Differential Reading Comprehension Skill Mastery Patterns of Immigrant and Domestic Students of Various Home Language Environments

by

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Abstract

The present study compared reading comprehension skill mastery profiles (SMPs) among 1600 grade-6 students with different immigration status and home language environments (HLEs) in Ontario schools in Canada. Immigrant students of five or more years of residence had significantly higher scores relative to domestic students. Inferencing was most predictive of total reading comprehension for both groups of students, followed by explicit comprehension and vocabulary skills. Students who mostly speak English at home while exposed to multilingual home language environments were significantly more likely to master both vocabulary and inferencing. According to the interactive compensatory model (Stanovich, 1980), various skills develop in support of one another in strengthen their total competency in skilled readers. The study result highlights the importance of examining students’ home language environments for tracking and supporting the development of reading comprehension skills, especially of higher order processing skills.
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To my family, thank you dad for always wanting the best for me. Thank you mom for all your prayers. Thank you sisters for the encouragement and understanding. Thank you Jin, you were always by my side. I am so blessed. Jesus Christ is my Saviour and I will not let His gift of life go to waste.
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Chapter 1: Introduction

There is a growing number of young multilingual learners in Canada. Many have emigrated from a non-English speaking nation while others were born into multilingual homes. The experience of acquiring English for immigrant students is different from those raised in multilingual home environments, as well as from monolingual native-English learners. Although multilingualism has shown much cognitive benefits for young learners (Bialystok, Craik, Green, & Gollan, 2009), many immigrant students of various home language environments have been found to lag behind the native speakers of English in reading comprehension. The lower performance is sometimes attributed to their immigration status (Baumert & Schumer, 2001), as well as lack of English exposure at home (August, Carlo, Dressler, & Snow, 2005).

In the current study, three reading comprehension skills are examined in regards to students of domestic or immigrant background, as well as their home language environment. Reading comprehension depends on both bottom-up and top-down processes. The data-driven bottom-up processes aim to gain comprehension via phonological, syntactical, and lexical decoding of the text features (Stanovich, 1980). The top-down processes incorporates prior knowledge, conceptual understanding of ideas to the text information in extracting both explicit and implicit meaning of the text (Goodman, 1967). An example of a top-down process is deriving the correct meaning of an unfamiliar word by using the context in which the word is used, as well as generating inferences to create coherence of the ideas in the text (Cain & Oakhill, 1999).

In the current field of research, decoding skills and vocabulary knowledge have been studied extensively. Decoding is the ability to identify written words which depend on phonological and orthographic processing skills (Neuhaus, Roldan, Boulware-Goeden, & Swank, 2006). Vocabulary knowledge is crucial for reading comprehension since vocabularies are the building blocks of written materials. However, processing skills, such as inferencing has yet to receive much attention, especially among younger students (Lee, 2013). It is necessary to examine how student performance on specific skills in order to provide tailored education for students of various linguistic backgrounds, examining their specific strengths and weaknesses in reading comprehension skills.
The purpose of this study was to examine the role of students’ immigration status and home language environment on differential reading comprehension skill profiles. The present study focused mainly on immigrant students that have resided in Canada for the minimum of 5 years and domestic students with multilingual home language environments. Three reading comprehension skills were examined: understanding explicit information of text, processing vocabulary knowledge, and inferencing. Students’ various reading comprehension skill profiles were examined to address the following research questions:

1. How do immigrant and domestic students vary in their mastery of reading comprehension skills?
2. Is skill predictability in total reading comprehension vary between immigrant and domestic students?
3. How does students from various home language environments vary in their mastery of reading comprehension skills?
4. Are students from a particular bilingual home environment more likely to have certain skill mastery profile compared to students from a monolingual home environment?
Chapter 2: Literature Review

2.1 Cognitive processes of reading comprehension

Reading is integral for transmitting learning materials to the minds of school-aged children. Reading comprehension is a multifaceted cognitive process moderated by various internal and external factors (National Reading Panel, 2000). The learner actively integrates text information with prior knowledge in creating a mental representation of the intended meaning of the text (Meneghetti, Carretti, & De Beni, 2006). Such models are focused on the processes involved in achieving reading comprehension, and are not specific to the language. According to the Simple View of Reading (SVR) model, decoding and linguistic comprehension are critical for achieving reading comprehension (Gough & Tunmer, 1985; Hoover & Gough, 1990). Decoding is defined as “word recognition accomplished through phonological coding” (Thompson, Tunmer, & Nicholson, 1993, p.7) and linguistic comprehension is the “ability to take lexical information… and derive sentence and discourse interpretation” (Thompson, Tunmer, & Nicholson, 1993, p.8).

Although decoding is a significant predictor for reading comprehension in young learners (Gottardo & Mueller, 2009; Hoover & Gough, 1990; Perfetti & Hart, 2001; Proctor, Carlo, August, & Snow, 2005; Yaghoub, Zadeh, Farnia, & Geva, 2012), it has much lower variability among older learners (Droop & Verhoeven, 2003; Landi & Perfetti, 2007). According to Paris (2005), constrained skills such as alphabetical and phonological knowledge and reading fluency have steep developmental trajectory and their proficiencies are reached relatively quickly. As decoding skill becomes automatized in older students, other higher order processing skills become more predictable for their reading comprehension, more so than decoding ability (National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network, 2005).

The construction-integration model postulated the importance of bottom-up (i.e. decoding process) as well as higher-order top-down processes involved in reading comprehension (Kintsch, 1988). A learner initially constructs the text base via decoding skills and then he or she integrates prior knowledge and his or her interpretation of the text in forming a coherent mental representation of the text (Kintsch, 1998). One of the key skills in top-down processes is
inferencing. It allows readers to perceive different parts of the text as a series of coherent events, leading to a holistic comprehension of the text (Van den Broek, Lorch, Linderholm, & Gustafson, 2001). Therefore, both decoding and top-down skills are necessary for reading comprehension (Adams, Anderson, & Durkin, 1978).

This is reflected in how students are assessed in school in Ontario, Canada. As students move up from one grade to the next, their reading materials become increasingly more difficult. However, the expectations for students’ mastery in various skills required for reading comprehension do not vary across grade levels. According to the Ontario curriculum the expectation for reading is the same for Grade 1 to Grade 8 (Ministry of Education, 2006):

1. read and demonstrate an understanding of a variety of literacy, graphic, and informational texts, using a range of strategies to construct meaning;
2. recognize a variety of text forms, text features, and stylistic elements and demonstrate understanding of how they help communicate meaning;
3. use knowledge of words and cueing systems to read fluently;
4. reflect on and identify their strengths as readers, areas of improvements, and the strategies they found most helpful before, during, and after reading.

It is apparent that various skills required for successful reading comprehension are encouraged in all grade levels. As students move up from one grade to the next, they encounter texts of higher level requiring greater ability in the various skills. Although students are expected to learn all skills, competency in the various reading comprehension skills is not at the same level across all individuals (Jang, Dunlop, Wagner, Kim, & Gu, 2013). The interactive-compensatory model hypothesized that for skilled readers, their strong or effective skills will compensate for the skills they lack (Goldsmith-Phillips, 1989). For instance, skilled readers are postulated to use their effective inferencing skill to deduct the meaning of the text even when faced with many unfamiliar words in the text (Stanovich, 1986).

2.1.1 The Role of Vocabulary Knowledge in Reading Comprehension

Of the various skills required for reading comprehension, vocabulary has continuously been a strong predictor of reading comprehension in students of various linguistic backgrounds (see August & Shanahan, 2006). A reader uses his or her vocabulary knowledge to infer “its
literal meaning, its various connotations, the sorts of syntactic constructions into which it enters, the morphological options it offers and a rich array of semantic associates such as synonyms and antonyms” (August, Carlo, Dressler & Snow., 2005, p. 51). Vocabulary knowledge are critical for comprehending the text. The text with a high proportion of unfamiliar words is likely to disrupt reading comprehension (August et al., 2005). In a review by the National Reading Panel (2000), explicit teaching of vocabulary leads to improved reading comprehension in L1 learners. As for English as a second (L2) learners, it was found that there is no incidental learning, but vocabulary knowledge is gained through attention towards the use of the language (Li & Suen, 2012). Hence, it is critical to assess and track students’ vocabulary development to understand and predict their reading comprehension.

