenced by their reading ability. After each statement was read by the assessors, children were given a few seconds to mark their answers in the SDQ questionnaire. Assessors were instructed not to look at children’s answers while the SDQ questionnaire was being administered so that children would not feel tempted to respond in a more socially desirable way than they would have otherwise. The Cronbach alpha coefficient for motivation for the eight reading items was .87 for the third-grade measure.

**Demographic information.** Children’s information about socioeconomic status, gender, and race was collected with a survey of parents or the school administrator.

**SES.** A composite variable in the ECLS-K dataset based on the parent survey was used. It indicates SES of children’s household at the time of data collection (Tourangeau et al., 2009).

Five variables were used to create the composite SES variable: Father/male guardian's education, mother/female guardian's education, father/male guardian's occupation, mother/female guardian's occupation (recoded based on the 1989 General Social Survey prestige score), and household income. Each of five variables was standardized (mean = 0, standard deviation = 1) and the average of the five standardized scores was coded as the SES composite variable, which ranged from -2.49 to 2.58. In the current study, the SES variable for the kindergarten year was used.

***Gender and minoritized status.*** The two composite variables for third graders' gender and race/ethnicity in the ECLS-K data were used, which were based on the parents' survey. In this dataset, gender had two values, female and male. In this study, the variable for gender was recoded to make male as the reference group (female = 1 and male = 0). Race originally had eight values in the ECLS-K data: Whites (non-Hispanic), Blacks (or African Americans, non-Hispanic), Hispanics (race specified), Hispanics (race unspecified), Asians, Native Hawaiians (or other Pacific Islanders), American Indians (or Alaska Natives), and More Than One Race. In this study, it was recoded into a two-value variable to specify minoritized status of children. Whites were recoded as non-minoritized and the other races were recoded as minoritized. Non-minoritized was used as the reference group (minoritized = 1, non-minoritized = 0).

### **Data Analytic Strategy**

**Preliminary analyses.** Confirmatory factor analysis was conducted with Mplus version 8 (Muthén & Muthén, 2015) to make sure the items were loaded on the motivational constructs, as designed by Marsh (1990) (i.e., reading attitudes and reader self-perception). The items were included as categorical variables in Mplus, and an WLSMV estimator was used. Unweighted descriptive analyses were conducted with StataSE version 15 (StataCorp, 2017) for the means,

standard deviations, and proportions for dichotomous variables such as gender and minoritized status.

**Longitudinal analyses.** Latent growth modeling was used to describe initial reading achievement and reading growth in two periods, between the spring of first grade and the spring of third grade, and between the spring of third grade and the spring of fifth grade. An appropriate sampling weight was included in the analysis based on the ECLS-K manuals (Tourangeau, Nord, et al., 2009), and the full information maximum likelihood (FIML) estimator was used in Mplus version 8 (Muthén & Muthén, 2015) to handle missing values. As a first step, growth models without any predictors were examined for all samples (i.e., unconditional models). Then, for the first research question, early general knowledge and early decoding skills measured in the fall of kindergarten, SES in the fall of kindergarten, gender, and minoritized status were added to the unconditional model to address the first research question (Figure 1.1). All predictors were regressed on the latent growth intercept and slope except for early decoding skills; decoding skills were regressed only on the time intercept. Previous research has shown that the correlations between reading development and constrained reading skills such as decoding skills are transitory (Paris, 2005). That is, the correlation between early decoding skills and reading development would be strong when children are acquiring decoding skills, but the correlation substantially decreases once all children have mastered decoding skills. For the second research question, the two third-grade motivational constructs for reading were added to the growth model developed for the first research question (Figure 1.2). The motivational constructs were regressed only on the time slope so that reading motivation in third grade could be examined in relation to reading growth between first and fifth grade by predicting third- and fifth-grade reading measures (not predicting the first-grade reading measure). The conditional models for the

research questions were examined for all samples as well as for each language group. The rate of growth and the magnitude of the coefficients of the predictors were compared between the language groups using the Wald chi-square test.

## **Results**

The results of preliminary data analyses are presented first, including descriptive data of the predictors and reading scores as well as factor analyses for the motivational constructs for reading. Then the results of the longitudinal data analyses for reading growth in the elementary years are presented.

### **Preliminary Analyses**

Descriptive data for the predictors, covariates, and reading scores are summarized in Table 1.1. Coefficients of correlations among the predictors, SES, and reading scores are presented in Table 1.2. Confirmatory factor analysis (CFA) was conducted because it is known that the items about reading experience in SDQ-1 asked students to “rate their ability, enjoyment, and interest in reading” (Marsh, 1990; Marsh et al., 1984, p. 945). Accordingly, two motivational constructs for reading (reader self-perception and reading attitudes) were hypothesized. Based on the descriptions of individual items, one motivational construct for reading was set to be explained by three items: SDQ 4 (“I get good grades in reading”), SDQ 13 (“Work in reading is easy for me”), and SDQ 33 (“I am good at reading”). For the other motivational construct for reading, five items were selected: SDQ 10 (“I like reading”), SDQ 18 (“I am interested in reading”), SDQ 21 (“I cannot wait to read each day”), SDQ 35 (“I like reading long chapter books”), and SDQ 39 (“I enjoy doing work in reading”).

In the CFA, two motivational constructs defined by their respective indicator items were examined together. Some correlations between residuals for indicators within the same

motivational construct were specified in the two-factor models to improve model fit. Three fit indices were used to evaluate model adequacy: CFI and TLI greater than .90 and an RMSEA less than .08 were viewed as indicating reasonably good fit (Hu & Bentler, 1999; Kline, 2011). The results of the CFA showed excellent fit (CFI = .997, TLI = .995, RMSEA = .037). Thus, two composite variables for motivational constructs were created by calculating the average of the responses of the corresponding items. When more than  $n/2$  items were missing, the value of the composite variable was coded as missing. The motivational construct for reading with the three items was named *reader self-perception*. The other motivational construct for reading was named *reading attitudes* because the descriptions of the items involve emotional responses related to reading (McKenna et al., 1995). The composite variables for reader self-perception and reading attitudes had 10 and 16 values, respectively, both ranging from one through four. The Cronbach alpha for reader self-perception was .74, and the Cronbach alpha for reading attitudes was .84.

### **Growth in Reading Achievement in the Elementary Years**

**Unconditional models.** Linear and nonlinear latent growth models were examined to determine the shape of growth in reading achievement, and their model fits are shown in Table 1.3. The fit indices indicated that the linear growth model did not explain the data well. The values of CFI and TLI were low, and the values of SRMR and RMSEA were greater than the suggested criteria values (SRMR = .08, RMSEA = .06). Additionally, the residual variance of the reading score in fifth grade was estimated to be significantly negative (so-called Heywood case, see Dillon, Kumar, & Mulani, 1987). The nonlinear growth model was examined by freely estimating the time score for the fifth-grade measure of reading. This model was fully saturated as all available degrees of freedom were used. Again, negative residual variances were found for

the first- and fifth-grade reading measures ( $-39.51, p = .036$  for first grade;  $-30.92, p = .003$  for fifth grade). The two negative residuals were constrained to be zero for model identification (e.g., King, 2015), and the fit of the nonlinear growth model with two degrees of freedom (Model 2-A) was examined (Table 1.3). The fit indices and statistics indicated that the nonlinear growth model fit the data well given acceptably high values of CFI and TLI indices and low values of SRMR and RMSEA indices.

The nonlinear model with a free time score was selected even though the negative and significant residual variances were observed because the linear growth model evidently could not explain the data well (Coertjens, Donche, De Maeyer, van Daal, & Van Petegem, 2017; Wang, 2004). Also, quadratic and piecewise models for nonlinearity were not available options for the current study as there were only three repeated measures of reading. The two research questions were examined by adding the predictors and covariates on the intercept and slope to the nonlinear model with a free time score. Negative residual variances were no longer a concern after the predictors and covariates were added to the unconditional model.

**Conditional models.** To address the first research question—whether early general knowledge explain reading growth from first through fifth grade—general knowledge and early decoding skills, measured in the fall semester of kindergarten, SES in the fall semester of kindergarten, minoritized status and gender were added to the unconditional nonlinear model (see Figure 1.1). The third slope loading was freely estimated, whereas the first two slope loadings were fixed as 0 and 1 for scale identification. The fit indices indicated that the model for the first research question fit the data of all sample well (Model 3, see Table 1.3), and there was no negative residual variance. Subsequently, this model was examined for each language group (Model 3-A for students who were ELs and Model 3-B for students who were MLs). This model

fit the data well for each group, given the values of fit indices. A negative but non-significant residual variance was observed when the model was examined for students who were ELs (-11.92,  $p = .669$ ). Muthén (2007, March 19) recommended constraining a non-significant negative residual variance to zero for the model estimation. The residual variance was constrained to be zero for both language groups to make the model estimations comparable between the two groups, which were multigroup nonlinear models (Model 3-C and Model 3-D). The vocabulary measure was added to the model for students who were ELs to compare the role of vocabulary knowledge with the role of general knowledge in reading growth (Model 3-E). The 3-C and 3-D models for both groups of students and the 3-E model for students who were ELs (with vocabulary measure) are discussed later.

The second research question asked how early general knowledge and third-grade reading motivation jointly explain reading growth from first grade through fifth grade. Early general knowledge, reading attitudes, reader self-perception, early decoding skills, and demographic covariates were added to the unconditional nonlinear model (see Figure 1.2). The model for the entire sample (Model 4) and the model for each group of students (Model 4-A for students who were ELs and Model 4-B for students who were MLs) showed a good fit (Table 1.3). The model with students who were MLs (Model 4-B) was accepted as a reasonable model, although it had slightly lower value of TLI (.897) than the criterion value of .9 (e.g., McInerney, Roche, McInerney, & Marsh, 1997). The multi-group models, 4-C and 4-D, are discussed later.

**Research question 1.** The multigroup nonlinear model (Model 3-C) fit the data well, in light of the high values of CFI and TLI (.957 and .929, respectively) and low values of SRMR and RMSEA (.045 and .052, respectively). Findings indicate that students' growth in reading decelerated on average over this period, as the freely estimated slope loadings for the growth in

reading between third and fifth grade were smaller than 2 in both groups ( $\lambda_3 = 1.52, SE = .02, p = .000$  for students who were ELs;  $\lambda_3 = 1.45, SE = .01, p = .000$  for students who were MLs). The significance test using the slope loading and its standard error also rejected the null hypothesis of linear growth in reading achievement for both groups,  $|(1.45 - 2)/0.01| > 1.96, p < .05$  and  $|(1.52 - 2)/0.02| > 1.96, p < .05$ . Although reading growth became slower between third and fifth grade, slope loading for the fifth-grade reading measure was significantly different from the third-grade  $|(1.45 - 1)/0.01| > 1.96$  and  $|(1.52 - 1)/0.02| > 1.96$ , indicating that the change between third and fifth grade was significant (Muthén & Muthén, 2010).

On average, the change in reading score was more pronounced for students who were ELs than students who were MLs in the time between third and fifth grade. For example, 34 percent of the total growth in reading in students who were ELs was explained by the change between third and fifth grade, compared to 31 percent of the total growth for students who were MLs. The Wald chi-square statistics showed that there was a significant difference in the freely estimated loadings for the fifth-grade reading measure between the language groups ( $\chi^2(1) = 11.39, p < .001$ ): the time score was significantly larger for students who were ELs (1.52) than students who were MLs (1.45). This indicates that the two groups had the same growth rate in reading between first and third grade, but differed in the growth rate between third and fifth grade.

A negative correlation between the intercept (i.e., initial reading scores) and slope was found in both groups. Regardless of language status, students who scored higher on the initial reading measure (first grade) were likely to display smaller growth in reading throughout the elementary years, compared to those who scored lower on the initial reading measure. The unstandardized and standardized coefficients of the predictors were summarized in Table 1.4.

Significant predictors on the intercept included early general knowledge, early decoding skills, SES, and gender for both groups. Early knowledge was also found to significantly explain the slope in both groups, while SES and minoritized status were significant factors on the slope for students who were MLs but not for students who were ELs. The finding indicated that early knowledge explained reading growth from first through fifth grade, while controlling for early decoding skills and demographic covariates in both language groups. (see Table 1.4).

In order to compare the coefficients of early general knowledge and demographic covariates on the intercept and slope, the freely estimated slope loadings were constrained to be the same between the two groups (Model 3-D). The model fit indices showed that the model explained the data well given the properly higher values of CFI and TLI and lower values of SRMR and RMSEA (See Table 1.3), even though the freely estimated slope loadings were constrained to be the same. The five coefficients on the intercept and four coefficients on the slope were compared via the Wald chi-square test for significant differences. The results showed that on the condition that the third slope loadings were the same, the coefficients on the intercept and slope were not significantly different between the two groups,  $\chi^2(9) = 5.03, p = .832$ . The re-estimated coefficients based on the Wald chi-square test were summarized in Table 1.6. When the coefficients of the independent variables and demographic covariates were constrained to be the same, the coefficient of SES to explain the growth slope among students who were MLs became non-significant, whereas the coefficient of minoritized status to explain the growth slope among students who were ELs became significant with the constraints on the coefficients and time scores. There was no significant difference in the coefficients of all predictors and covariates between the two groups. In sum, significant predictors of the intercept included early general knowledge, early decoding skills, SES, and gender for the two groups. In terms of the

prediction of the slope, early general knowledge and minorized status were significantly related to the growth rate in reading development in each group.

Measures of oral language ability in English were administered to the subsample of students who were ELs. Among the language measures, an expressive vocabulary measure was added to the growth model to examine whether early general knowledge still explains reading growth, while accounting for early vocabulary knowledge (Model 3-E). Adding the vocabulary measure, the model continued to fit the data well (CFI = .997, TLI = .995, SRMR = .025, RMSEA = .017). The result showed that the coefficients of early general knowledge were significant predictors of the intercept (standardized beta = .21,  $p = .000$ ) and the slope (standardized beta = .35,  $p = .000$ ) even after early vocabulary knowledge was included in the growth model. Early vocabulary knowledge did not significantly predict the initial measure (standardized beta = .05,  $p = .385$ ). The coefficient of early vocabulary knowledge on the slope was significant and negative (standardized beta = -.19,  $p = .005$ ). The non-significant association of the vocabulary measure with the initial status and the negative association with the slope appear to be due to the higher correlation between early vocabulary knowledge and early general knowledge (.71) than the correlations between early vocabulary knowledge and the reading measures (approximately .40 with each measure). Without early general knowledge, early vocabulary knowledge significantly predicted the initial status (standardized beta = .15,  $p = .013$ ), and the coefficient for the slope was not negative (standardized beta = .02,  $p = .667$ ).

**Research question 2.** The multigroup nonlinear model (Model 4-C) fit the data well given the high values of CFI and TLI (.934 and .907, respectively) and low values of SRMR and RMSEA (.052 and .053, respectively). The freely estimated time scores in the model for the second research question (1.52 for students who were ELs and 1.45 for students who were MLs)

were almost the same as those in the model for the first research question. In addition, the negative correlation between the intercept and slope was found in the model for both groups. Table 1.5 showed the unstandardized and standardized coefficients of the predictors. Adding the two motivational constructs for reading to the previous model (for the first research question) did not cause a noticeable change except that the coefficient of SES on the slope became nonsignificant in the model for students who were MLs. Reader self-perception predicted the reading growth between first and fifth grade in students who were MLs, but it did not for students who were ELs. Reading attitudes were not significantly related to reading growth between first and fifth grade in either group.

The freely estimated time scores were constrained to be the same between the two language groups (Model 4-D) in order to compare coefficients of the predictors and demographic covariates on the intercept and slope. The model fit the data well in light of model fit indices (See Table 1.3). The results of the Wald chi-square test showed that there was no difference in the magnitude of any coefficients on the intercept and slope,  $\chi^2(11) = 5.72, p = .892$ . The coefficients were constrained to be the same between the two groups (Table 1.6).

The coefficients of reader self-perception and minoritized status to explain the growth slope among students who were ELs became significant with the constraints on the coefficients and time scores. The insignificant result regarding reading attitudes might be due to the higher correlation between reading attitudes and reader self-perception (.61) than the correlations between reading attitudes and the reading measures (approximately less than .20 with each measure). Without reader self-perception, reading attitudes were significantly associated with reading growth in both groups to a similar extent,  $\chi^2(1) = .19, p = .665$ , and the coefficient was

positive (standardized beta for students who were ELs = .07,  $p = .000$ ; standardized beta for students who were MLs = .07,  $p = .000$ ).

