

Primary Students' Performance in Bilingual Reading Tests and Related Factors Accounting for Their Performance

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Abstract

Under the bilingual education system in Singapore, Chinese Singaporean students are required to be proficient in both Chinese and English languages. The education environment in Singapore is dominated by English, which in turn affects the development of reading ability in Chinese among students. To understand the development of Chinese and English reading abilities of Singapore children, we conduct research which include testing, questionnaire and interview of seven-, nine- and twelve-year-old Singaporean students, their parents and teachers. The students take the Chinese and English PIRLS and PIRLS-Literacy reading comprehension tests first, and then the PIRLS questionnaires. The univariate analysis of variance and the linear regression are used to comparatively analyze and discuss the data of tests and questionnaires by age and family language background (FLB), and to investigate the relationship between English and Chinese reading abilities. Secondly, we conduct semi-structured interviews with the parents and teachers selected by critical student cases according to their testing and questionnaire data, in order to discuss their growth of reading ability. We then categorize the data and analyze using social network analysis (SNA). Finally, we conduct structured observations on the two cases with maximum variation

sampling in order to find out the challenges involved. The study discovers that English language interferes significantly in the early stages of Chinese vocabulary accumulation, but such kind of interference decreases with age. Nine years old is the critical age when such interference decreases significantly. The results also show that the key factor affecting reading ability is vocabulary accumulation.

Keywords: Chinese, English, bilingual, reading ability, vocabulary accumulation

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0 Introduction

0.1 Bilingual Family Language Background

Singapore is a multiracial and multilingual country, with English being the dominant working language. It enhances the sense of identity and harmony among all ethnic groups, and has become the *lingua franca*: of Singapore. Besides English, Chinese Singaporean students learn their mother tongue, Chinese, in schools as it is also an official language, and important tool to preserve their traditional culture. Such a bilingual education policy is crucial to the development of Singapore and the preservation of mother tongue languages and cultures (Liu, 2009).

Bilingual is a term which is used to describe a learner who uses two or more languages to communicate (Rampton, M.B.H., 1990). According to *Longman Dictionary*, the definition of “Bilingual” is “written or spoken in two languages” or “able to speak two languages equally well”.

Chinese Singaporean students have a unique bilingual background, according to a major survey by the Ministry of Education in 2010. The percentage of primary six students who only (or most of the time) speak Mandarin at home is 37%, the percentage of speaking both Chinese and English frequently at home is 25%, while the proportion of those who only (or most of the time) speak English at home is 38%. According to their family language background (FLB), we can classify Chinese students into three main types, Chinese dominant (CD), bilingual in Chinese and English (CE), and English dominant (ED) (Hu X., Lam W.I.J, Tse S.K., 2016; Hu X., 2017).

Under the bilingual education system, the literacy and vocabulary accumulation of English and Chinese among Chinese Singaporean students develop concurrently. In the 2007 and 2015 Singapore primary school Chinese curriculum, students are required “to be able to identify the form, phonetics and meaning (of Han characters)” and achieve “vocabulary accumulation”. Henceforth,

the research of Chinese character education and vocabulary accumulation in our bilingual environment has attracted more attention from the academia in recent years.

0.2 Progress in International Reading Literacy Study

In the current internet age, reading is still one of main means for one to access information. Books and magazines in the world are increasing at an even faster rate than before (Yan, 2004). It was reported that the information generated by mankind doubles every two years, out of which 95% is electronic information (Lyman, Varian, 2000, 2011). Therefore, the need to develop good reading skills in this information age is getting more important.

0.2.1 Overview of PIRLS

The Progress in International Reading Literacy Study (PIRLS), has been conducted by the International Association for Evaluation of Education Achievement (IEA) since 2001. It aims to explore the nine-year-old children's learning achievement, reading experience of their mother tongue in school and at home, and to find out the factors affecting reading ability. Since 2001, it has been carried out every five years to track the development of children's reading ability (Tse S.K., Lam W.I.J., Lam Y.K., & Loh E.K.Y, 2005).

PIRLS has nearly twenty years of history, with more than one hundred international experts and over fifty countries participating in its tests. Sample texts in PIRLS include English, Chinese, German, and numerous other languages. The test text in PIRLS is usually set in English, and later translated, for our case, into Chinese, which is then translated back into English again, so as to test if both the first and last versions of the English texts are comparable. The test scores of the various languages are cross examined for their comparability, reliability and validity, and likewise with the data of the reading tests, so as to enable research across two or more languages.