There is cumulating research evidence that L2 learners have smaller breadth (San Francisco, Carlo, August, & Snow, 2006) and depth of word knowledge (Verhallen & Schoonen, 1993), which in turn contributes to their lack of vocabulary knowledge (August et al., 2005). Bialystok, Luk, Peets, and Yang (2010) compared vocabulary knowledge in monolingual and bilingual children of age 3 to 10. The study showed that bilingual students demonstrated lower vocabulary ability compared to their comparable monolingual peers. The authors stated that it may be the lack of English use at home that may have resulted in a consistently lower scores in bilingual peers of various ages. One possible reason for the difference may lie in the test instrument used, which had a high proportion of vocabularies related to home life, which would be less familiar to those less exposed to the target language at home. (August & Shanahan, 2006). Similarly, L2 learners experience greater difficulty when reading text with many unfamiliar words (Carlo, et al., 2004). L2 learners show different comprehension-related skill development from monolingual native speakers (August & Shanahan, 2006). Clear distinctions between students of various linguistic background are necessary to predict their literacy trajectory to be able to provide the most optimal guidance at the most optimal phase.

2.1.2 Inferencing

Increasing research has examined inferencing skill in relation to reading comprehension (Cromley & Azevedo, 2007). Inferencing is the ability to create coherence of both explicitly and implicated stated ideas within the text (Kispal, 2008; Van den Broek, 1990). Making appropriate inferences depends on decoding the text, understanding the implied meaning, as well as
extracting appropriate background knowledge (Lee, 2013). It depends on higher-order processes, According to Cain and Oakhill (1999), many students begin to generate inferences during reading more effectively when they enter middle school. This does not suggest that younger students cannot make inferences (Carlson, et al., 2014), but rather, the results emphasize the great cognitive load required for making inferences. Hence, less skilled comprehenders generate fewer inferences and are less likely to incorporate background knowledge compared to skilled comprehenders (Bowyer-Crane & Snowling, 2005; Cain & Oakhill, 1999).

Tighe and Schatschneider (2014) found that generating inferences depends highly on higher-order cognitive skills during reading. They have also found that it develops greatly with age, and many students experience growth in their inferencing skill as they enter middle school. The authors suggested this is so because they begin to read text that depend on various higher order skills beyond decoding text information. In the case of L2 learners, their inferencing proficiency is dependent on their general L2 proficiency, as well as the transfer of their L1 inferencing ability (Lee, 2013). Unfortunately, there is a lack of research in what contributes to L2 learners’ ability to generate inferences (Kispal, 2008).

2.1.3 Explicit comprehension

As noted, skills that are dependent on external sources such as prior knowledge greatly support reading comprehension and they require much cognitive load to incorporate many prerequisite skills. However, it becomes an issue when a reader relies too heavily and exclusively on prior knowledge (Adams et al., 1978). To avoid this problem, one must have an explicit understanding of the text. A learner gains explicit comprehension through bottom-up processes of deducting phonological, lexical, and syntactic knowledge of the text (Li & Suen, 2012). It has been suggested that lower-level processing skills must be mastered before a learner can allocate the cognitive resources to other necessary skills in enhancing their reading comprehension (LaBerge & Samuels, 1974; Palinscar & Brown, 1984; Perfetti, 1985; Stanovich, Nathan & Vala-Rossi, 1986). Grabe (2004) found that L2 readers relied more on bottom-up, rather than top-down processes, compared to L1 learners. The author attributed the lack of higher-level processes to L2 readers’ weak lower-level skills. In another study, L2 students perform poorly on higher-level skills due to deficiencies with lower-level skills, such that students with slow-decoding ability were unable to allocate their cognitive processes for performing higher-level
processes (LaBerge & Samuels, 1974; Perfetti, 1985). Since much cognitive load is required to process low-level skills such as decoding, L2 readers may not be able to allocate it to higher-order processes, which impedes reading comprehension. Overall, having vocabulary knowledge, as well as the explicit comprehension of the text, and the ability to generate inferences during reading will support reading comprehension.

2.2 Linguistic background of young elementary students

There is an increase in the number of multilingual individuals with the advancement of globalization. This is highly evident among school-aged children in Canada. In 2006, approximately 20% of new immigrants were under the age of 14 (n=223,200; Statistics Canada 2006). Ontario remains to be the most popular region of residence for more than half of the immigrants, accounting for 52% of all immigrants in years 2001 to 2006. They represent 28.3% of residents in Ontario. Of the 52% of the immigrants, 68.3% chose their home in the metropolitan area of Toronto. With increase in new immigrants, there is a huge proportion of individuals learning the official language of Canada, English. Interestingly, their status as either Canadian-born or foreign-born does not indicate their language status. Both groups include students who learn English as a second or an additional language (hereafter ELLs). They are individuals that are acquiring English as an additional language to their current linguistic repertoire. In 2006, nearly 150 languages were reported as a mother tongue among the foreign-born population. This is a reflection of the diversity in the linguistic background of individuals in Canada.

2.2.1 Immigration Status

Some studies have suggested it is the lack of opportunities for literacy learning at home for immigrant students, and not the immigration status as a circumstance that is causing immigrant students to perform below their domestic students (Goldenberg, Rueda, & August, 2006). In contrast, according to the Programme for International Student Assessment (PISA) statistics, of the students that fail to reach the desired reading level of the particular region, a high proportion of them were immigrant students (Baumert & Schumer, 2001). Some studies have focused on particular skills, and it was evident that reading comprehension and vocabulary knowledge were relatively lower for immigrant students (Bialystok et al., 2010; Kiegel et al.,
Others suggest that it is the overuse of students’ L1 at home that is leading to such poor performance in school (Stanat & Christensen, 2006). Furthermore, other studies have shown that once immigrant students have resided in the country for 5 years or longer, they do not perform any more below their monolingual native born peers (Jang et al., 2013; Paez, 2009). It is very difficult to make claims on immigration status on students’ literacy because it varies greatly across countries. For instance, immigration can take place between nations of similar or highly different educational progress. In a review by Cummins (2012), he stated “language spoken at home does not exert any independent effect on achievement but is rather a proxy for variables such as socioeconomic status and length of residence in the host country” (p. 1982).

Nevertheless, immigration status is an important feature in schools in Ontario. When students are enrolled in kindergarten, they are asked for their first language. The English Language Learners / ESL and ELD Programs and Services: Policies and Procedures for Ontario Elementary and Secondary Schools, Kindergarten to Grade 12 stated that:

- English as a Second Language (ESL) programs, which are for students whose first language is other than English or is a variety of English significantly different from that used for instruction in Ontario schools. (Ontario Ministry of Education, 2007, p. 22)

Such criteria make it much more likely that immigrant students are recommended to attend ESL programs. While immigrant students’ ESL attendance assumes their lack of English proficiency, domestic students may not be perceived to require language support, especially due to their conversational oral fluency (Cummins, 1979).

### 2.2.2 Home language environment

In Canada, a significant proportion of students are exposed to a multilingual home language environment. Such multilingual home language environments provide unique and diverse context of language learning and use across families and communities. The extent and the type of exposure and the use of the home language may have different impact on students’ linguistic proficiency necessary for academic success. Aarts and Verhoeven (1999) argued that the use of school language at home can predict their literacy outcomes. Similarly, in a more recent study by Haim (2014), he found that current language use was predictive of academic performance in the target language (Haim, 2014). A study with the Chinese-English bilingual
students found that engagement with Chinese reading materials and parental encouragement to use Chinese at home improved their Chinese competence (Lao, 2004). Whether it is their minority or dominant language, it seems like the greater exposure and the use of the language foster the language-dependent academic performances.