Descriptively, for every 10 points higher in early general knowledge (which had scores ranging from 6.99 to 47.69 with a mean of 22.23), the score in the first-grade reading measure (which had scores ranging from 24.63 to 184.05 with a mean of 77.36) was 8.48 points higher. Each additional unit of early decoding skills and SES was associated with 8.37 and 3.58 points higher on kindergarten reading measure, respectively. On average, female students scored 2.65 higher than male students in the kindergarten reading measure.

With respect to predicting the slope, for every 10 points higher in early general knowledge (which had scores ranging from 6.99 to 47.69 with a mean of 22.23), the growth rate in reading between first and third grade increased by 4 points (which had scores ranging from 51.46 to 200.75 with a mean of 122.67), and the growth rate between third and fifth grade increased by 1.84 points (which had scores ranging from 64.69 to 203.22 with a mean of 150.10) ( $4 \times .46$  [the re-estimated third slope loading was 1.46 for both groups.]). Each additional unit of reader self-perception (i.e., each 10 percentage higher of self-perception) was related to 1.58 points higher in the growth rate between first and third grade, and the growth rate between third and fifth grade increased by .73 points ( $1.58 \times .46$ ). The growth rate of students with minoritized status was 1.65 points less than that of students with un-minoritized status between first and third grade; Between third and fifth grade, the growth rate decreased by .76 points ( $1.65 \times .46$ ).

## **Discussion**

The study investigated reading growth in the elementary years by analyzing the ECLS-K dataset. The aim of the study was to understand the longitudinal associations of reading development with early general knowledge in the fall of kindergarten and reading motivation in

the spring of third-grade, while accounting for demographic information and early decoding skills measured in the fall of kindergarten. By distinguishing students who were ELs and students who were MLs, the study was able to compare the trajectory of reading growth and the role of early general knowledge and reading motivation in third grade between the two language groups. The study extends prior research in that it examined the important but under-studied predictors together (general knowledge and reading motivation) in relation to reading growth. In addition, unlike many previous studies that have either included one language group or controlled for the language status of students, this study investigated a joint model of reading growth with flexibility to allow for separate parameter estimation for each group.

Overall, the study found a gap in reading achievement between the two language groups in the elementary years. Students who were ELs scored lower on the reading measure in the winter of first grade compared to students who were MLs, and the gap in reading between the two groups continued through the winter of third grade. The reading growth of both groups of students decelerated between the winter of third grade through the winter of fifth grade, compared to the initial growth (between the winter of first and third grade). The reading growth decelerated less among students who were ELs than students who were MLs, resulting in a reduced gap in reading achievement in fifth grade. However, the gap in reading achievement remained, even though students who were ELs were catching up with students who were MLs at the end of the elementary years.

Early general knowledge measured in the fall of kindergarten predicted initial reading achievement in first grade and reading growth between first through fifth grade in both groups of students. The results are consistent with the positive role of general knowledge found in previous L1 reading research (Grissmer et al., 2010; Hwang & Duke, 2017; McNamara et al., 2011) and

L2 reading research (Hwang & Duke, 2017), while extending the previous research by showing the longitudinal contribution of general knowledge throughout the elementary years. The contribution of early general knowledge at the beginning of schooling to reading development was consistent from first through fifth grade. The magnitude of the coefficient on the intercept was similar with that of the coefficient on the slope for both groups, even after early decoding skills in the fall of kindergarten and demographic information of students were accounted for.

The finding that the magnitude of association between general knowledge and L2 reading growth was similar throughout the elementary years does not appear to support a threshold hypothesis. Arguably, students who are ELs are expected to have better L2 proficiency in later grades. Then, according to the threshold hypothesis, the magnitude of association between general knowledge and reading growth should decrease or increase in the later grades. However, the association was consistent from first through fifth grade. It is also possible that throughout the elementary years, L2 proficiency of students who were ELs might have been between upper and lower ends of threshold of L2 proficiency that would, according to the threshold hypothesis, enable students who were ELs to benefit from general knowledge.

Vocabulary knowledge is regarded as part of prior knowledge because words are labels for concepts (Duke, Pearson, Strachan, & Billman, 2011; Fitzgerald, Elmore, Kung, & Stenner, 2017). The study examined whether general knowledge in the fall of kindergarten still explains reading growth even after controlling for vocabulary knowledge in the fall of kindergarten among the sub-sample of students who were ELs. The result indicated that early general knowledge predicted the initial level of reading and reading growth throughout the elementary years. However, vocabulary knowledge did not explain the initial reading achievement (first grade) and was negatively related to the reading growth that might have been due to the

correlation with general world knowledge. The findings are consistent with previous research by Rydland et al. (2012) who concluded that among prior topic knowledge, L2 decoding skills and vocabulary knowledge, prior topic knowledge was the most important predictor for L2 reading comprehension of a text on that topic. Their study showed prior topic knowledge and L2 decoding skills were significant predictors for L2 comprehension of a text on that topic, whereas L2 vocabulary was not a significant predictor.

Despite the similar results between previous and the current study, the non-significant coefficient of L2 vocabulary knowledge in this study should be interpreted cautiously. The two studies differ in that general knowledge was a focus of the current study, whereas the previous study examined prior topic knowledge. Thus, to understand how general knowledge and vocabulary knowledge simultaneously predict reading growth, more evidence is necessary. Additionally, the vocabulary measure in this study was a subset of the language screening test, which aimed to determine whether a child can understand and respond to cognitive assessments (Tourangeau, Nord, et al., 2009). It is likely that the vocabulary measure did not assess vocabulary in-depth and/or academic vocabulary. With more rigorous vocabulary measure, results regarding the role of vocabulary might be different from the current study.

The coefficients of early general knowledge on the intercept and slope were similar between the two language groups. The result of the Wald chi-square test also indicated that there was no significant difference in the coefficients between the groups. The finding that the coefficient of general knowledge in predicting reading growth was similar between the groups does not support Carrell's conclusion (1983) that “unlike native speakers..., nonnative readers show virtually no significant effects of background knowledge” (p. 183). Carrell’s study (1983) included undergraduate students who were ELs and students who were MLs and focused on

topic familiarity, whereas the current study included both language groups in the elementary years and examined general knowledge. The different results between the two studies might be related to the different educational levels of participants and/or the different operationalization of knowledge. Nonetheless, the findings of the present study suggest that, at least during the elementary years, general knowledge are similarly related to reading growth in the two groups.

In addition, the finding of the current study is different from Hwang and Duke (2017) in that the concurrent association between third-grade science knowledge (a proxy measure for general knowledge) and third-grade reading comprehension was stronger in students who were ELs than students who were MLs in the Hwang and Duke study, suggesting that students who were ELs relied more on general knowledge than students who were MLs. The authors postulated that prior knowledge may partially compensate for still-developing English language proficiency in students who were ELs (see also Burgoyne et al., 2013). The different results between the two studies might be partly due to the growth in English language proficiency of students who were ELs. The current study included reading measures from first through fifth grade. For two more years of schooling after third grade, students who were ELs might have improved their English language proficiency to the extent they can leverage their L2 more than they did for previous grades. The reliance on prior knowledge might have been reduced among students who were ELs, and the magnitude of the association between early general knowledge and reading growth became similar between the two groups. Taking together the findings of Hwang and Duke and the current study, general knowledge predicted reading development in students who are ELs more or similarly, compared to that in students who are MLs.

The study extends prior research by examining how general world knowledge and reading motivation explain reading growth in L1 and L2. Two motivational constructs for

reading were added on the slope, but not on the intercept, so that the motivational constructs for reading can explain reading growth between first through fifth grade without being associated with the reading measure in the first grade. The results showed that third-grade reading attitudes were not significantly associated with the reading growth for both language groups. The finding is inconsistent with many previous studies that have revealed a positive relationship between reading attitudes and reading achievement in L1 (Park, 2011; Petscher, 2010) and L2 (Ghaith & Bouzeineddine, 2003; Kim, 2016). However, the results were similar with a study conducted by Becker et al. (2010). The authors observed that reading attitudes were not significantly related to L1 reading achievement in the later grades when a measure for prior reading achievement was accounted for. The non-significant result in this study should be interpreted cautiously. The nonsignificant coefficient of reading attitudes can be attributed to the high correlation between reading attitudes and reader self-perception. In fact, reading attitudes positively explained reading growth when reader self-perception was not included in the model.

Reader self-perception was observed to be significantly related to the reading growth in both groups to a similar degree according to the results of the Wald chi-square test. That is, those students who evaluated their reading achievement as high demonstrated higher reading growth than those students who evaluated their reading achievement as low, regardless of language status. However, compared to the magnitude of the association between early general knowledge and the reading growth, the relationship of reader self-perception with the reading growth was weak. The significant finding regarding reader self-perception in this study was consistent with previous L1 reading studies on reading self-efficacy (De Naeghel et al., 2012; Mucherah & Yoder, 2008; Retelsdorf et al., 2011), which reported the positive contribution of reading self-efficacy in reading achievement. However, Anmarkrud and Bråten (2009) showed a different

result from the current study. Their study found reading self-concept was not significantly related to L1 reading achievement when prior topic knowledge, domain knowledge, and the use of reading strategies were accounted for. Regarding L2 reading research, the current study showed a similar result to a study conducted by Taboada Barber et al. (2015). The authors also found reading self-efficacy was significantly related to reading comprehension in students who were ELs, while controlling for a measure for previous reading achievement. However, their finding was different from the current study in that they did not find any significant relationship for students who were MLs, despite the similar sample sizes between the two language groups. As there have been very few studies that have compared the role of reader self-perception in reading development by language status, we need more research on whether language status makes difference in the relationship between reader self-perception and reading development.

Additionally, the study found the backgrounds of students were associated with reading growth in different ways. SES and gender were significantly related to the initial reading achievement in first grade; however, they were not to the growth between first through fifth grade for both groups of students, while controlling for early decoding skills, general knowledge, and the two motivational constructs for reading. The result regarding SES appears to be similar to that of a study conducted by Kieffer (2011). It was reported that the coefficient for SES was significantly related to the initial level of reading, and the magnitude of the relationship between SES and the reading growth from kindergarten through eighth grade was reduced substantially, when controlling for the status of limited English proficiency and school poverty. On the contrary, in this study, minoritized status was not significantly associated with the initial reading achievement, but significantly and negatively related to the reading growth between first and fifth grade for both groups of students. Taking the results together, when controlling for the rest

of the independent variables, female students and students from higher SES were likely to perform better on the first-grade reading measure than male students and students from lower SES. However, the reading growth of female students and students from higher SES was not necessarily expedited compared to the other students. Minoritized students performed as well as non-minoritized students did on the first-grade measure, but as has been found in other studies (e.g., Bali & Alvarez, 2004; Benson & Borman, 2010), the reading growth of minoritized students decelerated slightly compared to that of non-minoritized students, when controlling for the rest of the independent variables.

### **Implications for Research and Practice**

Reading development in students who are ELs has distinctive characteristics from L1 reading development. For example, home language of students who are ELs can influence reading development in L2 because of cross-linguistic transfer between the two languages (Koda, 2004). Genesee, Lindholm-Leary, and Christian (2005) concluded, from the review of previous research, that students with L1 literacy skills can learn L2 reading more effectively and easily than those without L1 literacy experience. On the other hand, it has also been reported that the same factors contribute to reading development in L1 and L2. For example, Lesaux and Siegel (2003) found that working memory and phonological processing were associated with both L1 and L2 reading. As well, development of word reading skills was observed to be similar between both language groups (Chiappe & Siegel, 2006).

Even though prior knowledge has been considered important to comprehend texts (Kintsch, 1998, 2013), it appears that the extent to which the role of prior knowledge is similar or different between L1 and L2 reading development has not been studied well (for an exception see, Hwang and Duke, 2017). Additionally, the research literature has highlighted the importance

of reading motivation in reading development, but the magnitude of the contribution has not been compared between L1 and L2 reading with an exception of a study conducted by Taboada Barber et al. (2015). This study included students who were ELs and students who were MLs and compared the magnitude of the contribution of the two predictors in L1 and L2 reading growth.

Contrary to expectations, the study found that the magnitude of the contribution of early general knowledge in the fall of kindergarten to reading growth throughout the elementary years was similar between the two groups. That is, regardless of language status students who had stronger general knowledge about topics such as trains, planes, and firemen (Rock et al., 2002) measured at the beginning of schooling were likely to develop reading achievement more throughout the elementary years than those who had less general knowledge. According to the upper-end-threshold hypothesis, the relationship between general knowledge and reading growth would become weaker or non-significant (Carrell, 1983) in students who are ELs, presumably because their L2 proficiency is likely to be improved in later grades. There was no evidence in this study that students who were ELs benefitted less from general knowledge in reading development in later grades. However, this study did not include L2 proficiency of students who were ELs because it was not available in the ECLS-K dataset. It is recommended that future studies include a variable for L2 proficiency of students who are ELs to examine whether the role of general knowledge in reading development would depend on their L2 proficiency, and if so, whether the facilitative effect of general knowledge is specifically for students who are ELs and not for students who are MLs (i.e., whether L1 proficiency would also limit the benefit of general knowledge on reading development).

In addition, the results showed a small but significant relationship between reader self-perception and reading growth between first and fifth grade, which was similar between the two

groups. Reader self-perception predicted reading growth positively for the period when the growth rate was reduced (between third and fifth grade). Supporting students' confidence in reading may facilitate reading development even when reading growth is decelerated in later grades.

The Common Core State Standards emphasizes the importance of fostering knowledge to support reading development (Cervetti & Hiebert, 2015). For example, the standards recognize the mutual enhancement between reading and knowledge development: "By reading texts in history/social studies, science, and other disciplines, students build a foundation of knowledge in these fields that will also give them the background to be better readers in all content areas" (National Governors Association Center for Best Practices & Council of Chief State School, 2010, p. 10), and suggest the ELA curriculum be "intentionally and coherently structured to develop rich content knowledge within and across grades" (p. 10). However, despite the focus on knowledge development via reading in the CCSS, policies for promoting reading development in the elementary years such as Reading First (U.S. Department of Education, 2007) and the reading-by-third-grade movement (Diffey, 2016; Workman, 2014) have focused on developing reading skills apart from cultivating knowledge. It should be emphasized to policymakers based on these findings that enhancing students' knowledge has the potential to support reading development not only in students who are ELs but also students who are MLs. Additionally, the contribution of early general knowledge to reading growth throughout the elementary years might indicate that more curricular time for subject areas (social studies and science) in the primary grades may help foster reading development.

This study cannot reveal effective instructional approaches to enhance students' prior knowledge and confidence in reading to support their reading development. However, previous

studies that have examined reading instruction situated in knowledge-building goals showed promising practices (e.g., Concept-Oriented Reading Instruction, see Guthrie et al., 1998; Seeds of Science/Roots of Reading, Cervetti, Pearson, Bravo, & Barber, 2005; Project-based instruction, Halvorsen et al., 2012). More studies examining the application of these research-validated approaches for students who are ELs would be helpful to give guidance on how to effectively tailor reading instruction to meet the needs of students who are ELs (e.g., Duesbery, Werblow, & Twyman, 2011; Taboada Barber et al., 2015).

Regarding enhancing students' reading self-efficacy or self-concept, Taboada Barber et al. (2015) showed that explicit explanation and modeling of components of tasks (e.g., using reading strategies) and providing contingent feedback and praise in a judicious way can support reading self-efficacy in students who are ELs and students who are MLs. The extent to which students have reading self-efficacy can determine how much effort they will put forth for reading and whether they persist on reading tasks (Taboada Barber, 2016). Thus, it is very important to support confidence in reading or reading self-efficacy for all students, but particularly for students who are ELs because they might encounter more challenges when they have to develop reading achievement in L2 at the same time they are learning L2 (Lesaux & Harris, 2015).

### **Limitations**

The present study has several limitations. First, the national data used in the study (ECLS-K) was collected from 1998 through 2004. As the dataset is not recent, the results obtained from the sample might be different from today's reading growth in the elementary years. However, the ECLS-K is the only national dataset that allows longitudinal analyses throughout the elementary years. For future studies, researchers can use the ECLS-K 2011-2012 (Tourangeau et al., 2015) when the dataset becomes available to the public.