From an assessment point of view, PIRLS focuses on three aspects of

reading literacy: understanding process, reading purpose and reading behavior and attitude (Campbell, Kelly, Mullis, Martin, and Sainsbury, 2001:16). PIRLS defines reading ability as the ability for readers to understand and use language, which have both social and personal importance. For young readers, they construct meaning from various articles, participate in social activities through reading and study, and enjoy the fun of reading (Campbell, Kelly, Mullis, Martin, Sainsbury, 2001:15; Tse, Lam, Lam, Loh, 2005:11; Mullis, Kennedy, Martin, Sainsbury, 2006:3).

0.2.2 PIRLS-Literacy

Since 2013, the assessment framework of PIRLS has been integrated into the reading topic of PIRLS-Literacy - a test designed to evaluate students' early reading, and to measure the participant's reading comprehension. PIRLS-Literacy, accounting for 50% of the total score, mainly assesses the participant's ability to collect and retrieve obvious information; the reading paragraphs in this test are shorter, and the use of vocabulary and grammar is simpler than PIRLS (Ina V.S. Mullis, Michael O. Martin, 2013). It is mainly used to assess the stage of "pre-reading", and measures the developing reading abilities of young children.

0.2.3 Reading Comprehension

Carver (1973) considers reading to be complex and divides it into four processes: reader decodes the word and decides the meaning of the word in special sentences; combines the meaning of individual words together to fully understand the sentence; understands the implications of the passages and paragraphs, as well as the causes and consequences, assumptions, proofs, implications, implicit conclusions, and ideas related to the subject, but temporarily out of context; evaluates various concepts, including logic, evidence, authenticity and value judgments. The first two processes are of basic reading skills, the latter two are of reasoning and understanding. According to the theory by Carver, the four processes of reading comprehension are defined by PIRLS: (1) focus on and retrieve

explicitly stated information, (2) make straightforward inferences, (3) interpret and integrate ideas and information, and (4) evaluate and critique content and textual elements (Mullis et al. 2001, 2012, 2016; Tse, Lam et al. 2005; Tse, Lam, 2013).

Based on reading purposes and comprehension processes, the PIRLS framework provides the foundation for the PIRLS and PIRLS-Literacy assessments of students' reading achievement. PIRLS assesses students' reading achievement within the two overarching purposes for reading that account for most of the reading done by young students both in and out of school: reading for literary experience; and reading to acquire and use information. The PIRLS assessments integrate four types of comprehension processes within each of the two purposes for reading. Table 1 presents the reading purposes and processes assessed by PIRLS and the percentages of the test devoted to each for PIRLS and PIRLS-Literacy (Mullis, Martin, 2016).

Table 1
Percentages of the PIRLS and PIRLS-Literacy reading assessments devoted to each reading purpose and comprehension Process

Purposes for reading	PIRLS	PIRLS-Literacy
Literary experience	50%	50%
Acquire and use information	50%	50%
Processes of comprehension		
Focus on and retrieve explicitly stated information	20%	50%
Make straightforward inferences	30%	25%
Interpret and integrate ideas and information	30%	50%
Evaluate and critique content and textual elements	20%	

(Mullis, Martin, 2016, p13)

0.3 The Development Stages of Reading Ability

Chall (1983) divided the development of reading ability into six stages. Stage zero to stage two (before eight years old) belongs to the “learning to read”

period, while the three stages after eight years old, or stages three to five, belong to the “reading to learn” period (Chall, 1983; Tse & Lam, 2013). How young bilingual or multilingual readers’ progress from “pre-reading” to “learning to read”, and to “reading to learn” are certainly worthy of further studies.

0.4 The Interference between Two Languages

0.4.1 The Inhibitory Control Model of Bilingualism

Hermans et al. (1998) found that when bilinguals extract a word from their weaker language, the thesaurus of the dominant language are also activated and interfered by the extracted word. Hence, bilingual learners need more time to extract or decipher words. At the same time, Green (1998) proposed an Inhibitory Control (IC) model, which described the inhibition process in bilingual production. This model holds that when bilingual words were generated, the two words were inconsistent when they first got to be utilized. The experimental results of Meuter and Allport (1999) also showed that the response time of the bilingual conversion series becomes longer. This situation also occurred in the understanding of language (Heuven, Dijkstra, Grainger, 1998; Spivey, Marian, 1999; Kroll, Bobb, Misra, Guo, 2008).