Other studies have looked at the effects of home language in regards to bilingualism. Trying to balance the benefit of multilingualism and the use of the target language for academic success is difficult to manage. Multilingualism encourages the use of two or more languages – this unavoidably compensates the use of one language over the other. For instance, bilingual children have been reported to have smaller vocabulary size because there is there is less input, relative to monolingual students, at home of the language used in school at home (August et al., 2005). Lipka and Siegel (2012) suggested that a home environment that less resembles what students experience at home, learning at school becomes a greater struggle. Melby-Lervag and Lervag (2014) found that of L2 students, those not using the school language at home, had poorer language comprehension skills than those that used both their L1 and L2 at home. In addition, De Houwer (2007) found that children with one parent using both minority and dominant languages and the other parent using only the minority language have the greatest probability of using both languages. Contrarily, Lesau, Lipka, and Siegel (2006), found a similar proportion of good comprehenders in the group of students that spoke only English at home, to the group of students that spoke a non-English only or along with other (including English) at home. The current trend in the research findings is that greater exposure to the target language is beneficial in its reading comprehension. However, there is a great benefit of bilingualism for young learners, which will be discussed further in the following section.

2.2.3 Multilingual minds

Students’ language learning experience can be diverse, especially when they develop multilingual competences. According to Valdes and Figueroa (1994), such diversity may be attributable to various factors, including the following six features of bilingualism: age of acquisition, the functional ability, the relationship between L1 and L2, the context of acquisition, and its effect on the language system, stages in bilinguals’ life, and the circumstances to bilingualism. Depending on such features, individuals’ multilingual competences vary greatly. Cook (1992) introduced the concept of multicompetence in an attempt to understand the
multilingual mind. He had initially defined it as the knowledge of two or more language systems in one mind (1992). Cook was much influenced by Grosjean’s holistic view of bilingualism. For Grosjean, becoming a perfect user of a language was neither the defining factor nor the goal of bilingualism (Grosjean, 1985). He simply saw it as a byproduct of coping with multilingual environment. Hence, bilingualism is a tool for communication – and if such is achieved, it has served its purpose. It has now been established that perfect mastery of L1 and L2 is not the determining factor for bilingualism (Skutnabb-Kangas & McCarty, 2008); but rather, it is the ability to use both the L1 and L2 without experiencing much difficulty in switching back and forth (Grosjean, 2010; Ludi & Py, 2009; Valdes & Figueroa, 1994). L1 and L2 do not exist in isolation but are processed under one language system, allowing the ease of switching between the languages (Grabe & Stoller, 2009). This is evident though studies that have confirmed the transfer hypothesis, which states that L1 reading skills and strategies are transferred to L2 reading (Goodman, 1971). For instance, young Chinese and Spanish ELLs demonstrated cross-language transfer of word reading fluency and word reading accuracy – two lower-level processing skills that are crucial in the development of reading comprehension (Pasquarella, Chen, Gottardo, & Geva, 2015). In a study by Van Gelderen et al. (2007), they have found a strong relationship between L1 and L2 reading comprehension and a strong effect of metacognitive reading strategies on L2 reading comprehension. Similarly, August and Shanahan (2008) reported that many of the skills that predict reading comprehension among L1 readers play similar roles in predicting reading comprehension in L2 reading among elementary-school learners. Furthermore, according to the theory of linguistic interdependence (Cummins, 1979) well-established metacognitive strategies and skills in L1 transfer to L2 by incorporating cognitive processes (i.e. higher-order thinking skills as well as content materials (i.e. subject matter and conceptual knowledge). Although L1 and L2 depend on different syntactic and lexical knowledge, the processes required for reading comprehension are derived from the same cognitive and metacognitive processing system. Hence L2 speakers are not blank slates but have acquired the skills necessary in processing reading comprehension in a language other than the target language. It is important to note that the positive cross-linguistic transfer of skills is more likely to be evident once students have reached a sufficient level of L2 proficiency (Chen, Xu, Nguyen, Hong, & Wang, 2010).

2.3 Literature Summary
Various skills are required for reading comprehension. As students advance to higher grades, they are expected to advance their proficiency in a wider range of reading comprehension skills (Cain & Oakhill, 2006; Cromley & Azevedo, 2007). The predictability of low-level skills decreases with time (Andreassen & Braaten, 2010). For instance, in older elementary students, as decoding becomes automatized, high order processing skills such as vocabulary understanding and inferencing come to play significant role as predictors for their reading comprehension. Hence, more research is needed for understanding such higher-level skills that are neither easily automatized nor dependent on memory. Furthermore, more research is necessary for understanding various factors including home language environment beyond the past research that treated L2 learners as a homogenous group.
Chapter 3: Methods

3.1 Participants

The current study used data that were comprised of 120,767 Grade 6 students’ responses to the 2006 provincially delegated reading achievement test and a background questionnaire, developed by the Education Quality and Accountability Office (EQAO) in Ontario. In this study, I identified focal language groups based on their background information made available from the background questionnaire. Specifically, the following variables were used for grouping: immigration status, students’ length of stay in Canada, and various home language environments (HLEs). To pay close attention to students who had sufficient exposure to the English speaking school system in Ontario schools, the present study included students that immigrated to Canada no less than 5 years ago and those born in the country were selected. Using the criteria for grouping HLEs that Jang et al. (2013) developed in their study, I focused four largest home language groups for both immigrant and domestic students: (1) EnEn - those who hear and speak only English; (2) EqEn - those who hear both languages equally and only or mostly speak English; (3) EqEq - those who hear and speak both languages equally; and (4) OtOt - and those who hear and speak mostly or only the other language. Hence, this resulted in eight groups – four HLE groups for immigrant and domestic students respectively. The smallest subgroup (immigrant EqEn) had the population of 758, and the largest subgroup (domestic EnEn) with the population of 88,254, as shown in Table 1. Given large discrepancies in proportions among the groups, I randomly sampled 200 students from each of the HLE group. A total of 1,600 students were included in the present study sample.
Table 1

*Population Frequencies and the Percentage of Samples Used*

<table>
<thead>
<tr>
<th>HLE</th>
<th>Immigrant (%)</th>
<th>Domestic (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnEn</td>
<td>2,041 (9.80)</td>
<td>88254 (.23)</td>
</tr>
<tr>
<td>EqEn</td>
<td>758 (26.39)</td>
<td>3580 (5.59)</td>
</tr>
<tr>
<td>EqEq</td>
<td>1577 (12.68)</td>
<td>5846 (3.42)</td>
</tr>
<tr>
<td>OtOt</td>
<td>1709 (11.70)</td>
<td>3350 (5.97)</td>
</tr>
</tbody>
</table>

*Note.* HLE = home language environment; EnEn = spoken to and speaks English only at home; EqEn = spoken to in English and other language(s) at home and speaks English only at home; EqEq = spoken to and speaks English and other language(s) at home; OtOt = spoken to and speaks non-English language(s) at home.

3.2 Instrument

The EQAO assessment is a provincially mandated assessment, with the purpose of providing large-scale achievement results to the public on whether students are meeting the provincial mathematics and literacy curricular expectations. Students in Ontario take the EQAO tests in Grades 3, 6, and 9 during the 3-week period between May to June. The standards for student achievement consist of four levels. Level 4 indicates an achievement beyond the provincial standard (Level 3) and Levels 1 and 2 indicate an achievement below the provincial standard.

For the purpose of this study, the literacy component for the grade 6 population will be discussed from onwards. Two booklets are administered to the students to test their literacy (e.g., reading and writing) skills. Booklet one contains two testlets with expository (factual text) and explanatory (scientific text) passages. Each testlet includes 5 multiple-choice test items. Booklet
2 is comprised of two testlets with narrative and poetry passages and items that measure writing conventions. The testlets include 17 and 5 multiple-choice test items, respectively. The writing convention component includes 8 multiple-choice items.