Second, the study did not include some research-validated factors for reading development. For example, the quality and characteristics of reading instruction and home literacy environment were not examined because there is no direct observational data in the ECLS-K dataset. First language proficiency of students who were ELs was not used in this study because only Spanish-language proficiency was administered, but not proficiency of other languages, and those students whose Spanish language proficiency was assessed, were not given the general knowledge measure in fall of kindergarten.

Third, the study cannot inform reading growth of students who moved to the U.S. in the midst of the elementary years because the ECLS-K dataset only included students who started schooling in the U.S. from kindergarten. As those students who arrived in the U.S. in the later grades might encounter more and/or different challenges in learning English and content matter, future studies including these students are necessary.

Fourth, the vocabulary measure did not capture well vocabulary knowledge in students who were ELs. The vocabulary measure was a subset of the language screening test in the ECLS-K to determine whether a child's language proficiency in English was good enough to understand and respond to cognitive assessments. It is likely that the vocabulary measure assessed basic words, not academic words.

Table 1.1

*Unweighted Means, Standard Deviations, and Frequency of Variables*

	All students		Students who were ELs		Students who were MLs	
	Mean	SD	Mean	SD	Mean	SD
<b>Predictors – Means and standard deviations</b>						
Kindergarten Fall General knowledge	22.23	7.51	17.24	5.93	22.83	7.46
Kindergarten Fall Early decoding skills	2.32	1.13	1.03	1.13	1.18	1.10
G3 Spring Reader self- perception	3.22	.72	3.13	0.73	3.24	0.71
G3 Spring Reading attitudes	2.98	.72	3.36	0.67	3.29	0.74
Kindergarten Fall Vocabulary	n/a		1.03	1.13	n/a	
Kindergarten Fall SES	0.01	0.80	-0.39	0.82	0.07	0.78
<b>Dependent variable – Means and standard deviation</b>						
G1 Spring Reading score	77.36	23.87	72.14	23.10	78.46	23.86
G3 Spring Reading score	126.67	28.04	115.19	27.09	129.28	27.54
G5 Spring Reading score	150.10	26.39	139.25	26.28	152.70	25.66
<b>Predictors – Frequency (%)</b>						
Minoritized status (%)	Minoritized		Minoritized		Minoritized	
	44.81		93.13		35.73	
Female (%)	Female		Female		Female	
	48.82		49.34		48.87	

Table 1.2

*Coefficients of Correlations among Reading Measures, Early General Knowledge, Early Decoding Skills, Reading Self-perception, Reading Attitudes, and SES (Unweighted)*

Students who were	MLs ELs	1	2	3	4	5	6	7	8
		1. Grade 1 reading measure		.72 ***	.67 ***	.49 ***	.67 ***	.25 ***	.14 ***
2. Grade 3 reading measure		.74 ***		.84 ***	.62 ***	.57 ***	.27 ***	.14 ***	.43 ***
3. Grade 5 reading measure		.69 ***	.84 ***		.62 ***	.54 ***	.24 ***	.13 ***	.43 ***
4. Early general knowledge		.45 ***	.50 ***	.48 ***		.45 ***	.15 ***	.04 ***	.44 ***
5. Early decoding skills		.69 ***	.61 ***	.59 ***	.41 ***		.16 ***	.07 ***	.33 ***
6. Grade 3 reading self-perception		.15 ***	.16 ***	.14 ***	.12 ***	.11 ***		.59 ***	.09 ***
7. Grade 3 reading attitudes		.09 ***	.09 ***	.08 **	.04	.08 *	.57 ***		.03 ***
8. SES		.46 ***	.46 ***	.44 ***	.35 ***	.36 ***	.03	-.03	

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

Table 1.3

*Fit Statistics and Indices for Latent Growth Models*

Model	$\chi^2$ (df)	AIC	CFI	TLI	SRMR	RMSEA
<b>Unconditional models</b>						
1. Linear	1465.53 (1) ***	311992.70	0.646	-0.061	0.359	0.351
2. Nonlinear saturated model (freely estimated)	0.00 (0)	305061.85	1.000	1.000	0.000	0.000
2-A. Nonlinear model (freely estimated)	7.65 (2)*	305093.14	0.999	0.998	0.037	0.015
<b>Conditional models</b>						
3. Nonlinear model with predictors for RQ 1 (all sample)	290.45 (10) ***	445150.37	0.956	0.921	0.049	0.048
3-A. for ELs <sup>a</sup>	22.96 (11)*	54956.29	0.993	0.988	0.030	0.025
3-B. for MLs <sup>a</sup>	269.97 (11) ***	367289.11	0.95	0.917	0.047	0.049
3-C. Multi-group model <sup>a</sup>	369.39 (22) ***	422245.40	0.957	0.929	0.045	0.052
3-D. Model 3-C + a constraint <sup>a, b</sup>	381.18 (23) ***	422279.29	0.955	0.930	0.044	0.052
3-E. Model 3-A + vocabulary measure <sup>a</sup>	42.74 (13) ***	69960.51	0.984	0.975	0.033	0.035
4. Nonlinear model with predictors for RQ 2 (all sample)	463.49 (16) ***	492164.21	0.934	0.901	0.055	0.048
4-A. for ELs <sup>a</sup>	66.06 (17) ***	61575.16	0.971	0.959	0.041	0.040
4-B. for MLs <sup>a</sup>	418.23 (17) ***	405486.04	0.927	0.897	0.054	0.049
4-C. Multi-group model <sup>a</sup>	594.49 (34) ***	467061.20	0.934	0.907	0.052	0.053
4-D. Model 4-C + a constraint <sup>a, b</sup>	606.20 (35) ***	467095.61	0.933	0.908	0.052	0.053

Note. <sup>a</sup> The non-significant and negative residual variance of first-grade reading measure was constrained to be zero. <sup>b</sup> A constraint was imposed on the freely estimated time scores to make them equal between the two groups. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 1.4

*Unstandardized (b) and Standardized (beta) Regression Coefficients of the Intercept and Slope of the Multi-group Growth Model (3-C)*

	Intercept				Slope			
	ELs		MLs		ELs		MLs	
	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>
Early general knowledge ( <i>p</i> -values)	0.82	0.23	0.84	0.24	0.33	0.17	0.43	0.27
	<.001		<.001		<.001		<.001	
Early decoding skills ( <i>p</i> -values)	8.46	0.41	8.50	0.40				
	<.001		<.001					
SES ( <i>p</i> -values)	5.27	0.18	3.25	0.11	-0.11	-0.01	0.93	0.05
	<.001		<.001		=>.05		<.05	
Minoritized status ( <i>p</i> -values)	-0.14	-0.00	0.38	0.01	-2.25	-0.05	-1.35	-0.05
	=>.05		=>.05		=>.05		<.05	
Female ( <i>p</i> -values)	3.50	0.16	2.52	0.11	0.73	0.06	0.12	0.01
	<.05		<.01		=>.05		=>.05	
Constant	49.78	2.30	47.72	2.00	42.33	3.64	39.96	2.98
	<.001		<.001		<.001		<.001	

Table 1.5

*Unstandardized (b) and Standardized (beta) Regression Coefficients of the Intercept and Slope of the Multi-group Growth Model (4-C)*

	Intercept				Slope			
	ELs		MLs		ELs		MLs	
	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>
Early general knowledge ( <i>p</i> -values)	0.82	0.23	0.86	0.27	0.32	0.16	0.41	0.22
	< .001		< .001		< .01		< .001	
Early decoding skills ( <i>p</i> -values)	8.46	0.41	8.32	0.39				
	< .001		< .001					
Reader self-perception ( <i>p</i> -values)					0.81	0.05	1.74	0.09
					=> .05		< .001	
Reading attitudes ( <i>p</i> -values)					0.18	0.01	0.35	0.02
					=> .05		=> .05	
SES ( <i>p</i> -values)	5.26	0.18	3.29	0.11	-0.08	-0.01	0.84	0.05
	< .001		< .001		=> .05		0.08	0.07
Minoritized status ( <i>p</i> -values)	-0.17	-0.00	0.40	0.01	-2.22	-0.05	-1.62	-0.06
	=> .05		=> .05		=> .05		< .05	
Female ( <i>p</i> -values)	3.44	0.16	2.54	0.11	0.60	0.05	-0.05	-0.00
	< .05		< .01		=> .05		=> .05	
Constant	49.79	2.30	47.62	2.03	39.34	3.38	33.98	2.51
	< .001		< .001		< .001		< .001	

Table 1.6

*Unstandardized (b) and Standardized (beta) Regression Coefficients of the Intercept and Slope of the Multi-group Growth Models with Constraints on the Coefficients*

	Model 3-D (RQ 1)				Model 4-D (RQ 2)			
	Intercept		Slope		Intercept		Slope	
	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>
Early general knowledge ( <i>p</i> -values)	0.84	0.24 <sup>e</sup> 0.27 <sup>m</sup>	0.42	0.21 <sup>e</sup> 0.24 <sup>m</sup>	0.85	0.24 <sup>e</sup> 0.27 <sup>m</sup>	0.40	0.20 <sup>e</sup> 0.22 <sup>m</sup>
Early decoding skills ( <i>p</i> -values)	8.51	0.43 <sup>e</sup> 0.40 <sup>m</sup>			8.37	0.42 <sup>e</sup> 0.39 <sup>m</sup>		
Reader self-perception ( <i>p</i> -values)							1.58	0.09
Reading attitudes ( <i>p</i> -values)								< .001
SES ( <i>p</i> -values)	3.55	0.12	0.74	0.05 <sup>e</sup> 0.04 <sup>m</sup>	3.58	0.12	0.68	0.04
Minoritized status ( <i>p</i> -values)	0.37	0.00 <sup>e</sup> 0.01 <sup>m</sup>	-1.42	-0.03 <sup>e</sup> -0.05 <sup>m</sup>	0.39	0.01	-1.65	-0.03 <sup>e</sup> -0.06 <sup>m</sup>
Female ( <i>p</i> -values)	2.65	0.12 <sup>e</sup> 0.11 <sup>m</sup>	0.21	0.02	2.65	0.13 <sup>e</sup> 0.11 <sup>m</sup>	.027	0.00

*Note.* <sup>e</sup>These are beta coefficients for students who were ELs. <sup>m</sup>These are beta coefficients for students who were MLs.

Figure 1.1. Non-linear growth model for the first research question

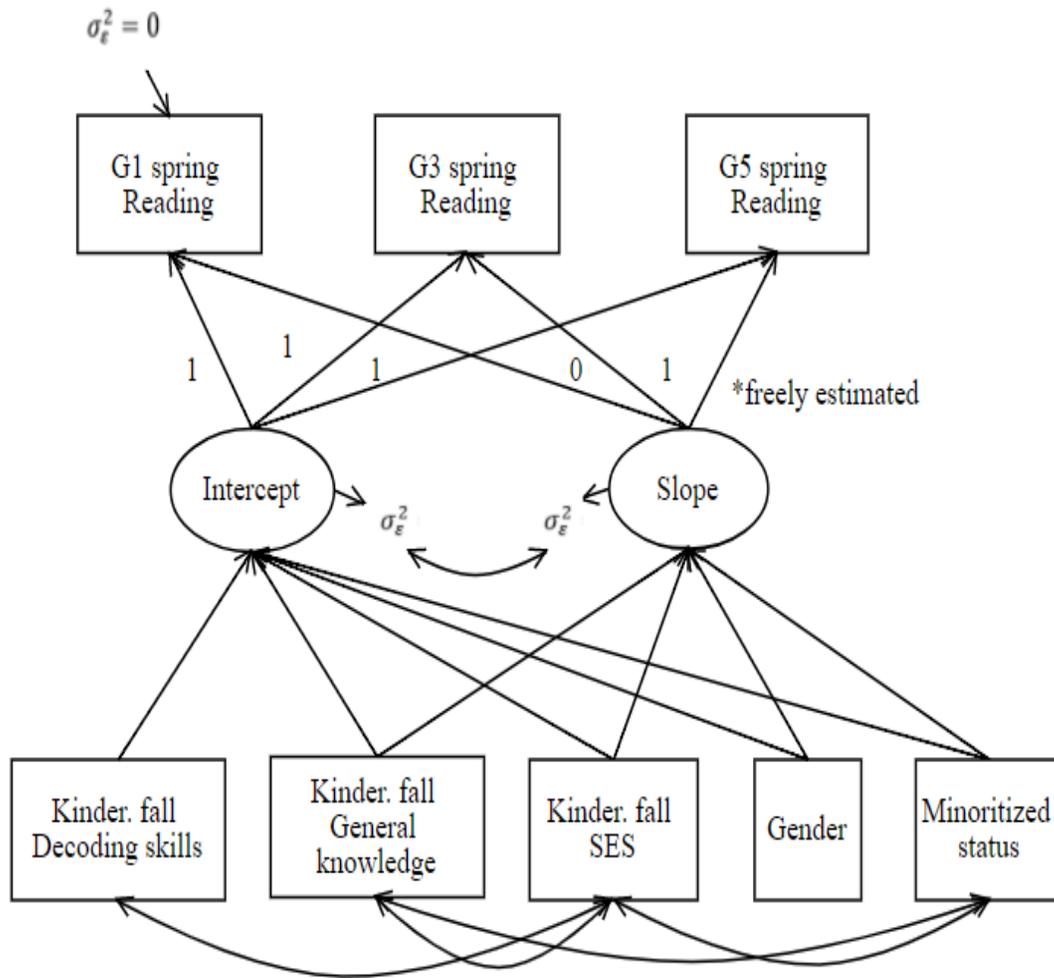
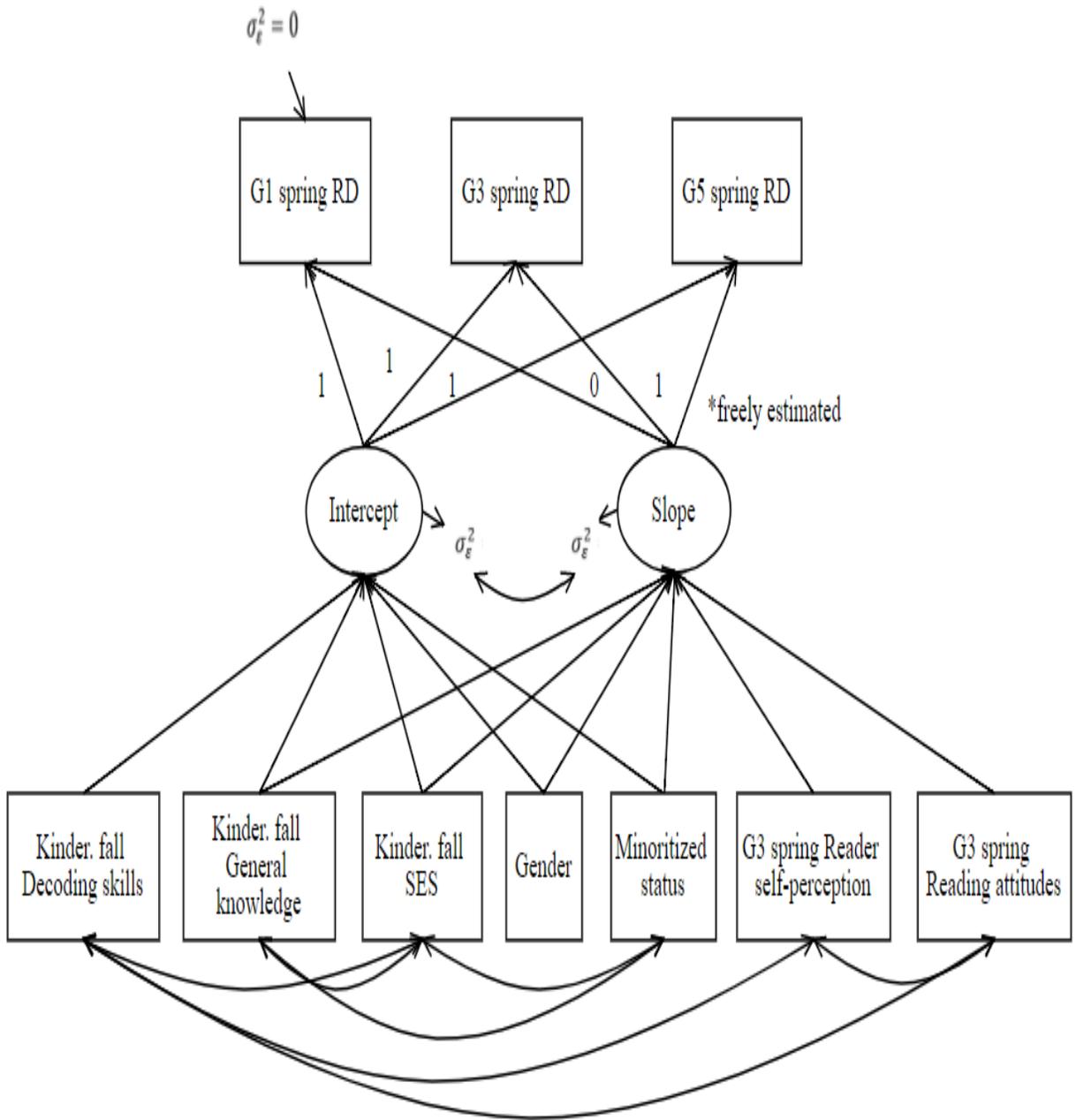


Figure 1.2. Non-linear growth model for the second research question



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## **Chapter 2: Manuscript 2: Relationships of General Knowledge and Reading Motivation with L1 and L2 Reading Comprehension of Informational and Narrative Genres**

### **Abstract**

Around the world, the number of students who are second language learners (SLLs) has been increasing and their reading development has been a concern to many educators. This study explored informational and narrative reading comprehension in fourth-grade students who were SLLs and students who were monolinguals (MLs) in five countries by focusing on two predictors, general knowledge and reading motivation. Multilevel regression analyses showed that general knowledge and readers' self-perception positively predicted reading comprehension of both genres to a similar extent in the two language groups. The strongest association was found between general knowledge and reading comprehension of each genre. The coefficient of reader self-perception was larger for reading comprehension of each genre than was the coefficient for home resources for learning, which has been traditionally been identified as a strong predictor of reading development. Implications for future research and practice for supporting reading comprehension are discussed.