0.4.2 Language-Specific Selection

Costa (2000, 2006) showed that non-skilled bilinguals tended to use inhibition mechanism on lexical retrieval, high level bilinguals would focus on the processing of one language model. In this time, the mechanism of vocabulary extraction will develop from the inhibitory control model to the model of language-specific selection. The lexical retrieval mechanism related to the fluency of the two languages during bilingual production (Li, Mo, Wang, Pan, 2006). When the bilinguals are reading, in bilingual lexical access, his/her dominant language may interfere with the weak language, and its degree of interference relates to the level and fluency of the two languages (Hu, Lam, Tse, 2016; Hu, 2017). In the context of

Chinese and English bilingual education, Han character acquisition and vocabulary accumulation should take into account the influence of such interfering factors.

0.4.3 The Interference and Transformation of Chinese and English Bilingual Reading

Our pilot study found that the unstable development of Chinese reading ability of both CE and ED groups was related to the interference between Chinese and English (Hu, Lam, Tse, 2016). Thus, the mechanism of vocabulary extraction has a direct impact on the development of children's reading ability. However, this phenomenon appears only at one stage. When the students have improved the standards of the two languages, the interference will diminish (Hu, Lam, Tse, 2016:35; Hu, 2017:350). As the educational language environment in Singapore is dominated by English, such an interference cannot be ignored in the learning of Han characters and the accumulation of vocabulary. As such, our research has decided to focus on the interference and facilitation of English reading on Chinese reading.

This paper aims to find out the successful experiences and the difficulties in the development of Chinese and English reading abilities for Chinese Singaporean students with different ages and family language background.

There are our three research questions:

Firstly, for these Chinese Singaporean students of different ages and FLB, what are the differences of their Chinese and English reading abilities? And how are the relationships between their Chinese and English reading abilities?

Secondly, what are the experiences and difficulties in developing the Chinese and English bilingual reading ability?

Thirdly, what are the critical factors in the development of their reading ability?

1 Research Design

1.1 Participants

We have a total of nine hundred and seventy-one participants in this study. The participants include sixty-two teachers, six parents, and nine hundred and three are Chinese Singaporean students including 225 seven-year-olds (25%), 305 nine-year-olds (34%), and 373 twelve-year-olds (41%). According to the family language background, 275 students (31% of total students) are from CD group, 389 students (43% of total students) are from CE group, and 239 students (26% of total students) are from ED group.

1.2 Research Methods

1.2.1 The Reading Test and Questionnaire

The students were first invited to take the reading comprehension test of Chinese and English, PIRLS and PIRLS-Literacy, and were given enough time (60 to 70 minutes) to complete the test. Each student was required to complete two types of test consisting of information expository and literary story texts, in both Chinese and English, and for PIRLS-Literacy and PIRLS. We then correct the test papers and record the statistic. The PIRLS questionnaire survey was then conducted to investigate the students' usage of English and Chinese, including the time and place of daily usage and the subject of communication.

As PIRLS is a test designed for fourth graders' reading comprehension, we have to cater to the younger participating 7-year-old students, hence this study included the less difficult articles from PIRLS-Literacy in the test volumes. Furthermore, during the process of data collection, we observed that the 7-year-old students can complete the test papers on time. Table 2 shows the eight articles and their items in the reading comprehension tests in the study.

Table 2**The eight articles of the test papers of reading comprehension test and their information**

Test Paper	Title of Article	Type	Language	Genres	Number of	
					Words	Items
1	从幼虫到蝴蝶	PIRLS-Literacy	Chinese	Information	630	16
	An Unbelievable Night	PIRLS	English	Literary	832	12
2	勇敢的夏洛特	PIRLS-Literacy	Chinese	Literary	721	18
	Searching for Food	PIRLS	English	Information	823	15
3	Brave Charlotte	PIRLS-Literacy	English	Literary	463	18
	寻找食物	PIRLS	Chinese	Information	1213	15
4	Caterpillar to Butterfly	PIRLS-Literacy	English	Information	378	16
	一个难以置信的晚上	PIRLS	Chinese	Literary	1289	12

1.2.2 The Focused Interview and Observation

The study first analyzes the scores of Chinese and English reading test, and combines the questionnaire data in order to conduct the critical case and the maximum variation case sampling of the students.

Then students whose scores of both Chinese and English reading test are high, and the gaps between Chinese and English reading results are small, are selected as the critical case sample (CCS). After that, semi-structured interviews were conducted for their parents and teachers in order to find out the common characteristics and the reasons of success in the balanced development of bilingual reading ability in Chinese and English. The other group of students whose scores of English reading test are high but those of Chinese are low are selected as the maximum variation case sample (MVCS). We observed their Chinese reading and vocabulary recognition.