3.3 Identifying reading skills in the EQAO test

Jang et al.’s study that identified six reading skills, three of which were further examined in the present study. The three skills of interest included: understanding explicit information (EXP), vocabulary knowledge (VOC) and inferencing (INF). There were a total of 10 items that examined EXP (i.e., In which field did Dorothy earn a diploma?); 8 items that examined VOC (i.e., In line 9, "flowers will wither" means?); and 8 items that examined INF (i.e., Where would this text most likely be published?; see Appendix A for the complete list of test items for each skill). They used cognitive diagnostic modeling, specifically the reduced Reparametrized Unified Model (RUM), to estimate individual students’ reading skill mastery levels (See Jang et al. (2013) for more information about profiling processes). Cognitive diagnosis modeling is a multidimensional latent class model used to estimate individual students’ skill mastery profiles (Jang, 2009). Q-matrix of relevant test items for the current study are presented in Table 2. Posterior probabilities of skill mastery (PPM) from Jang et al. were used to compare different HLE groups’ skill mastery levels. Higher $\pi^*$ value indicates greater probability of a test taker who has mastered all the required skill for a particular item to correctly answer it. Parameter $r^*$ indicates discrimination between masters to nonmasters, with lower values indicating higher discriminatory power. A $p$-value indicates difficulty of mastering the item, and point-biserial is a correlational discriminatory index. The proportion of students that have mastered each skill in the total population of 120, 767 were .67, .62, and .58, for EXP, VOC and INF respectively. Students’ total raw scores on their 40 multiple-choice test items were also used in the current study.
<table>
<thead>
<tr>
<th>Item</th>
<th>$\pi^*$</th>
<th>EXP</th>
<th>INF</th>
<th>VOC</th>
<th>$p$-value</th>
<th>point-biserial</th>
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<tr>
<td>1</td>
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<td>.78</td>
<td></td>
<td></td>
<td>.70</td>
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</table>
23 .92 .78 .77 .54
24 .94 .82 .79 .57
26 .89 .85 .77 .52
27 .50 .85 .48 .25
28 .91 .82 .75 .56
29 .45 .66 .38 .32
31 .96 .81 .75 .58
32 .69 .66 .56 .37
34 .85 .50 .67 .49
35 .74 .64 .63 .39
39 .70 .74 .62 .34

Note. EXP = textually explicit comprehension; VOC = processing vocabulary knowledge; and INF = inferencing; from “Elementary school ELLs' reading skill profiles using cognitive diagnosis modeling: Roles of length of residence and home language environment” by Jang, E. E., Dunlop, M., Wagner, M., Kim, Y., and Gu, Z., 2013, Language Learning, 63(3), p. 412. Adapted with permission.

3.3 Data analysis

Skill mastery profiles (SMPs) were created based on the estimates of skill mastery probabilities from Jang et al.’s study. Each student’s mastery or nonmastery in EXP, VOC and INF was determined by applying cut-off points, .4 and .6 to PPM values. Mastery was coded as 1 if a PPM was higher than .6 and nonmastery was coded as 0 if it was lower than .4. The SMP corresponds to their mastery in the order of EXP, VOC and INF. For instance, a student with
mastery in EXP and nonmastery in VOC and INF received SMP 1-0-0. Total of eight different skill mastery classes were identified.

In order to examine group differences in skill mastery between immigrant and domestic students, I calculated frequencies and the percentage of students under each SMP and conducted. An independent sample t-tests using the reading comprehension skills (EXP, VOC, and INF), as well as total reading comprehension scores. The scores for reading comprehension skills are PPM scores and their total reading comprehension scores are raw scores from the EQAO assessment. Binary logistic regression was performed to determine the likelihood of skill mastery for the immigrant or domestic groups. The immigrant group was set as a default group. Hierarchical regression analyses were conducted to test the predictability of the reading comprehension skills on the total reading comprehension scores. Scores obtained from the immigrant and domestic groups were analyzed separately. EXP was entered in Step 1, VOC entered in Step 2 and INF entered in Step 3 as predictor variables.

I calculated the frequencies and percentages of students under each HLE. Next, binary logistic regressions were run to test the likelihood of bilingual HLE groups to belong to each of the SMPs relative to the monolingual HLE group. From the descriptive statistic, SMPs 0-1-0 and 0-1-1 were further examined by conducting binary logistic regressions. EnEn group was set as the default group to be compared against a multilingual HLE group. Lastly, analysis of variance was conducted to compare total reading comprehension performance among SMPs.
Chapter 4: Results

This chapter presents the results of reading comprehension skill profiles of immigrant and domestic students, and subsequently it presents the results concerning the role of HLE on students’ reading comprehension skills. Lastly, I present the results from comparison between SMPs on their total reading comprehension.

4.1 Immigrant vs. domestic students

4.1.1 Distribution of immigrant and domestic students under the skill mastery profile

The frequency distributions of SMPs were compared between immigrant (n = 800) and domestic students (n = 800). As shown in Table 3, the order of the most to the least frequent SMPs for immigrant and domestic students was similar. For the immigrant group, the order of the most frequent to the least frequent SMPs was as followed: 1-1-1 (55.00%), 0-0-0 (20.38%), 1-0-0 (7.38%), 1-1-0 (6.63%), 1-0-1 (5.00%), 0-1-1 (1.63%), and 0-0-1 (1.25%). Similarly, under the domestic group, the order was the most frequent SMPs were 1-1-1 (45.75), 0-0-0 (28.63%), 1-1-0 (8.38%), 1-0-0 (7.00%), 1-0-1 (2.50%), 0-1-1 (2.13%), and 0-0-1 (1.88%). From the SMP frequencies of immigrant and domestic students, it seems like immigrant students are performing better than domestic students with highest percentage under the total mastery profile and lower percentage under the total nonmastery profile. As well, from the distribution of SMPs, the results suggest that inferencing is a harder skill to master for both immigrant and domestic students.
Table 3

Frequency of Skill Mastery Profiles

<table>
<thead>
<tr>
<th>SMP</th>
<th>Immigrant</th>
<th>Domestic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(EXP, VOC, INF)</td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
<td>Total</td>
</tr>
<tr>
<td>1-1-1</td>
<td>440 (55.00)</td>
<td>366 (45.75)</td>
<td>806 (50.38)</td>
</tr>
<tr>
<td>0-0-0</td>
<td>163 (20.38)</td>
<td>229 (28.63)</td>
<td>392 (24.50)</td>
</tr>
<tr>
<td>1-1-0</td>
<td>53 (6.63)</td>
<td>67 (8.38)</td>
<td>120 (7.50)</td>
</tr>
<tr>
<td>1-0-0</td>
<td>59 (7.38)</td>
<td>56 (7.00)</td>
<td>115 (7.19)</td>
</tr>
<tr>
<td>1-0-1</td>
<td>40 (5.00)</td>
<td>30 (3.75)</td>
<td>70 (4.38)</td>
</tr>
<tr>
<td>0-1-0</td>
<td>22 (2.78)</td>
<td>20 (2.50)</td>
<td>42 (2.63)</td>
</tr>
<tr>
<td>0-1-1</td>
<td>13 (1.63)</td>
<td>17 (2.13)</td>
<td>30 (1.88)</td>
</tr>
<tr>
<td>0-0-1</td>
<td>10 (1.25)</td>
<td>15 (1.88)</td>
<td>25 (1.56)</td>
</tr>
<tr>
<td>Total</td>
<td>800</td>
<td>800</td>
<td>1600</td>
</tr>
</tbody>
</table>

Note. SMP = skill mastery profile; EXP = textually explicit comprehension; VOC = processing vocabulary knowledge; and INF = inferencing.

4.1.2 Comparing reading comprehension skills between immigrant and domestic students

An independent samples t-test was performed to examine if there is a significant difference between the immigrant and domestic groups on their skill mastery estimates and the total scores (Table 4). The immigrant group showed significantly higher skill mastery estimates and a total score compared to the domestic students.
On EXP PPM scores – the posterior probabilities of mastering EXP, immigrant students ($M = .75, SD = .37$) scored significantly higher than domestic students ($M = .66, SD = .41$), $t(1598) = 4.51, p < .001$. On VOC PPM scores, immigrant students ($M = .67, SD = .37$) scored significantly higher than the domestic students ($M = .61, SD = .38$), $t(1598) = 3.44, p < .05$. On INF PPM scores, immigrant students ($M = .64, SD = .35$) scored significantly higher than the domestic students ($M = .57, SD = .36$), $t(1598) = 4.05, p < .05$. On the total reading comprehension scores, no significant difference was found between immigrant ($M = 3.28, SD = .72$) and domestic ($M = 3.11, SD = .73$) students, $t(1589) = 4.68, p = .63$.