*Keywords:* reading comprehension, second language reading, prior knowledge, reading motivation, international study

## Introduction

The responsibilities of schools to educate all children to develop a proficient command of language and advanced literacy skills have become more pressing in modern information- and knowledge-based societies. Reading comprehension in students who are second language learners (SLLs) has been a particular concern to many scholars and educators (Droop & Verhoeven, 1998; Mancilla-Martinez & Lesaux, 2010; Nakamoto, Lindsey, & Manis, 2007). Meta-analyses of 55 studies from the U.S. and European countries revealed that students who are SLLs lag substantially behind students who are monolinguals (MLs) in reading comprehension with a medium effect size ( $d = -.62$ ; Melby-Lervåg & Lervåg, 2014). Reading comprehension of students who are SLLs is a concern not specific to the US; other countries face similar challenges (Lesaux, Geva, Koda, Siegel, & Shanahan, 2008).

Understanding what contributes to reading comprehension in a second language (L2) is an important first step to improve reading comprehension for this population. Many previous L2 studies have focused on language-related predictors such as decoding skills and vocabulary (Taboada Barber, Cartwright, Smith, Patrick, & Archer, 2017). Fewer studies have investigated the role of prior knowledge and reading motivation in L2 reading comprehension. Most studies on the relationship between prior knowledge and L2 reading have shown that readers with more knowledge on a topic tend to comprehend topic-related text better than readers with less knowledge (Fang, 1994; Hammadou, 2000; Malik, 1990; Rydland, Aukrust, & Fulland, 2012). However, few studies have operationalized prior knowledge as broader general knowledge instead of specific topic knowledge related to a text.

Previous studies showing the positive role of reading motivation in L2 reading development have mostly included secondary or postsecondary students (Kim, 2016; Sani &

Zain, 2011; Taboada Barber et al., 2015), but only a few studies have included elementary students who are SLLs. Thus, more studies are needed that investigate the relationships of L2 reading comprehension with general knowledge and reading motivation in the elementary years (e.g., Hwang & Duke, 2017).

In order to bridge the gap in prior research, the present study focused on general knowledge and reading motivation. The study used three international datasets collected under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), namely TIMSS and PIRLS (see Foy, 2013; Mullis, Martin, Kennedy, Trong, & Sainsbury, 2009; Mullis, Martin, Ruddock, O'Sullivan, & Preuschoff, 2009) because they provide a unique opportunity to examine L2 reading comprehension in the elementary years across countries. Most L2 reading studies have been conducted at one research site, mostly in European and North America countries. The findings of these one-site studies are most likely not generalizable to all countries. Studies in many countries are needed because around the globe, approximately one out of ten students speak the language of instruction as a second language (OECD [Organisation for Economic Co-operation and Development], 2010) and we do not know whether models of reading are applicable in each of these settings. The analysis of the international data can reveal more generalizable findings to students who are SLLs in different countries. Moreover, the PIRLS dataset provides separate reading scores for informational and narrative text comprehension. As reading comprehension processes and achievement differ by genre (Duke & Roberts, 2010), it is valuable to examine the contributions of predictors in relation to text comprehension of each genre.

### **Conceptual Framework**

In this section, I discuss the conceptualization of reading comprehension according to the Construction-Integration Model (Kintsch, 1998, 2013) and explain prior knowledge and reading motivation as reader-related contributors to reading comprehension.

### **Reading Comprehension**

According to the Construction-Integration Model, reading comprehension can be defined as a process in which readers build a coherent mental representation of a text by constructing the textbase and the situation model of the text (Kintsch, 1998). Readers process three levels of text representation, namely, the surface level, the textbase, and the situation model (Kintsch & Rawson, 2005). Deriving the surface level of the text involves a perceptual process to decode words and parse phrases of the text. The textbase is the semantic representation of the text as was intended by the author and is derived by constructing the microstructure (the network of propositions) and the macrostructure of the propositions in the text (main idea or theme of the text). Readers build the situation model of the text by integrating the textbase with their prior knowledge. Kintsch (2013) posited that the quality of and characteristics of the situation model would widely differ among readers, depending on “readers' interests, purposes, and background knowledge” (p. 811). A reader with high prior knowledge and motivation may produce a more sophisticated situation model of the text, compared to a reader with low prior knowledge and motivation. From this perspective, prior knowledge and reading motivation would certainly be important factors to simultaneously predict reading comprehension.

The extent to which prior knowledge and reading motivation predict reading comprehension may differ by text genres due to the genre-specific nature of reading comprehension (Duke & Roberts, 2010). Two important text genres recurring in reading research are informational and narrative text. Informational texts are written for delivering information

about different aspects of world and narrative texts are written for sharing an interpretation of an experience or experiences (Duke, Caughlan, Juzwik, & Martin, 2012). Previous research has suggested that text genres affect processes of reading comprehension differently (e.g., Kirk & Pearson, 1996; Kucan & Beck, 1996; Wolfe & Mienko, 2007). For example, Kirk and Pearson (1996) found that first- and second-grade students made more predictions when they were reading a narrative text, whereas during reading an informational text, replacing unknown words with familiar words occurred more frequently. Studies have shown that factors predict informational and narrative text comprehension differently (Best, Floyd, & McNamara, 2008; Wolfe, 2005). Wolfe (2005) showed that *semantic association*, defined as the extent to which information embedded in texts is related to each other, predicted recall of informational texts more than recall of narrative texts. However, to my knowledge, no research has investigated whether genre affects the degree to which prior knowledge and reading motivation jointly predict reading comprehension.

### **Prior Knowledge**

Knowledge is information stored in long-term memory, including concepts or ideas and the relationships among them (Anderson & Pearson, 1984; Cook & Gueraud, 2005). Three levels of knowledge are primary influences on comprehension processes: lexical, featural, and script/scenario knowledge (Cook & Gueraud, 2005). The lexical level of knowledge refers to knowledge of the meaning of words. The featural level involves more information than can be denoted by the lexical level, such as a description of the relationship between concepts and ideas (e.g., ice is slippery; oil is flammable; water and oil are liquid). The script/scenario level indicates knowledge about an activity or a situation, such as preparing a meal or watching a movie. In reading research, different types of knowledge measures have been used: knowledge

related to a topic of a text (e.g., Mason, Tornatora, & Pluchino, 2013), domain knowledge pertinent to a particular field of study or discipline (e.g., Alexander & Kulikowich, 1991) and general knowledge, which is knowledge in more than one field of study or discipline (e.g., Kozminsky & Kozminsky, 2001).

General knowledge has been studied less frequently in relation to reading comprehension than topic and domain knowledge. However, it has been postulated that readers benefit from their general knowledge in building coherent mental representation of texts. Cook and O'Brien (2014) proposed that readers leverage their general knowledge to evaluate coherence among propositions in a text. Cain, Oakhill, Barnes, and Bryant (2001) posited that the ability to make good inferences may partially depend on general knowledge because it is resource to make inferences about what an author has not explicitly stated in a text.

In addition, empirical findings about the relationship between topic knowledge and reading comprehension can inform the mechanisms by which general knowledge supports reading comprehension because general knowledge is a collection of various topic knowledge. Strong general knowledge may bring benefits that topic knowledge has been observed to bring, such as making predictions (Fincher-Kiefer, 1992) and making inferences about meaning of unknown words (Cervetti, Wright, & Hwang, 2016; Kaefer, Neuman, & Pinkham, 2015), because of the higher probability of encountering texts that deal with familiar topics. General knowledge includes not only knowledge of different topics but also understanding of the relationships among the topics. Complex structure among different knowledge units can expedite process of activating relevant knowledge to a text (Bereiter, 1991).

### **Reading Motivation**

Reading motivation can be defined as a relatively stable willingness and intention to engage in reading (Wigfield & Guthrie, 1997). There are many overlapping and interrelated concepts in reading motivation. For the purposes of this study, I focused on three: reading attitudes, reader self-perception, and the value of reading.

Reading attitudes involve “a system of feelings related to reading which causes the learner to approach or avoid a reading situation” (Alexander & Filler, 1976, p. 1). Mathewson (1994) argued that reading attitudes comprise three components, namely, feelings about reading, readiness to initiate and involve in reading, and belief about reading. McKenna and Kear (1990), on the other hand, claimed that reading attitudes are mainly affective in nature. For example, the survey they developed, Elementary Reading Attitude Survey (ERAS), asks questions about how students feel about recreational and academic reading (e.g., how do you feel about reading for fun at home? how do you feel about reading in school?). Reading attitudes are overall perception of reading, whereas reader self-perception involves evaluation of self as reader.

Reader self-perception, defined as how readers feel about themselves as readers (Henk & Melnick, 1995), is a broad term that has been used to encompass reading self-efficacy and reading self-concept. Reading self-efficacy refers to “the belief that one can be successful at reading” (Wigfield & Guthrie, 1997, p. 422). A construct similar to reading self-efficacy is reading self-concept. Whereas self-efficacy is one’s confidence in reading regardless of social criteria and reference, self-concept involves opinion and feedback from others (Schiefele et al., 2012). Many inventories for reading motivation include both items for reading self-efficacy and reading self-concept (e.g., Chapman & Tunmer, 1995; Wigfield & Guthrie, 1997).

The value of reading consists of three components of beliefs about reading: readers’ beliefs about how interesting reading is (interest value), how important it is to read well

(attainment value), and how useful reading is to achieving current and future goals (utility value) (Wigfield & Eccles, 2000). The value of reading conceptually overlaps with reading attitudes because both constructs involve beliefs about reading. However, the value of reading is more related to the perception about what can be gained through engaging in reading, whereas reading attitudes are related to overall perception of reading experience. For example, readers can gain enjoyment (interest value) and achievement (attainment value) and fulfill a requirement for a future plan (utility value) by engaging in reading.

## **Review of the Literature**

### **Prior Knowledge and Reading Comprehension in a First Language**

**Topic knowledge.** Many L1 studies have investigated the role of topic knowledge in comprehending text about that topic in L1. Among them, more studies have examined informational text comprehension than narrative text comprehension. Studies on the relationship between topic knowledge and informational text comprehension in L1 have consistently reported that knowledge about a topic of a text can facilitate L1 informational reading comprehension on that topic (Ho, Tsai, Wang, & Tsai, 2014; Recht & Leslie, 1988; Spilich, Vesonder, Chiesi, & Voss, 1979; Taylor, 1979; Waniek & Schäfer, 2009; Yochum, 1991).

On the other hand, studies that have examined the role of topic knowledge in comprehending a narrative text have yielded inconsistent results. Schneider, Körkel, and Weinert (1989) reported the positive role of topic knowledge in comprehending a narrative text in L1 about events dealing with that topic in third-, fifth-, and seventh-grade students. However, in a study with college students who were MLs, Wolfe and Mienko (2007) showed a different result. They examined recall of information about the circulatory system after reading narrative and informational texts that contained information about it. Students' prior knowledge about the

circulatory system was predictive of recall from informational texts but did not significantly predict recall of information about the circularly system embedded in a narrative text. The authors hypothesized that the comprehension process of the narrative text might have focused on integration of story elements rather than integration of prior knowledge.

**Domain and general knowledge.** Compared to L1 studies on the role of topic knowledge, relatively few studies have examined the role of domain knowledge (Anmarkrud & Bråten, 2009; Davou, Taylor, & Worrall, 1991; Tarchi, 2010) or general knowledge (Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010; Hwang & Duke, 2017). Among previous studies on the role of domain or general knowledge, informational text comprehension was used as a measure more frequently than narrative text comprehension. Tarchi (2010) showed that domain knowledge in history, along with topic knowledge on the English revolution, contributed to informational text comprehension about the English revolution in seventh-grade students who were MLs.

Regarding general knowledge, Best et al. (2008) and McNamara, Ozuru, and Floyd (2011) found that general knowledge positively predicted reading comprehension of informational texts in elementary students who were MLs. Best et al. (2008) observed the positive role of general knowledge even after decoding skills were controlled for. However, when topic knowledge as well as decoding skills are controlled, general knowledge did not predict informational reading comprehension. Priebe (2011) examined the role of general knowledge in reading comprehension of informational text in fourth- and sixth-grade students who were MLs. The author formed two groups of students whose topic knowledge on octopuses and decoding skills were matched to each other, but who differed in general knowledge. A subtest of Wechsler Intelligence Scale for Children, *Information*, was used to measure general knowledge that asked

children questions about a range of topics from history, science, and geography. The results indicated that there was no group difference in comprehending the text on octopus, indicating general knowledge might not have played a significant role. Priebe (2011) argued that the result might be attributed to the fact that only one passage about octopuses was used in the study and suggested future studies include more passages to examine the relationship between general knowledge and reading comprehension. Studies using multiple passages on different topics are needed to better understand the role of general knowledge in reading comprehension.

In addition, the relationship between general knowledge and narrative reading comprehension in L1 has remained unclear. McNamara et al. (2011) examined the association of general knowledge with narrative and informational text comprehension in fourth-grade students who were MLs. They found that general knowledge was significantly related to both genres, but stronger for informational text. However, Best et al. (2008) showed that general knowledge did not predict narrative text comprehension in third-grade students who were MLs when decoding skills were controlled, but without partialling out decoding skills, general knowledge did predict narrative text comprehension. For informational reading comprehension, they found that general knowledge was a significant predictor regardless of whether decoding skills were controlled.

### **Prior Knowledge and Reading Comprehension in a Second Language**

**Topic knowledge.** The positive role of topic knowledge has been observed in comprehending informational text on that topic in L2 (Ariew & Ercetin, 2004; Barry & Lazarte, 1995, 1998; Fang, 1994; Hammadou, 1991, 2000; Rydland et al., 2012), whereas no research has been conducted, to my knowledge, to examine the association between topic knowledge and narrative reading comprehension in students who are SLLs.

**Domain and general knowledge.** Almost no research has examined the role of domain knowledge in reading comprehension in L2. With respect to general knowledge, Hwang and Duke (2017) investigated its role, along with decoding skills, reading motivation, and demographic covariates, in reading comprehension in third-grade students who were SLLs and students who were MLs in the U.S., using data from the Early Childhood Longitudinal Study (ECLS-K, Tourangeau, Nord, Lê, Sorongon, & Najarian, 2009). General knowledge was the most important contributor to L1 and L2 reading comprehension, and a stronger relationship was found between general knowledge and L2 compared to L1 reading comprehension. However, their study only included U.S. students, thus the generalization of the study was limited to the U.S. context. Their study also did not examine reading comprehension in different genres.