Table 4

*Independent Sample T-Test of Immigrant and Domestic Students on Reading Comprehension Skills*

<table>
<thead>
<tr>
<th></th>
<th>Immigrant</th>
<th>Domestic</th>
<th>$t$</th>
<th>df</th>
<th>95% CI for mean differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXP</td>
<td>.75 (.37)</td>
<td>.66 (.41)</td>
<td>4.51*</td>
<td>1598</td>
<td>.05, .13</td>
</tr>
<tr>
<td>VOC</td>
<td>.67 (.37)</td>
<td>.61 (.38)</td>
<td>3.44**</td>
<td>1598</td>
<td>.03, .10</td>
</tr>
<tr>
<td>INF</td>
<td>.64 (.35)</td>
<td>.57 (.36)</td>
<td>4.05**</td>
<td>1598</td>
<td>.04, .11</td>
</tr>
<tr>
<td>Reading</td>
<td>3.28 (.72)</td>
<td>3.11 (.73)</td>
<td>4.68</td>
<td>1589</td>
<td>.10, .24</td>
</tr>
</tbody>
</table>

*Note.* **$p < .05$; ***$p < .001$. EXP = textually explicit comprehension; VOC = processing vocabulary knowledge; INF = inferencing; Reading = total reading comprehension.

4.1.3 Probability of total mastery and total nonmastery by immigrant and domestic students
Binary logistic regression analysis was conducted to determine the likelihood of immigrant or domestic group belonging to the total mastery profile 1-1-1 (Table 5). The immigrant group was set as the default group to be compared against the domestic group. The results from the binary logistic regression show that domestic group had 31% less chance of belonging to the total mastery profile, compared to the immigrant group.

Table 5

*Binary Logistic Regression Predicting the Probability of Immigrant and Domestic Students with Total Skill Mastery Profile*

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>SE</th>
<th>Wald’s $X^2$</th>
<th>df</th>
<th>p</th>
<th>$e^\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
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<td>.07</td>
<td>7.97</td>
<td>1</td>
<td>.01</td>
<td>1.22</td>
</tr>
<tr>
<td>Domestic</td>
<td>-.37</td>
<td>.10</td>
<td>13.65</td>
<td>1</td>
<td>.00</td>
<td>.69</td>
</tr>
</tbody>
</table>

*Note.* Cox & Snell $R^2 = .009$, Nagelkerke $R^2 = .011$.

Binary logistic regression analysis was conducted to determine the likelihood of immigrant or domestic group belonging to the total nonmastery profile 0-0-0 (Table 6). Immigrant group was set as the default group to be compared against domestic group. Results from the binary logistic regression shows that the domestic group had 57% higher chance to belong to the SMP, 0-0-0 domestic.
Table 6

Binary Logistic Regression Predicting the Probability of Immigrant and Domestic Students with Total Non-Skill Mastery Profile

<table>
<thead>
<tr>
<th></th>
<th>$\beta$</th>
<th>SE</th>
<th>Wald’s $X^2$</th>
<th>df</th>
<th>$p$</th>
<th>$e^{\beta}$</th>
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<tr>
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<td>241.12</td>
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<td>.00</td>
<td>.26</td>
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<tr>
<td>Domestic</td>
<td>.45</td>
<td>.12</td>
<td>14.61</td>
<td>1</td>
<td>.00</td>
<td>1.57</td>
</tr>
</tbody>
</table>

Note. Cox & Snell $R^2 = .009$, Nagelkerke $R^2 = .014$.

4.1.4 Amount of variance explained by reading comprehension skills on the total reading comprehension

To assess the predictive power of INF, 3-step hierarchical regression analysis was conducted with total score as a dependent variable, and EXP, VOC and INF as the predictor variables, for immigrant and domestic students, separately. For both analyses, EXP was entered in Step 1, VOC entered in Step 2, and INF entered in Step 3.

Table 7 outlines the results from the immigrant sample. With EXP in the model, it significantly predicted total reading comprehension, $R^2 = .58$, $F(1, 792) = 1090.68, p < .001$. When VOC was added to the model, it again significantly predicted total reading comprehension, with $R^2$ change of .06; $F(1, 791) = 709.88, p < .001$. In step 3, INF was added to the model, which resulted in an additional .04 $R^2$ change in predicting total reading comprehension, $F(1, 790) = 562.09, p < .001$. From the standardized coefficient, it is evident that INF had the greatest predictability in the total score, ($\beta = .35, SE = .08$), compared to EXP ($\beta = .31, SE = .07$) and VOC ($\beta = .23, SE = .07$). As expected, the skill with the lowest chance of mastering, had the highest contribution in the variance of total score.
Table 7

Hierarchical Regression testing the Predictability of Reading Comprehension Skills on Immigrant Students’ Total Reading Comprehension

<table>
<thead>
<tr>
<th>$R^2$ Change</th>
<th>Predictors</th>
<th>Unstandardized Coefficients</th>
<th>$R^2$ Change</th>
<th>Standardized Coefficients</th>
<th>$p$</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$b$</td>
<td>$SE$</td>
<td>$\beta$</td>
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<tr>
<td>Step 1</td>
<td>.58</td>
<td>(Constant)</td>
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<td>.04</td>
<td>.00</td>
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<td></td>
<td></td>
<td>VOC</td>
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<td>.40</td>
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<tr>
<td>Step 3</td>
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<td>(Constant)</td>
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<td>.03</td>
<td>.00</td>
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<tr>
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<tr>
<td></td>
<td></td>
<td>INF</td>
<td>.73</td>
<td>.08</td>
<td>.35</td>
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</table>

Note. EXP = textually explicit comprehension; VOC = processing vocabulary knowledge; and INF = inferencing.

Similar results were found for the domestic students (Table 8). EXP was entered in Step 1 which significantly predicted total reading comprehension, $R^2 = .58, F(1, 795) = 1097.82, p < .001$. VOC significantly contributed to the model by .07 increase in $R^2, F(1, 794) = 728.25, p < .001$. Lastly, INF was added to the model and it also contributed to the model significantly
with $R^2$ change of .04; $F(1, 794) = 589.95, p < .001$. From the standardized coefficient, it is evident that for domestic students, INF ($\beta = .36, SE = .07$) had the highest predictability in total score, in comparison to EXP ($\beta = .31, SE = .06$) and VOC ($\beta = .23, SE = .07$).

From the two hierarchical regression analyses, immigrant students and domestic students showed highly similar results. In both analyses, all three skills significantly contributed to the variance of total score. This was not surprising since EXP, VOC and INF PPM scores were derived from applying the CDM model to the EQAO assessment, and total score is the raw total score from the EQAO assessment. The goal of the analysis was to compare the relative contributions of the three skills to the total score. VOC, which had a higher score than INF, but lower compared to EXP for both immigrant and domestic students showed the least amount of variance in total score. EXP, which had the highest score for both immigrant and domestic students, contributed to the prediction of total score less than INF – the hardest skill to master for both immigrant and domestic students.
Table 8

*Hierarchical regression testing the Predictability of Reading Comprehension Skills on Domestic Students’ Total Reading Comprehension*

<table>
<thead>
<tr>
<th></th>
<th>$R^2$</th>
<th>Predictors</th>
<th>Unstandardized Coefficients</th>
<th>$R^2$ Change</th>
<th>Standardized Coefficients</th>
<th>$p$</th>
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<td>$b$</td>
<td>$SE$</td>
<td>$\beta$</td>
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<td></td>
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<tr>
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<td>.00</td>
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<tr>
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<td></td>
<td>EXP</td>
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<td>.04</td>
<td>.76</td>
<td>.00</td>
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<tr>
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<td></td>
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<td>VOC</td>
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<td>.07</td>
<td>.43</td>
<td>.00</td>
</tr>
<tr>
<td>Step 3</td>
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<td>.00</td>
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<td>EXP</td>
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<td>.06</td>
<td>.31</td>
<td>.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VOC</td>
<td>.45</td>
<td>.07</td>
<td>.23</td>
<td>.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>INF</td>
<td>.75</td>
<td>.07</td>
<td>.36</td>
<td>.00</td>
</tr>
</tbody>
</table>

*Note.* EXP = textually explicit comprehension; VOC = processing vocabulary knowledge; and INF = inferencing.

4.2 Role of home language environment on reading comprehension skills

4.2.1 Descriptive statistics on home language environment groups
Frequencies of students of various HLEs were categorized according to the skill mastery profiles (Table 9). Proportions within each profile were also reported. Most SMPs had similar distribution across the home language environments (HLEs). The bottom three SMPs showed the highest variation in proportion size. Forty percent of the 010 group were from the EnEn HLE; 43% of the 011 group were from the EqEn HLE; and 44% of students under the SMP 0-0-1 are of the EnEn HLE. From these proportions, it seems that students from the EnEn HLE group are likely to have the SMP 0-1-0 and SMP 0-0-1 (mastery in VOC, mastery in INF, respectively), relative to the other HLE groups, while students from the EqEn HLE group are likely to have SMP 0-1-1 (mastery in VOC and INF).
### Table 9

*Frequency and percentage of Home Language Environments for Skill Mastery Profiles*

<table>
<thead>
<tr>
<th>SMP</th>
<th>Frequency (%)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EnEn</td>
<td>EqEn</td>
<td>EqEq</td>
<td>OtOt</td>
</tr>
<tr>
<td>1-1-1</td>
<td>196 (24)</td>
<td>215 (27)</td>
<td>204 (25)</td>
<td>191 (24)</td>
</tr>
<tr>
<td>0-0-0</td>
<td>101 (26)</td>
<td>85 (22)</td>
<td>98 (25)</td>
<td>108 (28)</td>
</tr>
<tr>
<td>1-1-0</td>
<td>29 (24)</td>
<td>33 (28)</td>
<td>28 (23)</td>
<td>30 (25)</td>
</tr>
<tr>
<td>1-0-0</td>
<td>23 (20)</td>
<td>28 (24)</td>
<td>37 (32)</td>
<td>27 (23)</td>
</tr>
<tr>
<td>1-0-1</td>
<td>19 (27)</td>
<td>10 (14)</td>
<td>18 (26)</td>
<td>23 (33)</td>
</tr>
<tr>
<td>0-1-0</td>
<td>17 (40)</td>
<td>10 (24)</td>
<td>7 (17)</td>
<td>8 (19)</td>
</tr>
<tr>
<td>0-1-1</td>
<td>4 (13)</td>
<td>13 (43)</td>
<td>4 (13)</td>
<td>9 (30)</td>
</tr>
<tr>
<td>0-0-1</td>
<td>11 (44)</td>
<td>6 (24)</td>
<td>4 (16)</td>
<td>4 (16)</td>
</tr>
<tr>
<td>Total</td>
<td>400 (25)</td>
<td>400 (25)</td>
<td>400 (25)</td>
<td>400 (25)</td>
</tr>
</tbody>
</table>

*Note.* SMP = skill mastery profile; EnEn = spoken to and speaks English only at home; EqEn = spoken to in English and other language(s) at home and speaks English only at home; EqEq = spoken to and speaks English and other language(s) at home; OtOt = spoken to and speaks non-English language(s) at home.

#### 4.2.2 Role of home language environment predicting vocabulary only

A binary logistic regression analysis was conducted to determine the likelihood of a particular HLE group belonging to the SMP 0-1-0 (mastery in VOC without mastering EXP and INF; Table 10). The results from the binary logistic regression showed that of the four HLE
groups, EnEn had the highest probability of mastering VOC without mastering EXP and INF, as shown in the negative standardized regression coefficient values for EqEn, EqEq, and OtOt. There was one significant group difference: EnEn against EqEq. Specifically, the odds of EqEq mastering VOC without mastering EXP and INF are 60% lower than EnEn. EnEn did not have a significantly higher probability of mastering VOC without mastery in EXP and INF compared to EqEn \( (\beta = -.55, p = .18) \) and OtOt \( (\beta = -.78, p = .07) \). An overall correct classification rate was 97.4%. This result shows that the EnEn HLE group has the highest mastery of VOC when the other skills are not mastered yet. This is aligned to the descriptive results showing the highest percentage of EnEn (40) and the lowest percentage of EqEq (17) under the SMP 0-1-0.

Table 10

*Binary Logistic Regression testing for the Probability of Mastery in Vocabulary Only by Home Language Environment*

<table>
<thead>
<tr>
<th></th>
<th>( \beta )</th>
<th>( SE )</th>
<th>Wald’s ( X^2 )</th>
<th>df</th>
<th>( p )</th>
<th>( e^{\beta} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td>5.695</td>
<td>3</td>
<td>.13</td>
<td></td>
</tr>
<tr>
<td>HLE(EqEn)</td>
<td>-.55</td>
<td>.41</td>
<td>1.84</td>
<td>1</td>
<td>.18</td>
<td>.58</td>
</tr>
<tr>
<td>HLE(EqEq)</td>
<td>-.91</td>
<td>.46</td>
<td>4.03</td>
<td>1</td>
<td>.05</td>
<td>.40</td>
</tr>
<tr>
<td>HLE(OtOt)</td>
<td>-.78</td>
<td>.44</td>
<td>3.20</td>
<td>1</td>
<td>.07</td>
<td>.46</td>
</tr>
</tbody>
</table>

*Note.* Cox & Snell \( R^2 = .003 \), Nagelkerke \( R^2 = .016 \); HLE = home language environment; EnEn = spoken to and speaks English only at home; EqEn = spoken to in English and other language(s) at home and speaks English only at home; EqEq = spoken to and speaks English and other language(s) at home; OtOt = spoken to and speaks non-English language(s) at home.

4.2.3 Role of home language environment predicting vocabulary and inferencing mastery
A binary logistic regression was run to test for the probability of mastering both VOC and INF in the absence of EXP mastery (SMP 0-1-1; Table 11). The results from the logistic regression analysis showed that EqEn had the highest probability of belonging to the SMP 0-1-1. The results showed that EqEn and OtOt had higher probability of mastery VOC and INF without mastering EXP, compared to EnEn, as shown in their significantly positive standardized regression coefficient values. The odds of EqEn HLE group mastering both VOC and INF without mastering EXP are 2.33 times higher than the EnEn HLE group, with the difference of 1.20 ($p = .04$). EqEq ($\beta = .00, p = 1.00$) and OtOt ($\beta = .82, p = .17$) groups did not show any significant difference to EnEn in their probability of mastering both VOC and INF without mastering EXP. This result is reflected in the previously presented descriptive statistics on the distribution of students under the HLEs for SMP 0-1-1 (Table 3). EqEn made up .43 of the total proportion within SMP 0-1-1, while EnEn made up a proportion of .13.

Table 11

<table>
<thead>
<tr>
<th></th>
<th>$\beta$</th>
<th>SE</th>
<th>Wald’s $X^2$</th>
<th>df</th>
<th>$p$</th>
<th>$e^\beta$</th>
</tr>
</thead>
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<tr>
<td>Constant</td>
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<td></td>
<td>7.06</td>
<td>3</td>
<td>.07</td>
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<tr>
<td>HLE(EqEn)</td>
<td>1.20</td>
<td>.58</td>
<td>4.35</td>
<td>1</td>
<td>.04</td>
<td>3.33</td>
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<tr>
<td>HLE(EqEq)</td>
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<td>.71</td>
<td>.00</td>
<td>1</td>
<td>1.00</td>
<td>1.00</td>
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<tr>
<td>HLE(OtOt)</td>
<td>.82</td>
<td>.61</td>
<td>1.85</td>
<td>1</td>
<td>.17</td>
<td>2.28</td>
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</table>

*Note.* Cox & Snell $R^2 = .005$, Nagelkerke $R^2 = .028$. HLE = home language environment; EnEn = spoken to and speaks English only at home; EqEn = spoken to in English and other language(s) at home and speaks English only at home; EqEq = spoken to and speaks English and other language(s) at home; OtOt = spoken to and speaks non-English language(s) at home.
4.3 Comparison between SMPs on total reading comprehension

An analysis of variance (ANOVA) was conducted to compare the skill mastery profiles among the HLE groups in order to examine how they differed on their total reading comprehension score from the EQAO assessment. Preliminary analysis of ANOVA was conducted with eight SMPs. Results showed significant SMP group differences, $F(7, 1583) = 347.55, p < .001$. Significantly higher reading comprehension scores were obtained from the all-mastery (SMP 1-1-1) group against the other 7 SMPs and significantly lower reading comprehension scores were obtained from the all-nonmastery (SMP 0-0-0) group, compared to the other seven SMPs.