Understanding the role of general knowledge in reading comprehension of different genres is important. Reading comprehension processes are different across genres (e.g., Kirk & Pearson, 1996; Wolfe, 2005). Thus, it is possible that the role of prior knowledge differs by genre as well. Kucan and Beck (1996) investigated think-aloud protocols of four fourth-graders' reading of narrative and informational texts in L1. They observed that for the narrative texts, the children tended to use prior knowledge to make hypotheses about an upcoming event, whereas for informational texts, they tended to rely on prior knowledge to comment on and offer opinions about the text content. It is reasonable to think that the role of general knowledge would be stronger for informational reading comprehension than narrative reading comprehension, as suggested by the Wolfe and Mienko (2007) study, described earlier. One of the major purposes of reading informational texts is to gain knowledge, thus readers might utilize general knowledge more in comprehending informational texts than narrative texts. However, no L2 research that I am aware of has examined the role of general knowledge in reading comprehension by genre.

## **Prior Knowledge and Language Status**

Prior knowledge might have the potential to compensate for low L1 language proficiency. Schneider et al. (1989) found that students with high knowledge about soccer but with low verbal ability recalled more after reading a narrative text about a soccer game than students with low-knowledge about soccer and high verbal ability. The authors argued that knowledge about soccer could compensate for low verbal ability in comprehending a text about soccer. If prior knowledge can compensate for low language proficiency, then it can be postulated that prior knowledge would play a more important role in L2 reading comprehension than L1 reading comprehension when L2 proficiency of students who are SLLs is still developing. In fact, Hwang and Duke (2017) found that the coefficient of prior knowledge (operationalized as general knowledge) in predicting reading comprehension was significantly larger in students who were SLLs than students who were MLs. The authors postulated that prior knowledge can compensate for still-developing language proficiency in students who are SLLs.

On the other hand, some L2 researchers have claimed that the relationship of prior knowledge with L2 reading is qualitatively different from its relationship to L1 reading in that the extent to which prior knowledge predicts reading comprehension would depend on L2 proficiency (i.e., the language threshold hypothesis) (Carrell, 1983; Hudson, 1982). For example, Carrell (1983) found that for advanced and high-intermediate SLLs, topic familiarity did not predict L2 comprehension of informational texts on that topic. On the other hand, Ridgway (1997) showed that there was no significant relationship between topic familiarity and L2 informational reading comprehension in students who were SLLs with low L2 proficiency.

As it has remained contentious whether the role of prior knowledge in reading comprehension may or may not differ by language status, studies that investigate both L1 and L2 reading comprehension in relation to prior knowledge are needed.

### **Motivation for Reading and Reading Comprehension in a First Language**

**Reading attitudes.** Reading attitudes have been observed to have a significant relationship with reading achievement. A meta-analysis of 32 studies conducted by Petscher (2010) demonstrated that reading attitudes and reading achievement have a moderately strong relationship ( $Z = 0.32$ ). A stronger relationship was found for elementary students ( $Z = 0.44$ ) than for middle school students ( $Z = 0.24$ ). In addition, reading attitudes in earlier grades have been observed to be associated with reading comprehension in later grades, even after reading comprehension in earlier grades was controlled for (Kush, Watkins, & Brookhart, 2005; Martínez, Aricak, & Jewell, 2008). Readers with positive attitudes toward reading are more likely to engage in reading, which would enhance their reading achievement (McKenna, Conradi, Lawrence, Jang, & Meyer, 2012; McKenna, Kear, & Ellsworth, 1995). Intrinsic motivation, which conceptually overlaps with reading attitudes (Schiefele et al., 2012), was also found to have an indirect relationship with reading comprehension, mediated by reading behavior (Guthrie et al., 2006; Guthrie, Hoa, et al., 2007; Schaffner, Schiefele, & Ulferts, 2013).

**Reading self-efficacy and reading self-concept.** Previous studies have shown that reading self-efficacy and reading self-concept are significantly related to L1 reading achievement in the elementary (De Naeghel, Van Keer, Vansteenkiste, & Rosseel, 2012 for reading self-efficacy; Katzir, Lesaux, & Kim, 2009 for reading self-concept) and secondary years (Mucherah & Yoder, 2008; Retelsdorf, Köller, & Möller, 2011 for reading self-efficacy; Arens, Yeung, & Hasselhorn, 2014 for reading self-concept). Cartwright, Marshall, and Wray (2015) found that

reading self-efficacy, along with the value of reading, predicted reading comprehension in first- and second-grade students, while controlling for decoding skills, language proficiency, and reading-specific executive function. Conlon and Zimmer-Gembeck (2006) showed that reading self-concept, along with reading attitudes, contributed to reading comprehension, even after controlling for literacy-related variables such as phonological and orthographic skills, in seventh-grade (the final grade of elementary school in Queensland) students in Australia.

**Value of reading.** Compared to reading attitudes and reading self-efficacy or self-concept, perceived value of reading has received less research attention. McGeown, Duncan, Griffiths, and Stothard (2015) examined how the extent to which readers' values, along with reading self-concept and word reading, explained L1 reading comprehension in secondary students in the U.K. The results showed that the value of reading was positively related to reading comprehension in L1. Similarly, Anmarkrud and Bråten (2009) found that the value of reading was positively related to reading comprehension in L1 in ninth-grade students in Norway, even after reading self-concept, prior knowledge, and the use of reading strategies were controlled.

### **Motivation for Reading and Reading Comprehension in a Second/Foreign Language**

**Reading attitudes.** In L2 and foreign language (FL) research, reading attitudes have also been found to predict reading comprehension. Sani and Zain (2011) examined whether reading attitudes, along with reading self-efficacy, were related to reading achievement in English in middle-school students who spoke Bahasa Malaysia as their L1 and English as their L2. The survey items asked students to rate their feelings about reading in English (e.g., "Reading in English is almost always boring"), beliefs about reading (e.g., "Reading in English is a waste of time"), and readiness to read (e.g., "I like to read in English before I go to bed") (p. 248), which

are components of reading attitudes conceptualized by Mathewson (1994). They showed that attitudes about reading in English were related to reading comprehension in English.

Ghaith and Bouzeineddine (2003) investigated the relationship between reading attitudes and FL reading comprehension in middle school students who were English as a foreign language (EFL) learners in Lebanon. The authors asked students to “determine feelings towards reading” (p. 119) in general (i.e., not limited to FL reading). Their reading-attitude survey appears to be related to willingness to read (e.g., “Do you willingly read?”) and interest in reading (e.g., “Do you enjoy reading?”). One item, however, asked a question about reading self-efficacy (“Do you feel successful when reading?”), which might have partially contributed to less than desired alpha reliability (.63). The study showed that the students with more positive attitudes toward reading were more likely to have higher reading achievement in English than those with less positive reading attitudes.

**Reading self-efficacy.** In L2 research, Taboada Barber et al. (2015) examined the contribution of self-efficacy (e.g., “I can read a school book,” “I can understand the main idea of a story,” p. 48) to reading comprehension in middle school students who were SLLs and students who were MLs. The results showed that for students who were SLLs, reading self-efficacy predicted reading comprehension in L2, while earlier reading comprehension scores were held constant. However, the association between reading self-efficacy and reading comprehension in students who were MLs was not significant. The finding appears to indicate that the role of self-efficacy may not be the same in L1 and L2 reading comprehension. Sani and Zain (2011), a study mentioned earlier, found that reading self-efficacy (e.g., “I believe that I am a better reader in English than most other students in my grade,” “I believe that I am a poor reader in English,”

p. 248), along with reading attitudes, predicted L2 reading comprehension positively in adolescent Malaysian students who spoke English as their L2.

**Value of reading.** To my knowledge, no L2/FL research has examined the perceived value of reading. However, a survey originally designed to measure reading attitudes in students who are EFL learners was shown to have three constructs related to the value of reading, which were named *intellectual value* (e.g., “I can get various information if I read in English”), *practical value* (“Reading English is useful for my future career”), and *linguistic value* (“I can acquire vocabulary if I read English”) (Yamashita, 2007, p. 91). Yamashita (2007) found that the three types of value of reading did not predict reading comprehension in English in college students who were EFL learners in Japan. A similar result was found in a study that used the same survey instrument for college students who were EFL learners in South Korea (Kim, 2016). However, these two studies were conducted in FL settings; studies on the value of reading in L2 settings are needed.

**Gaps in L2 studies on reading motivation.** Very scant attention was given to the role of the value of reading in L2 reading comprehension. In addition, most L2 studies on reading attitudes and reading self-efficacy have explored reading comprehension in secondary or postsecondary students (Ghaith & Bouzeineddine, 2003; Kim, 2016; Sani & Zain, 2011; Taboada Barber et al., 2015); few have included students who are SLLs in the elementary years. More research is needed to examine the relationship between these motivational constructs and L2 reading comprehension in elementary students who are SLLs.

### **Present Study**

The present study aimed to explore the role of general knowledge (approximated with a science knowledge measure) and reading motivation in informational and narrative reading

comprehension in students who were SLLs and students who were MLs in the elementary years. International datasets were used to include students who were SLLs from different countries. Understanding reading comprehension in students who were SLLs around the world is important because this population has been ever growing around the world. The results of PISA's survey revealed that approximately 10 percent of 15-year-old students across countries speak the language of instruction as their second language (OECD [Organisation for Economic Co-operation and Development], 2010). Also, reading development of students who are SLLs lags behind that of students who are MLs in many countries (Droop & Verhoeven, 1998; Lesaux et al., 2008; Melby-Lervåg & Lervåg, 2014). However, more than 80 percent of studies on reading motivation were conducted in one country in North America and European countries (Conradi, Jang, & McKenna, 2014). Findings from the current study that included students from different countries will be more applicable to supporting reading development in students who are SLLs around the world.

The present study included five countries: Australia, Canada (Quebec), Germany, Hong Kong, and Singapore. This study provides a unique contribution to the literature in four respects. First, students across several countries around the globe were included in the study. Second, the two important but under-studied contributors, general knowledge (instead of knowledge specific on a topic of a passage) and reading motivation, were examined to understand how they jointly predict reading comprehension. Third, the role of the contributors was examined in relation to informational and narrative reading comprehension, respectively. Fourth, reading comprehension in each genre was examined separately for students who were SLLs and students who were MLs, rather than assuming reading development would be similar, regardless of language status. The study addressed the following research question:

In five countries (Australia, Canada (Quebec), Germany, Hong Kong, and Singapore), how are fourth-grade reading motivation and science knowledge (a proxy for general knowledge) related to informational and narrative reading comprehension in students who are SLLs and students who are MLs?

## **Method**

### **Dataset**

This study consists of secondary data analyses using three international datasets collected by the International Association for the Evaluation of Educational Achievement (IEA): the dataset of Trends in International Mathematics and Science Study (TIMSS) 2011, the dataset of Progress in International Reading Literacy Study (PIRLS) 2011, as well as the combined dataset of the TIMSS and PIRLS 2011.

The TIMSS 2011 provides international comparative data about achievement in science knowledge and mathematics in fourth-grade and eighth-grade students as well as information about their backgrounds and schools. The achievement data in science knowledge and mathematics consist of total scores and subscores by cognitive domain (knowing, applying, and reasoning) and by content domain (e.g., life, physical, earth science for science knowledge). Science knowledge was used as a proxy for general knowledge in the study because it measured knowledge of more than one discipline.

The PIRLS 2011 provides international comparative data about reading achievement in fourth-grade students and information about their backgrounds and schools. It has total scores for reading comprehension and subscores by purposes of reading (reading to acquire and use information and reading for literary experience) and by processes of comprehension (retrieval and straightforward inferencing as well as interpreting, integrating, and evaluating).

The IEA defined the fourth-grade population as those students who had four years of schooling, equivalent to Level 1 of UNESCO's International Standard Classification of Education (ISCED) (primary education). Both TIMSS 2011 and PIRLS 2011 employed a two-stage random sampling design: as a first step, schools were randomly selected, then one class or more classes within each selected school was/were chosen to participate in the studies (Martin & Mullis, 2012).

The IEA created the combined dataset of the TIMSS and PIRLS 2011 with data from 37 countries that participated in both studies to offer opportunities to examine the associations among reading, science, and mathematics achievement in fourth-grade students. Proper sampling weights adjusted for the combined dataset were provided by the IEA. The combined dataset includes information about students' demographics (e.g., home resources for learning) and their school (e.g., availability of library). In addition, total scores on science knowledge and mathematics (from the TIMSS 2011) and total scores on reading comprehension and information about students' experience in reading (from the PIRLS 2011) were included in the combined dataset. However, the combined dataset did not provide subscores within reading comprehension, science knowledge, and mathematics. With the combined dataset, for example, the association between comprehending texts for literary experience and science knowledge cannot be analyzed.

The current study aimed to examine reading comprehension of informational and narrative texts and science knowledge. Given the limitations of the combined data set, the three international datasets were merged using ID variables for countries and students. The merged datasets included the subscores for science knowledge measure from the TIMSS 2011, subscores for reading to acquire and use information and subscores for reading to have literary experience from the PIRLS 2011, students' responses to survey items about their experience in reading, their

demographic information, and proper sampling weights from the combined dataset of the TIMSS and PIRLS 2011. The use of three datasets for data analysis by merging them together was confirmed as “certainly feasible” (P. Foy [a director of sampling, psychometrics, and data analysis for the TIMSS and PIRLS assessments], personal communication, March 20, 2017).

Among 37 countries, five countries (Australia, Canada [Quebec], Germany, Hong Kong, Singapore) were selected for the current study because these countries showed higher immigration rates compared to the rest of the countries (United Nations, 2016). Accordingly, it was expected that there were sufficient fourth-grade students who were SLLs in the data from the five countries. On average, the students were 9.5 years old at the time of testing. The unweighted sample size is summarized in Table 2.1.

### **Measures and variables**

**Language status.** Language status of the fourth-grade students was determined by an item in the PIRLS 2011 Student Questionnaire (IEA, 2011, p. 4) that asked students “How often do you speak <language of test> at home?” Students chose one response among the three: “I always or almost always speak <language of test> at home,” “I sometimes speak <language of test> and sometimes speak another language at home,” “I never speak <language of test> at home.” The students who chose the first option were considered students who were MLs because they reported that their primary home language was the same as the language of the test. Choosing the second or third option indicated that students’ primary home language was probably not the same as the language of the test. Thus, those students who chose the second or third option were considered students who were SLLs.

**Reading measure.** PIRLS defined reading literacy as “the ability to understand and use those written language forms required by society and/or valued by the individual. Young readers

can construct meaning from a variety of texts. They read to learn, to participate in communities of readers in school and everyday life, and for enjoyment” (Mullis et al., 2009, p. 11). Half of the reading measure in the PIRLS 2011 assessed reading comprehension for literary experience and the other half assessed reading comprehension for acquiring and using information (Mullis, Martin, Foy, & Drucker, 2012) (see Appendix A for a description of passages in the reading measure). Narrative fiction was the main form of literary texts because other types of literary texts, such as poetry, were considered to be difficult to include in the measure due to curricula and cultures across the countries. Five narrative and five informational passages were included in the measure.

Within each of the literary and informational text readings, four major processes of reading comprehension were assessed: 1) *focusing on and retrieving explicitly stated information* (20 percent), 2) *making straightforward inferences* (30 percent), 3) *interpreting and integrating ideas and information* (30 percent), and 4) *examining and evaluating content, language, and textual elements* (20 percent) (Mullis et al., 2009, p. 14). The international median of Cronbach’s alpha reliability coefficients was .88 (Martin & Mullis, 2012). The IEA provided five plausible values (i.e., multiply imputed scores) for reading comprehension for each genre.

**Science knowledge measure.** Researchers of the TIMSS 2011 conceptualized science knowledge as a crucial instrument to make informed decisions about one’s own life and the society in which they live (Mullis et al., 2009). The science measure consisted of three content domains: life science, physical science, and earth science. The TIMSS 2011 chose the three content domains because most topics in these domains were included in fourth-grade science curricula in countries participating in the TIMSS 2011 (Mullis et al., 2009). Among the three content domains, more items were assigned to assess knowledge of life science (45 percent) than

physical science (35 percent) and earth science (20 percent) (see Appendix B for examples of topics for each content domain and examples of skills for each cognitive dimension).