Excluding SMP 1-1-1 and SMP 0-0-0 (Table 12), ANOVA was conducted to see how students of different SMP performed on their reading comprehension (Table 13). Significant differences between SMPs were found, $F(5, 396) = 22.25, p < .001; \eta^2 = .22$). The total reading comprehension mean scores were higher for the 2-skills mastery profiles – 1-0-1 ($M = 3.31, SD = .34$), 1-1-0 ($M = 3.20, SD = .34$) and 0-1-1 ($M = 3.18, SD = .37$) – and lower for the 1-skill mastery profiles – 1-0-0 ($M = 2.99, SD = .37$), 0-0-1 ($M = 2.88, SD = .40$) and 0-1-0 ($M = 2.68, SD = .06$). From the mean scores, I carefully infer that VOC has the lowest contribution to the total reading comprehension score – with the highest mean found in the SMP 1-0-1 (mastery in all but VOC, and the lowest mean found in SMP 0-1-0 (mastery in only VOC).
Table 12

Descriptive Statistics for Total Reading Comprehension by Skill Mastery Profile

<table>
<thead>
<tr>
<th>SMP</th>
<th>Total reading comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
</tr>
<tr>
<td>1 0 1</td>
<td>70</td>
</tr>
<tr>
<td>1 1 0</td>
<td>120</td>
</tr>
<tr>
<td>0 1 1</td>
<td>30</td>
</tr>
<tr>
<td>1 0 0</td>
<td>115</td>
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<td>0 0 1</td>
<td>25</td>
</tr>
<tr>
<td>0 1 0</td>
<td>42</td>
</tr>
</tbody>
</table>

Note. SMP = skill mastery profile.

Table 13

Analysis of Variance of Skill Mastery Profile by Total Reading Comprehension

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>$F$</th>
<th>$\eta^2$</th>
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</thead>
<tbody>
<tr>
<td>SMP</td>
<td>14.40</td>
<td>5</td>
<td>2.88</td>
<td>22.25</td>
<td>.22</td>
</tr>
<tr>
<td>Error</td>
<td>21.25</td>
<td>396</td>
<td>.13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. SMP = skill mastery profile.
Multiple comparisons revealed that all 2-skills mastery profiles – 1-0-1, 1-1-0 and 0-1-1 – performed significantly higher than 1-skills mastery profiles – 0-1-0 and 0-0-1 (Table 14). This shows that any combination of two skills mastery will perform higher than VOC only masters (SMP 0-1-0) and INF only masters (SMP 0-0-1). However, this was not true for the EXP only masters (SMP 1-0-0). Only SMP 1-0-1 and SMP 1-1-0 performed significantly higher than SMP 1-0-0. Hence, for VOC only masters (SMP 0-1-0) and INF only masters (SMP 0-0-1), achieving master in the other two skills (SMP 1-0-1 and SMP 1-1-0, respectively) instead would enhance their reading comprehension. But for EXP only masters, it is not the case, as shown by the non-significant scores between SMP 0-1-1 and SMP 1-0-0.

One last group difference was found between SMP 1-0-0 and SMP 0-1-0, with significantly higher mean score obtained by SMP 1-0-0. This is the only mean difference found amongst the same number of skill mastery profiles (e.g. amongst SMPs 1-0-0, 0-1-0 and 0-0-1). Again we see that mastery in EXP contributes to their total reading comprehension scores more than VOC skill. However, this can be alternatively interpreted as the EQAO assessment’s greater representation of the EXP skill, relative to the VOC skill.
Table 14

*Multiple Comparisons of Skill Mastery Profiles in Total Reading Comprehension*

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Mean Difference</th>
<th>SE</th>
<th>Adjusted 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 0 1 vs. 0 1 0</td>
<td>.63</td>
<td>.07</td>
<td>.43, .84</td>
</tr>
<tr>
<td>1 1 0 vs. 0 1 0</td>
<td>.51</td>
<td>.06</td>
<td>.32, .71</td>
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<td>0 1 1 vs. 0 1 0</td>
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<td>.09</td>
<td>.25, .75</td>
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<tr>
<td>1 0 1 vs. 0 0 1</td>
<td>.44</td>
<td>.08</td>
<td>.19, .68</td>
</tr>
<tr>
<td>1 0 1 vs. 1 0 0</td>
<td>.33</td>
<td>.06</td>
<td>.17, .49</td>
</tr>
<tr>
<td>1 1 0 vs. 0 0 1</td>
<td>.32</td>
<td>.08</td>
<td>.09, .55</td>
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<td>1 0 0 vs. 0 1 0</td>
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<td>.11, .50</td>
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<td>0 1 1 vs. 0 0 1</td>
<td>.30</td>
<td>.10</td>
<td>.02, .60</td>
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<tr>
<td>1 1 0 vs. 1 0 0</td>
<td>.21</td>
<td>.05</td>
<td>.07, .35</td>
</tr>
</tbody>
</table>
Chapter 5: Discussion and Conclusion

The present study examined reading comprehension skills in immigrant and domestic students of various home language backgrounds. The Grade 6 provincial reading achievement assessment data were used to study three reading comprehension skills: explicit understanding of text, processing vocabulary knowledge and inferencing. Students’ individual reading skill profiles were created based on PPM estimates from the application of cognitive diagnostic modeling to the assessment data. Students’ mastery of each of the skills was used to create skill mastery profiles (SMPs), consisting of the status of mastery or nonmastery in each skill; hence, this resulted in eight SMPs (2^3=8). As well, their raw total scores were also examined for further analyses. This chapter will first discuss the findings from immigrant and domestic students’ comparison in their reading comprehension skills, followed by the role of home language environment on students’ reading comprehension skills. Lastly, limitations of the study are discussed.

5.1 Comparison between immigrant and domestic students

The study results show that the proportion of SMPs was similar between the immigrant and domestic groups. For instance, the total mastery profile (mastery in all three skills) had the greatest proportion, followed by the total nonmastery profile. The inferencing skill was the hardest to master, with the lowest proportion found for the INF only mastery profile.

Many studies have suggested that immigrant students perform below their domestic peers in literacy related tasks, including overall reading comprehension (Baumert & Schumer, 2001; Stanat & Christensen, 2006), and vocabulary knowledge (Bialystok et al., 2010). In the current study of Grade 6 students that have resided in the country for the minimum of 5 years, independent sample t-tests revealed that immigrant students performed significantly higher than domestic students on all three reading comprehension skills (Table 4). Residing in the host country for the minimum of 5 years seem to be an important factor determining immigrant students reading proficiency against their domestic peers. Paez (2009) found that immigrant students of various ethnic backgrounds and social economic status performed significantly lower than their comparable domestic peers on an English-language proficiency test. A possible reason
for such results may be due to variability within the immigrant students. Their immigrant students varied greatly in age (age 10 to 16) and immigrated to the host country, on average, 3.88 years prior to the study. Similarly, the length of residence was a factor which determined immigrant students’ proficiency against native Canadian-born students (Jang et al., 2013).

Further analyses were conducted to see if a significantly greater proportion of immigrant students would have total mastery compared to domestic students. The results from the binary logistic regression analysis showed that immigrant students were significantly more likely to belong to the total mastery profile compared to the domestic students. As well, domestic students were significantly more likely to belong to the total nonmastery compared to immigrant students. This result calls for attention to domestic students struggling with reading comprehension. In Ontario, students born outside of Canada are provided with the opportunity to attend English as a second language (ESL) programs. Such criteria used to determine students’ access to such programs can lead to missed opportunities for domestic students that may benefit from language support.

Lastly, hierarchical multiple regression analyses were conducted to examine the predictive power of reading comprehension skills onto students’ total reading comprehension. The results showed that for both immigrant and domestic students, VOC had the smallest contribution, followed by EXP, and it was INF that had the greatest contribution to their total reading comprehension. This showed that immigrant and domestic students experience similar difficulties with the skills. Because their PPM scores on their reading comprehension skills were derived from their total reading comprehension score, careful interpretation of the results were required. The assessment itself may have weighted items that discriminated mastery and nonmastery in INF more, relative to VOC and EXP. However, the EQAO assessment weighted each item on the multiple choice equally and for the current study, INF had 8 items, VOC had 8 items and EXP had 10 items. Hence, the weight of skills does not explain for the strength of skills as predictors for total reading comprehension.

5.2 Home language environment matters in students’ reading comprehension

In Ontario, Canada, many students are raised in multilingual homes (Statistics Canada, 2006). However, multilingualism for young school aged learners was traditionally seen as a
disadvantage (Duncan & de Avila, 1979). Although this view was rejected by contemporary researchers, its benefits are not fully acknowledged in the current educational systems. The present study investigated the influences of multilingual home environments onto students’ reading skills. Instead of using students’ ESL program status, the present study identified students’ language background in terms of the amount of exposure (spoken to) and use (speaking) of their language(s) at home.

Although many studies have shown differences between bilinguals and monolinguals, there has been a lack of close attention to the different home language environment (HLE) within the bilingual students. To examine whether speaking and hearing L1 and L2 has any differences, students of various HLEs were examined. First, distribution of students of various HLE were categorized according to their SMP. Binary logistic regression was ran to test if any of the bilingual HLE group was significantly more likely to belong to any of the SMP. Two significant differences were found. Bilingual students that speak and hear both their L1 and L2 at home were much more likely to belong to the SMP of vocabulary mastery only. This showed that of the students that has mastery in vocabulary, but has yet to mastery explicit comprehension and inferencing are much more likely to speak and hear both L1 and L2 at home compared to students from a monolingual HLE. No differences were found between the monolingual group to other HLE groups.

In addition, it was found that bilingual students that mostly spoke English at home were much more likely to belong to the vocabulary and inferencing mastery profile compared to monolingual students. No significant differences were found between other bilingual students and monolingual students. The results are consistent with the interactive-compensatory (IC) model (Goldsmith-Phillips, 1989). When there are variations in the strength of skills for individuals, their strong skills would support other skills that are relatively weak. The IC model postulates that skilled readers are more likely to show this pattern of development. In the case of bilingual students that uses English at home, VOC and INF were both mastered, suggesting a relatively more homogenous skill mastery status. This may have resulted from their ability for one skill to support another.
Furthermore, the study results suggest that the ability to comprehend explicitly stated textual information is not a prerequisite skill for mastering other higher-order processing skills. LaBerge and Samuels (1974) claimed that when lower-level skills are lacking, cognitive load cannot be allocated in processing higher-order skills, such as inferencing. In the current study, EXP was considered to be a basic comprehension skill, relative to VOC and especially INF. The proportions of SMPs confirmed that EXP was indeed a more basic skill (greater proportion of students under profiles with EXP mastery). If the theory is correct, students with nonmastery in EXP should have also exhibited nonmastery in either or both VOC and INF. The current study does not suggest that explicit comprehension must be mastered before vocabulary knowledge and inferencing skills are mastered. When hierarchical understanding of students’ abilities in reading comprehension takes place, teaching is initially focused on skills at the base level until they are mastered. If a student fails to master those skills, the same lesson will persist until they reach the desired level of proficiency; and if not, it is presumed that other skills will also fail to reach proficiency. We dismiss the possibility of strengthening their higher level skills that may contribute to the improvement of the non-mastered skill at the base level. From the SMP distribution, total mastery (1-1-1) and total nonmastery (0-0-0) were the greatest in proportion, followed by mastery in EXP and VOC (1-1-0) and EXP only (1-0-0). This supports the idea that lower skills must be mastered first. However, the following largest profiles – 1-0-1, 0-1-0, 1-0-0 and 0-0-1 – are inconsistent with such proposition. Although students under these profiles made up only 10.44% of the total number of students ($N = 1,600$), attention towards such minority students are crucial since the school curriculum are constructed with average student in mind.

In regards to the particular skills chosen, while inferencing was most predictive of reading comprehension scores for immigrant and domestic students’ reading comprehension, it was also the hardest skill to master. Inferencing depends on both prior knowledge and text information. Some researchers caution that struggling readers often over rely on their background knowledge – which is often faulty or incomplete – causing them to move further from, rather than closer to the intended meaning of text (Rapp et al., 2007). As well, lack of explicit comprehension of the text can hinder their interpretation of the text meaning. Think-aloud intervention delving into the students’ processes during reading may provide more information on the areas that students are struggling with.
5.3 Conclusion and Future Directions

With the growing diversity in young students’ language backgrounds, schools in Canada provide English as a second language (ESL) programs for newly immigrated students in need of intense English teachings. Both immigrant and domestic students come from homes with various linguistic environments. The present study examined the role of home language environments on students’ reading comprehension skill profiles. The results from the study confirm that immigration status is not a predictor of reading comprehension once immigrant students have resided in the host country for more than 5 years (Jang et al., 2013). Rather domestic students showed significantly lower reading comprehension skills. Since many domestic children are born into a multilingual home language environments, they may not be receiving much English support at home. The growing diversity in the various linguistic exposure from young age demands research among Canadian-born students that have not receive much attention from schools. Further, the study highlights that domestic students exposed to multilingual home language environments have performed significantly below the immigrant counterparts on their reading comprehension skills, including explicit understanding of text, vocabulary understanding and inferencing, which is consistent with Jang et al. (2013). The study also revealed variations in students’ skill mastery levels, suggesting that explicit teaching of each skill is necessary in improving their total reading comprehension. For example, inferencing was the skill that contributed the most to their total reading comprehension scores, and it highlights the importance of inferencing for advancing students’ reading comprehension ability as they engage in increasingly more challenging academic text. Various home language environments revealed bilingual students that most often speak English at home were most likely to mastery both vocabulary and inferencing. Variations in the probability of home language environment groups of having certain skill mastery profile revealed the importance of the use of the language. Future studies should not limit itself in comparing monolinguals against bilinguals, but to examine the factors contributing to the different types of bilingualism. For instance, since the current study revealed the importance of the use of L2 at home for reading comprehension skills in the target language, examining the context in which students’ L1 and L2 are used may reveal cross-linguistic transfer in either or both directions. Although the current study showed the importance of the use of the target language, it did not dismiss the significant benefit of multilingualism.
Understanding the optimal balance between fostering multilingual mind to continuous practice with the target language should inform students as to optimally help oneself in academic success.
References


Ludi, G., & Py, B. (2009). To be or not to be ... a plurilingual speaker. *International Journal of Multilingualism, 6*(2), 154-167.


Appendix A

EQAO Multiple Choice Questions

Understanding explicit information (EXP)

6. What is the centre of the corn kernel?
11. In paragraph 1-3, what is Dorothy doing?
13. How did Dorothy's mathematics teacher react to Dorothy's excitement? The teacher…
14. As a young girl, Dorothy Lovesay tried to
17. In which field did Dorothy earn a diploma?
18. According to the article, who helped shape Dorothy's role as a social activist?
19. For which work did Dorothy win a Governor General's Award?
20. According to the article, how did Dorothy spend much of her time after her work gained
   recognition around the world?
28. What is Samuel anxious to share with Janet?
29. In paragraph 3, why is Janet startled?

Processing vocabulary knowledge (VOC)

1. At the meeting on June 6, Ravi Singh will record the minutes. What does "record the
   minutes" mean?
2. On June 7, recess will be postponed. What does postponed mean?
12. Read this sentence: She wiggled in her desk, and the piece of paper she held quivered.
   What does quivered mean?
23. In line 9, "flowers will wither" means
24. In line 20, "stiff are the ponds" means that the water is
34. Read the sentence below. It is not __ for students to pay such a large bus __ to go to the
   summer __.
35. Which of the following words is spelled correctly?
39. Which word is a homonym of the word "scent"?
Inferencing (INF)

4. What topics will Constable Kim Phillips most likely discuss with the students?
5. In line 23, what do the words “icy breath” mean?
10. Where would this text most likely be published?
21. How did Dorothy's success in her field probably make other writers feel?
26. According to the poem, when does King Frost reign?
27. What is the main reason the author wrote the poem "Flowers and Frost" in three stanzas?
31. Read this sentence from the text. On the bottom was a perfect imprint of a seashell. What does the word "imprint" tell about the rock?
32. What form of writing is "The Secret"?