Science knowledge was conceptualized as general knowledge in the study because the measure for science knowledge captured knowledge from more than one domain (life, physical, and earth science). Arguably, science knowledge can be conceptualized as science domain knowledge (questioning about the grain size of the domain). However, domain knowledge in reading research has been operationalized as knowledge related to a domain a text's topic is part of (e.g., knowledge about geography to understand a text about the Grand Canyon) (Cervetti & Wright, in press.). In order for a science knowledge measure to function as domain knowledge, topics or themes of the PIRLS 2011 reading measure should belong to life, physical, and early science. However, the reading measure consisted of 10 passages that had different topics and themes. The proximity between the science knowledge measure and topics or themes of passages varied greatly.

Additionally, there were three-types of cognitive skills that fourth-grade students were expected to draw on to respond correctly to the science test items: *knowing* (40 percent of science items), *applying* (40 percent), and *reasoning* (20 percent). That is, items for each content domain could be categorized into these three cognitive dimensions. Items for *knowing* assessed fourth graders' grasp of scientific facts, concepts, and procedures, while items for *applying* requested fourth graders to use their knowledge of science concepts to solve problems straightforwardly related to the science concepts. *Reasoning* items went beyond direct application of science concepts and asked students to reason from scientific principles to provide answers to situations in which contexts were unfamiliar or complicated. In the current study, only the subscore for *knowing* was used. The international median of Cronbach's alpha reliability

coefficients was .78 (Martin & Mullis, 2012). The IEA provided five plausible values for the science knowledge score.

**Motivation for reading.** Three sets of items about reading in the Student Questionnaire were used in the current study: six items under the header “What do you think about reading?,” seven items under “How well do you read?,” and six items under “Do you read for any of the following reasons?” (IEA, 2011, pp. 14–16). Students were requested to answer how much they agree with statements of about reading, listed under each question, on a four-point Likert scale (agree a lot, agree a little, disagree a little, disagree a lot) (see Appendix C). The statements listed under the first question assessed reading attitude (e.g., “I would be happy if someone gave me a book as present”), thus the students’ responses were coded in a way that a larger number indicated a more positive attitude toward reading. For example, agreeing a lot with the statement, “I think reading is boring,” was coded as one, whereas disagreeing a lot with the statement was coded as four.

The statements listed under the second header tap into reading self-efficacy (e.g., “I usually do well in reading”) or reading self-concept (e.g., “My teacher tells me I am a good reader”). In order to refer to both reading self-efficacy and reading self-concept, the term *reader self-perception* was used in the current study (Henk & Melnick, 1995). The students’ responses were coded in a way that a larger number indicated more positive reader self-perception. For example, agreeing a lot with the statement, “reading is harder for me than for many of my classmates,” was coded as one, whereas disagreeing a lot with the statement was coded as four. Students’ responses to another statement, “reading is easy for me,” were coded as four when they agreed a lot, but coded as one when they disagreed a lot.

The statements listed under the third question assessed the value of reading (e.g., It is important to be a good reader). The students' responses were coded in a way that a larger number indicates placing higher value on reading. For example, agreeing a lot with the statement, "it is important to be a good reader," was coded as four, whereas disagreeing a lot with the statement was coded as one. Based on expectancy-value theory (Eccles, 1983), some researchers have found an interaction effect between self-concept and value of task (Nagengast et al., 2011; Trautwein et al., 2012). Thus, the interaction term of the value of reading and reader self-perception was included in reading models in the current study.

In order to examine the underlying constructs of reading motivation, the current study used factor analyses with the data from the five countries, rather than using scale scores provided in the combined TIMSS and PIRLS 2011 dataset. In computing the scale scores, responses of students from all 37 participating countries were used (Martin & Mullis, 2012), thus the scale scores for students in the five countries, chosen for the current study, were influenced by the responses of students from the rest of the countries. After factor analyses, new composite variables for motivational constructs were calculated for the current study. The composite variables are discussed more in the Data Analytic Strategy and Results sections.

**Demographic information.** The Home Resources for Learning Scale (HRLS) and gender were included as demographic covariates in reading models. The HRLS was created by the IEA using students' responses to questions concerning the number of books at home and the number of study supports at home (internet connection and/or own room), as well as parents' responses to questions on their levels of education and occupation and the number of children's books at home. Parents' education, occupation levels, and income are indicators of socioeconomic status, but the datasets did not have information about parents' income. Thus, in

this study, the HRLS was used as a proxy for SES. The students' gender was asked by one question ("Are you a girl or a boy?") in the Student Questionnaire. Male students were the reference group (female = 1, male = 0).

### **Data Analytic Strategy**

One set of analyses for the study included exploratory and confirmatory factor analyses to identify motivational constructs using Mplus 7.4 (Muthén & Muthén, 2015). Each item for reading motivation was treated as an ordinal categorical variable, instead of a continuous variable, thus weighted-least-square estimator with mean and variance adjustment (WLSMV) was selected for factor analyses. Oblique rotation was utilized because correlations among constructs of reading motivation were expected (Fabrigar, Wegener, MacCallum, & Strahan, 1999). In order to account for different sample sizes across the five countries, a weight (*SENWGT*) that can adjust sample sizes to be equivalent across countries was used as recommended by the IEA (Foy, 2013). The adequacy of new factors identified with exploratory factor analyses was assessed with confirmatory factor analysis. It was expected that there would be three motivational constructs: reading attitudes, reader self-perception, and the value of reading.

After factor analyses, descriptive statistics and correlations among informational and narrative reading comprehension scores, science knowledge scores, composite variables for reading motivation, and the HRLS were calculated using the appropriate weight variable (*TOTWGT*). For the correlational analysis, a different weight (*SENWGT*) was used so that the correlation coefficients were not influenced by differences in sample sizes.

Another set of analyses included multi-group multilevel regression analyses to investigate the associations of science knowledge and reading motivation with informational and narrative

reading comprehension in students who were SLLs and students who were MLs. The multilevel regression model had two levels (student-level and school-level). For the student-level, a reading comprehension measure in fourth grade was regressed on fourth-grade science knowledge, motivational constructs for reading, and control variables (HRLS and student gender). For the school-level, the average value of the HRLS in each school and dummy variables for country were included to examine whether the intercept at the student level varies depending on the school-level variables.

For each model for informational and narrative reading comprehension, null models without any variables were examined first, followed by analyses with all variables except science knowledge. Then science knowledge was added to the models. The stepwise approach was used because it allowed examination of the distribution of variance across levels and exploration of whether the associations of motivational constructs with reading comprehension of each genre would change due to the addition of science knowledge to the models. In addition, a weight for each level was calculated and used, as recommended by Rutkowski, Gonzalez, Joncas, and von Davier (2010). To account for missing data, full-information maximum likelihood estimation with robust standard errors (*estimator = MLR*) was used in Mplus (Enders & Bandalos, 2001). The equations used in the analyses are as follows:

Level 1: Fourth-grade informational or narrative reading comprehension score =  $\pi_0 + \pi_1$  (fourth-grade science knowledge) +  $\pi_2$  (fourth-grade reading attitudes) +  $\pi_3$  (fourth-grade reader self-perception) +  $\pi_4$  (fourth-grade value of reading) +  $\pi_5$  (fourth-grade reader self-perception  $\times$  fourth-grade value of reading) +  $\pi_6$  (the HRLS) +  $\pi_7$  (Female) +  $e_0$ ,

Level 2:  $\pi_0 = \beta_{00} + \beta_{01}$  (average school HRLS) +  $\beta_{02}$  (country dummy variable for Canada [Quebec]) +  $\beta_{03}$  (country dummy variable for Germany) +  $\beta_{04}$  (country dummy variable for Hong Kong) +  $\beta_{05}$  (country dummy variable for Singapore) +  $r_{00}$ .

In addition, null hypotheses that coefficients of independent variables are the same between the two language groups were tested through the Model Test option in Mplus (i.e., Wald chi-square test).

## Results

### Factor Analyses for Motivational Constructs

An exploratory factor analysis was conducted to identify underlying motivational constructs in the items in the PIRLS 2011 questionnaire. The number of constructs was determined based on descriptive values; factor models with factors of eigenvalues greater than 1 were selected. Among them, a factor model that showed a better model fit (i.e., value of the RMSEA less than 0.5) was selected (Muthén & Muthén, 2009). A three-factor model was selected because its RMSEA value was the closest to less than .05, while the others had RMSEA values much larger than .05. Table 2.2 shows item loadings on three factors that would potentially capture motivational constructs for reading. Items with factor loadings equal to or greater than .50 were selected for a confirmatory factor analysis.

The first factor consisted of four items: C (“I would be happy if someone gave me a book as present”), D (“I think reading is boring”), E (“I would like to have more time for reading”), and F (“I enjoy reading”). The four items were related to one of three components of reading attitudes (Mathewson, 1994): C and F related to feelings about reading, D related to beliefs about reading, and E related to readiness to initiate and involve in reading. In addition, the items C and E were very similar to some items in the Elementary Reading Attitude Survey (ERAS, McKenna

et al., 1995, p. 956) such as, “How do you feel about getting a book for a present?” and “How do you feel about spending free time reading?” Thus, the first construct was labeled *reading attitudes*. The second factor consisted of five items: G (“I usually do well in reading”), H (“Reading is easy for me”), I (“Reading is harder for me than for many of my classmates”), K (“I have trouble reading stories with difficult words”), and M (“Reading is harder for me than any other subject”). All statements reflect evaluation of reading ability: the three items (G, H, and K) are more relevant to reading self-efficacy, whereas the other two items (I and M) are more about reading self-concept because they reflect comparison to other people or other tasks. The second construct was named *reader self-perception*. The third factor consisted of four items, namely, O (“It is important to be a good reader”), Q (“I learn a lot from reading”), and R (“I need to read well for my future”). The item O was related to attainment value (Durik, Vida, & Eccles, 2006), whereas the other two items were related to a utility value (Anmarkrud & Bråten, 2009). Additionally, the two items, G (“I usually do well in reading”) and L (“My teacher tells me I am a good reader”), had loadings larger than .5 on the third construct, but their wordings were not relevant to the value of reading. As well, the item, P (“My parents like it when I read”), was not included even though its loading was larger than .5 because it states how much the students’ parents value reading rather than the students themselves.

A confirmatory factor analysis was conducted to examine whether the three-factor model for reading motivation fit the data well. Each of three constructs was specified by its items, and some correlations between residuals of items within the same construct were allowed. A model with values of the CFI and TLI greater than .90 is considered to have a reasonably good fit (Hu & Bentler, 1999; Kline, 2011). For the RMSEA, values less than .05 show that a model has a good fit, and values from 0.5 through 0.8 indicate a reasonable fit (Hu & Bentler, 1999; Kline,

2011). The fit indices showed that the three-factor model in the current study had an adequate fit (RMSEA = .059, CFI = .974, TLI = .962). The three composite variables for each motivational construct were created by computing the mean of the selected items if there were valid data on at least  $n/2$  of the  $n$  items.<sup>1</sup> The value of the composite variables was coded as missing when there was missing data in the responses of more than  $n/2$  items.

Before running multi-group multilevel regression analyses, descriptive statistics and correlations among continuous variables were computed (see Table 2.3). Correlation coefficients among the variables for all samples from the five countries are presented in Table 2.4.

### **Multi-group Multilevel Regression to Explain Reading Comprehension**

A null model without predictors was first examined to see the distribution of variance across levels. For reading comprehension of both genres, the intraclass correlation coefficient indicated that approximately 27 percent of the variance in informational or narrative reading comprehension lay between the schools in the five countries, and the rest of the variance (approximately 73 percent) lay between the students. Then, motivational constructs, HRLS, and gender at the student level as well as the school average HRLS and dummy variables for countries at the school level were included in the null model (see Table 2.5 for the informational model and Table 2.6 for the narrative). Wald chi-square tests were conducted to examine whether the coefficient of each variable was significantly different between the two language groups. The results showed that there were no significant differences in the coefficients between the two groups ( $\chi^2(7) = 8.75, p = .271$  for informational reading comprehension;  $\chi^2(7) = 7.68, p$

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<sup>1</sup> Composite variables created for this study were different from scale scores created by PIRLS researchers. As a result of analyzing responses of students from the five countries chosen for this study, 11 items (see Appendix C) were used to create the composite variables: for reading attitudes (item C, D, E, and F), for reader self-perception (item G, H, K, I, and M), and for the value of reading (item O, Q, and R). However, as a result of analyzing all responses of students from 37 countries, the scale scores were made from all items (see Appendix C) for each of 37 countries. For *Students Like Reading Scale*, items from A to F and the two additional items (“I read for fun,” “I read things that I choose myself”) under a question (“How often do you do these things outside of school?”) were used. For the *Students Motivated to Read Scale*, items from G to M were used. For the *Students Confident in Reading Scale*, items from N to S were used.

= .362 for narrative reading comprehension). Accordingly, the coefficients of all variables were re-estimated by constraining them to be the same between the language groups (see Table 2.7 for the informational and Table 2.8 for the narrative). With the constraints imposed on the coefficients of the variables, the coefficient of reading attitudes for students who were SLLs became significant in reading comprehension for each genre, and the coefficients of the value of reading for students who were MLs became non-significant in the model for informational reading comprehension. The models for both genres with the constraints on the coefficients showed that reader self-perception and reading attitudes predicted the reading comprehension measures, whereas the value of reading was not significantly related to the reading comprehension measures.

After the relationships between motivational constructs and reading comprehension of each genre were examined, science knowledge was added to the models (see Table 2.5 for the informational and Table 2.6 for the narrative). Wald chi-square tests were conducted to compare the coefficients of all variables including science knowledge between the two language groups. The results showed that no variable had significantly different coefficients by language status ( $\chi^2(8) = 4.85, p = .774$  for informational reading comprehension;  $\chi^2(8) = 5.82, p = .667$  for narrative reading comprehension). Additionally, a series of Wald chi-square tests were conducted for each country (without dummy variables for countries) to test differences of the coefficients at a significant level according to language status. Consistent with the results from the Wald chi-square tests with five countries altogether, there were no significant differences in the coefficients of all variables between the two groups in each of the five countries. The coefficients of each factor at the student- and school-level were constrained to be the same between the language groups.

Before constraining the coefficients of the variables, reading attitudes did not significantly explain informational and narrative reading comprehension in students who were SLLs. However, after constraining the coefficients of reading attitudes to be the same between the two groups, reading attitudes were found to be a significant and positive factor in reading comprehension of both genres, regardless of language status. In addition, reader self-perception did not predict informational reading comprehension in students who were MLs, but after constraining the coefficients to be the same between the two groups, reader self-perception predicted informational reading comprehension in both groups.

Table 2.7 and Table 2.8 display the unstandardized and standardized coefficients of the variables, estimated with the constraints, in predicting informational and narrative reading comprehension in fourth-grade students who were SLLs and students who were MLs. After including science knowledge to the model, the absolute values of the coefficients of the motivational constructs decreased for informational and narrative reading comprehension except the interaction term (between reader self-perception and the value of reading) for narrative reading comprehension. However, adding science knowledge did not make a difference in the extent to which statistical significance of the motivational constructs was observed. Approximately 10 percent more variance in reading comprehension of each genre was explained by adding science knowledge to the reading models. The following discusses each variable in relation to informational and narrative reading comprehension from the results of multi-group multilevel regression models with the constraints imposed on the coefficients of all variables between the two groups.

Science knowledge, reading attitudes, and reader self-perception were found to significantly predict informational and narrative reading comprehension in students who were

SLLs and students who were MLs. The standardized coefficients indicated that science knowledge had the strongest association with informational and narrative reading comprehension, followed by reader self-perception and reading attitudes. One standard deviation higher scores in the science knowledge measure were associated with approximately .4 standard deviations higher scores in informational and narrative reading comprehension, regardless of language status.

The standardized coefficients of science knowledge and reader self-perception were larger than the coefficient of the HRLS. Reading attitudes were significant for both genres, but the standardized coefficients were much smaller compared to the coefficients of science knowledge and reader self-perception. The value of reading and the interaction term between the value of reading and reader self-perception did not predict informational and narrative reading comprehension. The non-significant result about the value of reading might be partially attributable to higher correlation between the value of reading and reading attitudes (.49) than the correlation between the value of reading and reading comprehension (approximately .07 for both genres). In addition, the intercept at the student level significantly differed by the average school HRLS. Across the five countries, fourth-grade students who went to wealthier schools were likely to perform better in reading comprehension than those who went to less wealthy schools even when HRLS was the same among the students.

The coefficients of science knowledge on reading comprehension were compared between the two genres with Wald chi-square tests. The results indicated that there was no significant difference between the association of science knowledge with the informational reading comprehension and the association of science knowledge with narrative reading comprehension for students who were SLLs ( $\chi^2(1) = .25, p = .614$ ) and for students who were

MLs ( $\chi^2(1) = 2.46, p = .117$ ). Additionally, a series of Wald chi-square tests were conducted for each country (without dummy variables for countries) to examine differences between the two genres regarding the coefficients for science knowledge. For Australian and Canadian (Quebec) data, the coefficients of science knowledge on informational and narrative reading comprehension were similar, regardless of students' language status. However, for students who were MLs in Germany, students who were MLs in Hong Kong and students who were SLLs in Singapore, the coefficient of science knowledge was significantly larger for informational reading comprehension than narrative reading comprehension ( $\chi^2(1) = 7.07, p = .008$  for Germany;  $\chi^2(1) = 5.21, p = .022$  for Hong Kong;  $\chi^2(1) = 4.16, p = .04$  for Singapore). Taking the results from analyses of multi-country data and individual country data, the association between general knowledge and informational reading comprehension appears to be similar to or stronger than the association between general knowledge and narrative reading comprehension.

## **Discussion**

The current study investigated how general knowledge and reading motivation (reading attitudes, reader self-perception, and the value of reading), important but under-studied predictors, simultaneously predicted fourth-grade reading comprehension in L1 and L2. The study was able to include students who were SLLs in five countries with high immigration rates (Australia, Canada [Quebec], Germany, Hong Kong, and Singapore), unlike most previous research that has examined data from one country, and analyzed three international datasets, rarely used in previous research (PIRLS 2011, TIMSS 2011, and the combined TIMSS & PIRLS 2011 datasets). This study investigated and compared the role of general knowledge and reading motivation in both informational and narrative genres, extending previous research that has examined either informational or narrative reading comprehension. Multi-group multilevel

regression analyses were selected in order to explore the reading model for each language group because the assumption of the same trajectory for language and literacy development between the language groups is not recommended (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014).

### **General Knowledge and Reading Comprehension of Informational and Narrative Texts**

Fourth-grade students' general knowledge (approximated with a science knowledge measure) was found to be positively related with reading comprehension, regardless of language status. The current study cannot provide an explanation about how general knowledge facilitates reading comprehension, but a study by Cozijn, Noordman, and Vonk (2011) suggests that general knowledge supports drawing inferences about the relations among propositions in a text, which is an essential part of successful reading comprehension. Best et al. (2008) and McNamara et al. (2011) also postulated that readers' general knowledge facilitates inference generation about information not explicitly stated in a text, resulting in the coherent mental representation of the text. Complicated networks of knowledge might have facilitated accessing and activating knowledge units that are relevant or partially related to topics of texts in the reading measure.

General knowledge positively predicted informational and narrative text comprehension separately (e.g., McNamara et al., 2011), and the coefficients of general knowledge on reading comprehension of each genre were similar between students who were SLLs and students who were MLs. The findings of this study suggest that having strong general knowledge may facilitate reading comprehension of both genres, regardless of language status. Results mirror the findings of the Hwang and Duke (2017) study in that general knowledge was the most important factor among the factors they examined. However, the finding of the current study was not consistent with Hwang and Duke (2017) in that the authors showed general knowledge played a

more important role in reading comprehension in students who were SLLs than students who were MLs in third grade. The different results might be partially due to different predictors used in each study. Hwang and Duke (2017) included decoding skills and early decoding skills (kindergarten and first grade), which were not included in this study.

In terms of genres, the current study could not find a significant difference between the association of general knowledge with informational reading comprehension and the association of general knowledge with narrative reading comprehension from analyzing data from the five countries, unlike McNamara et al. (2011) who found that general knowledge was more strongly associated with informational reading comprehension than narrative reading comprehension. However, separate analyses for each country revealed that informational reading comprehension was more strongly related to general knowledge than narrative reading comprehension in Germany (for students who were MLs), Hong Kong (for students who were MLs), and Singapore (for students who were SLLs). Findings for these countries were partially in accordance with the findings of McNamara and her colleagues; it is difficult to infer why the other countries (Australia, Canada [Quebec]) did not show the same effect. In addition, the finding of this study regarding narrative text comprehension was not consistent with the finding of the study by Best et al. (2008). The authors found that general knowledge was not significantly related to narrative reading comprehension. The different results might be partially due to the addition of decoding skills in reading models in the study by Best and her colleagues. Further, the authors used sequential multiple regression analyses. When general knowledge was entered first in the model for narrative reading comprehension before decoding skills, both factors were significant. However, when decoding skills were entered first (i.e., controlled for), general knowledge measure became non-significant.

The finding that general knowledge could predict narrative reading comprehension needs more explanation because it is a science knowledge measure used in the study to approximate general knowledge. Information embedded in narrative passages in the reading measure might be related to life, physical, and/or earth science, and having knowledge about the information might have assisted in the comprehension of narrative texts. For example, a passage titled *Fly, Eagle, Fly*, used in PIRLS 2011 (publicly released) contains information and vocabulary about birds (“An eagle chick had hatched from its egg a day or two earlier, and had been blown from its nest by the terrible storm”). In comprehending the sentence, knowledge about birds such as baby birds are born in eggs, and birds are living in nests, can be greatly helpful. Also, in order to understand the part of the passage that describes mountain climbing (“Sometimes their path was dangerous...crossing narrow shelves of rock and taking them into dark crevices and out again...He looked down the cliff...”); having knowledge about the appearance of mountains and vocabulary to describe them would facilitate comprehension. Alternatively, there could be a lurking variable that caused the significant association between science knowledge and narrative text comprehension. For example, students with a higher Intelligence Quotient might perform well on the science knowledge measure and reading comprehension measure (for both genres). Another possibility is that students who have greater science knowledge tend to have greater knowledge in other subjects such as history or geography. Not only science knowledge but also knowledge of different topics of social studies might have jointly facilitated narrative reading comprehension.

### **Reading Motivation and Reading Comprehension of Informational and Narrative Texts**

The current study identified three motivational constructs for reading, namely reading attitudes, reader self-perception, and the value of reading. Consistent with previous research, we

found a positive relationship between reading attitudes and reading comprehension in L1 (Guthrie et al., 2006; Guthrie, Hoa, et al., 2007; Schaffner et al., 2013) and L2 (Ghaith & Bouzeineddine, 2003; Kim, 2016) for both informational and narrative text genres. That is, the more positive attitudes toward reading fourth-grade students had, the higher reading scores for both genres they were likely to have with the other factors held constant.

The present study showed the positive relationship of reader self-perception with L1 and L2 reading achievement for both genres. The finding is in accord with previous L1 reading studies (Cartwright et al., 2015; Park, 2011) and L2 reading studies (e.g., Sani & Zain, 2011) on the relationship between reading self-efficacy/self-concept with reading comprehension. However, the finding of this study was different from a study by Taboada Barber et al. (2015) in that they showed reading self-efficacy was a significant predictor of L2 reading, but not of L1 reading. The different results from the Taboada Barber et al. study might be partially due to the former statistically controlled for previous reading achievement. In the current study, previous reading achievement was not controlled for.

The value of reading has been studied with reading self-efficacy (or self-concept) based on the expectancy value theory (Eccles, 1983). Thus, in the current study, the value of reading was examined along with reader self-perception and the interaction term between the value of reading and reader self-perception. The value of reading and the interaction term did not significantly predict reading comprehension in L1 and L2, whereas reader self-perception was a significant factor. This finding is not consistent with some previous studies. For example, McGeown et al. (2015) found that the value of reading and reading self-concept (marginal significance for reading self-concept,  $p < .06$ ) predicted reading comprehension positively, while controlling for decoding skills. Anmarkrud and Bråten (2009) showed that the value of reading

was associated with reading comprehension even after prior knowledge and the use of reading strategies were controlled for, whereas reading self-efficacy was not a significant predictor. The non-significant result about the value of reading in this study should be interpreted cautiously because it might be partially due to the higher correlation between the value of reading and reading attitudes than the correlation between the value of reading and reading comprehension. Additionally, the value of reading only captured the attainment and utility values, not interest value. The results might be different if all dimensions of the value of reading were included.

### **Home Resources for Learning and Reading Comprehension**

Home resources for learning were significantly related to reading comprehension of both genres in students who were SLLs and students who were MLs. However, the relationship between the index of home resources for learning and reading comprehension was weaker than the relationships of reading comprehension with science knowledge and reader self-perception for both groups. That is, higher reader self-perception or stronger science knowledge would be associated with a larger increase in reading comprehension scores than would occur with higher home resources for learning. This suggests that fostering science knowledge and positive reader self-perception may have the potential to support reading comprehension development in the elementary years to a meaningful degree. Schools may have more control over their ability to support general knowledge and reader self-perception than home resources for learning. Indeed, educators can cultivate general knowledge and positive reader self-perception to support reading development (e.g., Guthrie, McRae, & Klauda, 2007; Taboada Barber et al., 2015).

### **Implications for Research and Practice**

The positive relationships between general knowledge and informational and narrative reading comprehension in students who were SLLs and students who were MLs suggest

fostering general knowledge may support reading comprehension in both genres, regardless of language status. However, national guidelines for teaching reading to elementary students have not always attended to knowledge development. For example, the Australian Government made changes to the national curriculum to place a greater emphasis on teaching of phonics and to reduce the amount of content in subject matter (Australian Government, 2016). The current national syllabus of language learning and literacy development in Singapore (the English Language Syllabus 2010) emphasizes the integration of different language and literacy skills (e.g., reading, writing, vocabulary, grammar), but knowledge receives less attention (Ministry of Education, 2010). Exceptionally, *Reading across the Curriculum* and *Language across the Curriculum*, designed by the Hong Kong Education Bureau, promotes opportunities for students to develop reading and language skills in the context of building knowledge. The curricula aim to enhance students' reading and language achievement by engaging them in applying their language and literacy skills to construct knowledge in eight subject matters including Chinese language arts, English language arts, mathematics, social studies, and science (Curriculum Development Council, 2015).

Policymakers and curriculum writers should understand that fostering students' knowledge development not only has benefit in its own right, but also has the potential to support reading comprehension, regardless of students' language status. For example, Connor et al. (2017) tested the efficacy of *content-area literacy instruction* (CALI) that integrates content area studies (social studies and science) with literacy instruction for students from kindergarten through fourth-grade students. Using randomized controlled trials, the authors showed that the implementation of CALI not only improved students' knowledge in content area studies but also their oral and reading comprehension skills. However, recent publications about supporting

reading development in students who are SLLs by UNESCO (Daghé et al., 2017) and by National Academies of Sciences, Engineering, and Medicine (2017) did not include fostering general knowledge as one of their recommendations for supporting L2 reading development. The findings of this study with students in different countries and evidence from a study by Connor et al. (2017) can contribute to the recommendation about fostering general knowledge for supporting L1 and L2 reading development of students around the world. This study is informative, but more studies are needed to address the causal relationship between general knowledge and L2 reading comprehension.

Future research can address whether general knowledge uniquely predicts reading comprehension of different genres beyond vocabulary knowledge in students who are SLLs and students who are MLs. Vocabulary knowledge is considered part of general knowledge, mostly related to the lexical level of knowledge according to categories of knowledge by Cook and Gueraud (2005). Thus, it is postulated that the significant results of general knowledge in this study may be partially due to the contribution of vocabulary knowledge. In addition, general knowledge extends vocabulary knowledge as it includes featural and scenario/script levels of knowledge (Cook & Gueraud, 2005). Accordingly, it is hypothesized that general knowledge would explain reading comprehension beyond vocabulary knowledge. However, the postulation and hypothesis could not be examined in this study because the international datasets did not provide a vocabulary measure. Some may argue that the significant results of general knowledge would just reflect the role of vocabulary knowledge in reading comprehension. However, based on the findings of the study by Rydland et al. (2012), the significant result of general knowledge would go beyond the role of vocabulary knowledge. The authors found that topic knowledge positively predicted comprehension of a text about that topic even after L2 vocabulary was

included in their regression model. More studies are needed to examine how general knowledge and vocabulary knowledge jointly explain reading comprehension in L1 and L2.

Reading attitudes and reader self-perception positively predicted reading comprehension of both genres in students who were SLLs and students who were MLs. Attention to fostering positive reading attitudes and reader self-perception may help support development of L1 and L2 reading comprehension. The current study did not examine how we can foster positive reading attitudes and reader self-perception in students, but previous studies have examined instructional techniques that can enhance them. For example, providing multiple opportunities to experience situational interest in reading (e.g., temporal interest in reading about birds) and stimulating tasks (e.g., examining different feathers of birds) can support students' intrinsic reading motivation (Guthrie et al., 2006), which conceptually overlaps with reading attitudes (Schiefele et al., 2012). In addition, modeling and scaffolding of reading tasks and providing specific and informative feedback to reading tasks (e.g., using comprehension strategies) can bolster students' reading self-efficacy (Taboada Barber et al., 2015).

### **Limitations**

The current study has several limitations. First, general knowledge did not include knowledge of social studies, but only included knowledge about different domains of science because there was no measure for social studies in the international datasets. Second, language status was determined only by primary home language, which was reported by students. Other information about language status such as teacher report was not available in the dataset. Third, students who were SLLs used different first languages (e.g., Malay, Mandarin, and Tamil for Singapore), and the linguistic distance between L1 and L2 might have influenced the development of reading comprehension. However, the linguistic distance between L1 and L2

was not included in the reading models of the current study because of small sample sizes for each group of students who used the same L1 at home. Fourth, the study did not examine important contributors for reading such as vocabulary knowledge, decoding skills, and cognitive flexibility because there were no available measures in the international datasets. Fifth, it is possible that there is a lurking variable that might explain the relationship between science knowledge and reading comprehension, such as IQ or test strategies, but was not included in the study.

### **Conclusion**

The study explored the role of general knowledge and reading motivation in informational and narrative reading comprehension in students who were SLLs and students who were MLs in five countries. The analyses of the PIRLS and TIMSS datasets, rarely used jointly in previous studies, revealed that general knowledge, reader self-perception, and reading attitudes jointly explain reading comprehension of both genres in students who were SLLs and MLs to a similar extent (approximately  $R^2 = .40$ ), while gender, home resources for learning (student-level covariates), the average school home resources for learning, and countries (school-level covariates) were held constant. The findings of the study can inform ongoing efforts to promote reading development in the elementary years, particularly for students who are SLLs.

Table 2.1

*Sample Size for Each Country*

	Total sample size	Language of reading test	Students who were SLLs	Students who were MLs
Australia	5,943	English	1,151	4,718
Canada (Quebec)	4,142	English or French	1,294	2,782
Germany	3,928	German	720	2,928
Hong Kong	3,802	Chinese	1,183	2,541
Singapore	6,208	English	4,196	1,982

Table 2.2

*Factors from Exploratory Factor Analysis (N = 23,533)*

Item	Factor			Model fit indices
	1	2	3	
A				RMSEA = .054; CFI = .96; TLI = .942
B				
C	.56			
D	.72			
E	.76			
F	.80			
G		.53	.55	
H		.62		
I		.79		
J				
K		.58	.52	
L				
M		.73		
N				
O			.76	
P			.61	
Q			.59	
R			.74	
S				
Eigenvalues (rotated)		1.46		

*Note.* Loadings (rounding up to second decimal) < .5 were omitted.

Table 2.3

*Means and Standard Deviations for Informational and Narrative Reading Comprehension Scores, Science Knowledge Scores, Reading Attitudes, Reader Self-perception, the Value of Reading, and HRLS*

	Australian students who were		Canadian (Quebec) students who were		German students who were		Hong Kong students who were		Singapore students who were	
	SLLs	MLs	SLLs	MLs	SLLs	MLs	SLLs	MLs	SLLs	MLs
Informational reading comprehension	515.97 (82.65)	532.52 (79.77)	534.94 (65.84)	537.13 (63.08)	513.17 (67.82)	547.89 (71.08)	573.66 (57.80)	580.96 (55.41)	560.59 (77.19)	588.88 (74.51)
	528.77 (80.87)		536.41 (63.82)		538.02 (71.65)		577.49 (57.09)		569.30 (77.86)	
					550.00 (73.45)					
Narrative reading comprehension	510.14 (84.56)	532.42 (81.59)	533.76 (64.74)	541.54 (64.09)	522.18 (62.93)	552.96 (63.95)	564.51 (66.91)	568.79 (66.22)	557.14 (84.02)	587.05 (80.81)
	527.54 (82.84)		539.28 (64.37)		544.30 (64.96)		566.14 (66.96)		566.33 (84.60)	
					548.72 (74.88)					
Science knowledge scores	500.24 (84.48)	524.97 (81.46)	513.47 (65.84)	521.97 (64.12)	491.15 (71.14)	539.58 (67.70)	534.29 (74.89)	549.78 (71.22)	559.08 (91.82)	593.80 (87.83)
	519.32 (83.08)		519.91 (64.64)		528.24 (70.42)		543.79 (73.30)		569.89 (92.40)	
					536.23 (79.69)					
Reading attitudes	3.25 (0.80)	3.16 (0.85)	3.34 (0.71)	3.30 (0.71)	3.19 (0.77)	3.20 (0.79)	3.29 (0.75)	3.22 (0.75)	3.25 (0.76)	3.26 (0.79)
	3.18 (0.84)		3.31 (0.71)		3.20 (0.78)		3.23 (0.76)		3.25 (0.77)	
					3.23 (0.60)					
Reader self- perception	3.15 (0.65)	3.21 (0.66)	3.15 (0.66)	3.22 (0.65)	3.24 (0.64)	3.31 (0.66)	1.75 (0.64)	3.00 (0.66)	3.10 (0.61)	3.31 (0.57)
	3.20		3.20		3.30		3.01		3.17	

	(0.66)		(0.65)		(0.66)		(0.63)		(0.61)	
					3.17 (0.40)					
Value of reading	3.63 (0.56)	3.56 (0.61)	3.57 (0.49)	3.50 (0.51)	3.62 (0.57)	3.56 (0.55)	3.34 (0.78)	3.27 (0.74)	3.48 (0.63)	3.52 (0.64)
	3.58 (0.60)		3.52 (0.55)		3.57 (0.55)		3.29 (0.76)		3.49 (0.64)	
					3.55 (0.58)					
HRLS	11.05 (1.62)	11.72 (1.62)	11.10 (1.47)	11.15 (1.40)	9.87 (1.70)	10.90 (1.72)	9.87 (1.85)	9.70 (1.75)	10.41 (1.60)	11.34 (1.48)
	11.60 (1.64)		11.14 (1.41)		10.72 (1.76)		9.76 (1.78)		10.71 (1.62)	
					10.71 (3.06)					

*Note.* Standard deviations are in parenthesis.

Table 2.4

*Coefficients of Correlations among Informational and Narrative Reading Comprehension**Scores, Science Knowledge Scores, Reading Attitudes, Reader Self-perception, the Value of Reading, and HRLS by Language Status*

Students who were	MLs SLLs	1	2	3	4	5	6	7
9. Informational reading comprehension			.88 ***	.61 ***	.27 ***	.43 ***	.03	.40 ***
10. Narrative reading comprehension		.87 ***		.60 ***	.24 ***	.42 ***	.03	.38 ***
11. Science knowledge scores		.64 ***	.61 ***		.15 ***	.33 ***	.02	.39 ***
12. Reading attitudes		.24 ***	.20 ***	.15 ***		.37 ***	.38 ***	.21 ***
13. Reader self-perception		.36 ***	.37 ***	.29 ***	.32 ***		.18 ***	.24 ***
14. Value of reading		.05	.05	.02	.46 ***	.22 ***		.06
15. HRLS		.41 ***	.38 ***	.41 ***	.20 ***	.23 ***	.03	

*Note.* \*\*\*  $p < .001$

Table 2.5

*Multi-group Multilevel Regression Analyses without Constraints Predicting Informational Reading Comprehension in Fourth Grade*

Fixed effect	Fourth-grade students who were							
	SLLs				MLs			
	wo/science knowledge		w/science knowledge		wo/science knowledge		w/science knowledge	
	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>
Intercept at level 1, $\pi_0$								
Intercept at level 2, $\beta_{00}$	208.24**	7.72**	111.11*	6.63*	343.62 ***	12.12***	176.06 ***	10.17***
Average school HRLS, $\beta_{01}$	12.66***	0.45***	6.05*	0.34**	16.68***	0.57***	8.66***	0.48***
Canada (Quebec), $\beta_{02}$	8.07*	0.07**	7.62**	0.11**	8.07*	0.07**	7.62**	0.11**
Germany, $\beta_{03}$	22.14***	0.38***	14.23***	0.40***	22.14***	0.36***	14.23***	0.38***
Hong Kong, $\beta_{04}$	94.08***	0.46***	64.39***	0.50***	94.08***	0.44***	64.39***	0.49***
Singapore, $\beta_{05}$	57.76***	0.17***	27.28***	0.13***	57.76***	0.17***	27.28***	0.13***
Science knowledge, $\pi_1$			0.43***	0.46***			0.42***	0.42***
Reading attitudes, $\pi_2$	6.31	0.07	4.75	0.05	9.16***	0.11***	8.22***	0.09***
Reader self-perception, $\pi_3$	48.63*	0.48*	31.42*	0.30*	24.27*	0.24*	20.22	0.19
Value of reading, $\pi_4$	15.96	0.14	9.81	0.08	-21.68*	-0.18*	-12.56	-0.10
Interaction, $\pi_5$	-5.54	-0.27	-3.21	-0.15	3.76	0.18	1.57	0.07
HRLS, $\pi_6$	12.63***	0.33***	6.79***	0.17***	10.02***	0.26***	6.19***	0.15***
Female, $\pi_7$	1.50	0.02	6.76	0.10	-4.18	-0.06	3.59	0.05
R-square								
Level 1		.26		.43		.29		.44
Level 2		.32		.31		.39		.35

Note. Interaction = interaction term between reader self-perception and the value of reading. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 2.6

*Multi-group Multilevel Regression Analyses without Constraints Predicting Narrative Reading Comprehension in Fourth Grade*

Fixed effect	Fourth-grade students who were							
	SLLs				MLs			
	wo/science knowledge		w/science knowledge		wo/science knowledge		w/science knowledge	
	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>	<i>b</i>	<i>beta</i>
Intercept at level 1, $\pi_0$								
Intercept at level 2, $\beta_{00}$	210.36**	8.06**	114.74*	7.05*	454.71 ***	12.47***	184.00 ***	10.96***
Average school HRLS, $\beta_{01}$	11.72***	.43***	5.38*	.33*	16.50***	0.57***	8.76***	0.50***
Canada (Quebec), $\beta_{02}$	13.31***	0.13***	12.92***	0.20***	13.31***	0.12***	12.92***	0.19***
Germany, $\beta_{03}$	29.48***	0.52***	21.88***	0.62***	29.48***	0.50***	21.88***	0.60***
Hong Kong, $\beta_{04}$	82.11***	0.41***	53.92***	0.43***	82.11***	0.39***	53.92***	0.42***
Singapore, $\beta_{05}$	57.19***	0.18***	27.74***	0.14***	57.19***	0.17***	27.74***	0.13***
Science knowledge, $\pi_1$			.42***	0.47***			.39***	0.42***
Reading attitudes, $\pi_2$	4.46	0.05	2.84	0.03	5.02**	0.06**	4.08**	0.05**
Reader self-perception, $\pi_3$	56.38**	0.58**	39.63**	0.39**	28.12**	0.29**	24.43*	0.25*
Value of reading, $\pi_4$	19.85	0.18	13.84	0.12	-15.56	-0.13	-6.72	-0.06
Interaction, $\pi_5$	-7.56	-0.38	-5.24	-0.25	2.23	0.11	.11	0.00
HRLS, $\pi_6$	10.93***	0.30***	5.22***	0.14***	9.23***	0.25***	5.61***	0.15***
Female, $\pi_7$	9.65*	0.16*	15.63**	0.23**	5.59*	0.09*	12.95***	0.20***
R-square								
Level 1		.25		.42		.27		.41
Level 2		.34		.37		.40		.41

*Note.* Interaction = interaction term between reader self-perception and the value of reading. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 2.7

*Multi-group Multilevel Regression Analyses with Constraints Predicting Informational Reading Comprehension in Fourth Grade*

Fixed effect	Without science knowledge				With science knowledge			
	Fourth-grade students who were				Fourth-grade students who were			
	SLLs	MLs	SLLs	MLs	SLLs	MLs	SLLs	MLs
	<i>b</i>		<i>beta</i>		<i>b</i>		<i>beta</i>	
Intercept at level 1, $\pi_0$								
Intercept at level 2, $\beta_{00}$	497.08 ***	310.59 ***	10.74***	11.05***	155.91 ***	157.09 ***	9.11***	9.18***
Average school HRLS, $\beta_{01}$	16.09***		0.55***		8.14***		0.45***	
Canada (Quebec), $\beta_{02}$	7.92*		0.07*		7.49**		0.11**	
Germany, $\beta_{03}$	21.90***		0.36***		14.08***		0.38***	
Hong Kong, $\beta_{04}$	94.23***		0.44***		64.36***		0.49***	
Singapore, $\beta_{05}$	57.91***		0.17***		27.48***		0.13***	
Science knowledge, $\pi_1$					0.42***		0.45***	0.43***
Reading attitudes, $\pi_2$	8.74***		0.10***		7.69***		0.08***	0.09***
Reader self-perception, $\pi_3$	31.60**		.31**		24.27*			0.23***
Value of reading, $\pi_4$	-12.06		-.10		-6.58		-.06	-.05
Interaction, $\pi_5$	1.26		.06		0.13			.01
HRLS, $\pi_6$	10.50***		.28***	.27***	6.30***			.16***
Female, $\pi_7$	-3.45		-.05		4.03			.06
R-square								
Level 1	.27			.29			.43	
Level 2		.37					.34	
Total variance explained	.28		.30				.42	

Note. Interaction = interaction term between reading self-perception and the value of reading. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 2.8

*Multi-group Multilevel Regression Analyses with Constraints Predicting Narrative Reading Comprehension in Fourth Grade*

Fixed effect	Without science knowledge				With science knowledge			
	Fourth-grade students who were				Fourth-grade students who were			
	SLLs	MLs	SLLs	MLs	SLLs	MLs	SLLs	MLs
	<i>b</i>		<i>beta</i>		<i>b</i>		<i>beta</i>	
Intercept at level 1, $\pi_0$								
Intercept at level 2, $\beta_{00}$	303.58 ***	313.25 ***	11.19 ***	11.54 ***	163.81 ***	166.46 ***	9.90***	10.06***
Average school HRLS, $\beta_{01}$	15.54***		0.55***		8.05***		0.46***	
Canada (Quebec), $\beta_{02}$	12.98***		0.12***		12.59***		0.19***	
Germany, $\beta_{03}$	29.12***		0.50***		21.67***		0.60***	
Hong Kong, $\beta_{04}$	82.20***		0.40***		54.06***		0.43***	
Singapore, $\beta_{05}$	57.25***		0.17***		28.38***		0.14***	
Science knowledge, $\pi_1$					0.40 ***		0.45***	0.43***
Reading attitudes, $\pi_2$	4.98**		0.06**		3.91**		0.05**	
Reader self-perception, $\pi_3$	35.34***		0.36***	0.37***	28.56**		0.28**	0.29**
Value of reading, $\pi_4$	-6.99		-0.06		-1.57		-0.01	
Interaction, $\pi_5$	-0.14		-0.01		-1.26		-0.06	
HRLS, $\pi_6$	9.56***		0.26***		5.56***		0.15***	
Female, $\pi_7$	6.06*		0.10*		13.16***		0.20***	
R-square								
Level 1	.25		.27				.41	
Level 2		.39					.4	
Total variance explained	.27		.29				.4	

Note. Interaction = interaction term between reading self-perception and the value of reading. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

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## **Appendices**

## Appendix A

### PIRLS 2011 Assessment Passages

(Martin & Mullis, 2012)

Narrative Passages	
<i>Enemy Pie</i>	<i>A contemporary story about friendship narrated by the male character</i>
<i>Fly, Eagle, Fly</i>	<i>An allegorical tale from Africa about fulfilling destiny of an eagle</i>
<i>The Empty Pot</i>	<i>A traditional tale set in China about honesty</i>
<i>Flowers on the Roof</i>	<i>A contemporary story about friendship</i>
<i>Shiny Straw</i>	<i>An animal story about heroism and a reckless attitude</i>
Informational Passages	
<i>Day Hiking</i>	<i>A leaflet (tri-fold format) to give information about hiking</i>
<i>The Giant Tooth Mystery</i>	<i>A scientific and historical text about stages in the discovery of dinosaurs</i>
<i>Leonardo Da Vinci</i>	<i>A biographical text about the inventions of Leonardo da Vinci</i>
<i>Sharks</i>	<i>An article to give information about Sharks</i>
<i>Where's the Honey?</i>	<i>A passage describing the relationship between honeyguide bird and the Boran people in Africa</i>

## Appendix B

### Content Domains and Cognitive Skills Assessed in Fourth-grade Science Knowledge Test in TIMSS 2011 (Mullis et al., 2009)

Content domains	
Life science	<ul style="list-style-type: none"> <li>- <i>Characteristics and life processes of living things (e.g., comparing living and nonliving things)</i></li> <li>- <i>Life cycles, reproduction, and heredity (e.g., tracing general steps in the life cycle of plants and animals)</i></li> <li>- <i>Interactions with the environment (e.g., describing bodily responses in animals to outside conditions such as heat and cold)</i></li> <li>- <i>Human health (e.g., identifying signs of health or illness)</i></li> </ul>
Physical science	<ul style="list-style-type: none"> <li>- <i>Classification and properties of matter (e.g., naming three states of matter, solid, liquid, and gas, and sort materials on the basis of physical properties such as weight/mass, volume, magnetic attraction)</i></li> <li>- <i>Energy – Sources and effects (e.g., identifying common light sources, recognizing that magnets have north and south poles)</i></li> <li>- <i>Forces and motion (e.g., identifying gravity on falling objects, push/pull forces)</i></li> </ul>
Earth science	<ul style="list-style-type: none"> <li>- <i>Earth's structure, physical characteristics, and resources (e.g., relating features of earth's landscape with human use)</i></li> <li>- <i>Earth in the solar system (e.g., describing the solar system as a group of planets)</i></li> </ul>
Cognitive dimensions	
Knowing	<ul style="list-style-type: none"> <li>- <i>Recall/recognize (make/identify accurate statements about science facts)</i></li> <li>- <i>Define (provide/identify definitions of scientific terms, use scientific vocabulary)</i></li> <li>- <i>Describe characteristics, illustrate with examples, and demonstrate knowledge of scientific instruments</i></li> </ul>
Application	Not included in this study
Reasoning	Not included in this study

## Appendix C

### *What You Think about Reading and Reasons for Reading* in PIRLS 2011 Student Questionnaire (IEA, 2011)

What do you think about reading? Tell how much you agree with each of these statements (Agree a lot, agree a little, disagree a little, disagree a lot).

- a) I read only if I have to.
- b) I like talking about what I read with other people.
- c) I would be happy if someone gave me a book as a present.
- d) I think reading is boring.
- e) I would like to have more time for reading.
- f) I enjoy reading.

How well do you read? Tell how much you agree with each of these statements (Agree a lot, agree a little, disagree a little, disagree a lot).

- g) I usually do well in reading.
- h) Reading is easy for me.
- i) Reading is harder for me than for many of my classmates.
- j) If a book is interesting, I don't care how hard it is to read.
- k) I have trouble reading stories with difficult words.
- l) My teacher tells me I am a good reader.
- m) Reading is harder for me than any other subject.

Do you read for any of the following reasons? Tell how much you agree with each of these statements (Agree a lot, agree a little, disagree a little, disagree a lot).

- n) I like to read things that make me think.
- o) It is important to be a good reader.
- p) My parents like it when I read.
- q) I learn a lot from reading.
- r) I need to read well for my future.

s) I like it when a book helps me imagine other worlds