1.2.3 The Methods of Data Analysis

The study uses the univariate analysis of variance to analyze the results based on the reading test and questionnaire data of age and family language background. Quantitative and comparison analyses were conducted on the gap between Chinese and English reading test scores (GCERTS), the gap of the daily usage frequency between Chinese and English (GCEDUF). Furthermore, linear regression analysis (LRA) was used to explore the relationship between Chinese and English bilingual reading. We transcribed the interview and observation data, and carry out the classification, social network analysis (SNA), as well as the case comparative analysis. Finally, we combine the results of quantitative and qualitative analyses to discuss the successful experience of developing bilingual reading ability, the critical factors and difficulties affecting reading. Next, we explore possible remedies to resolve these difficulties.

In order to ensure reliability and validity, the study uses PIRLS sample as test and questionnaire, uses statistical program of Statistical Package for the Social Science (SPSS) and UCINET Software to calculate and analyze the reading test, questionnaire and interview data. The terms and abbreviations mentioned in this article are shown as Appendix 1.

2 Data Analysis and Findings

2.1 The Analysis of Test and Questionnaire Results

2.1.1 The Test Results of Chinese and English Reading

After the Chinese and English reading test scores are calculated and normalized to 100 points, the reading test scores are analyzed by the univariate analysis of variance (one-way ANOVA). The mean value in Chinese is 58, standard deviation $SD=30$, standard error $SR=1.02$, p value $p = 0.00 < 0.01$, while the mean value of English is 75, $SD=25$, $SR=0.84$, $p = 0.00 < 0.01$. The gaps between

Chinese and English reading test scores, which are the absolute values of the difference between English and Chinese reading test results are compared with different ages and different family language backgrounds.

Figure 1(a) shows the graphs of reading test results and gaps comparison between Chinese and English for students of different ages, whereas Figure 1(b), (c) and (d) show those data for each FLB.

Figure 1

The reading test results and gaps comparison between Chinese and English of the students with different ages and FLBs

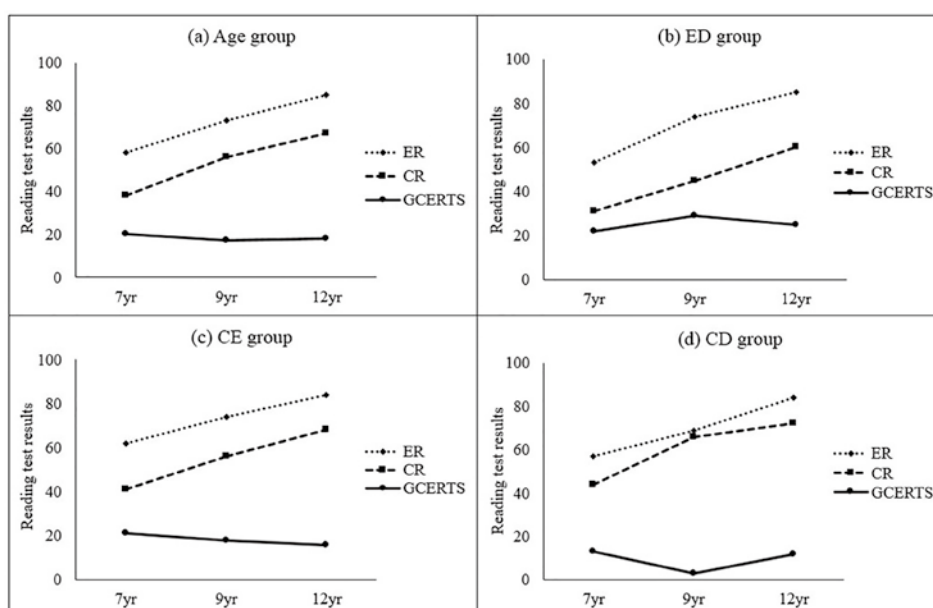


Figure 1(a) shows that the GCERTS of 7-year-old group is 20 which is larger than both 9- and 12-year-old groups. As seen from the comparisons among Figures 1 (b), (c) and (d), the Chinese reading (CR) and English reading (ER) results for 7-year-olds in the ED group is the weakest. A possible reason is that students are novice readers when they are 7 years old, and their CR is vulnerable to interference by ER. From Figure 1(a), the GCERTS of the 9-year-old group is 17 which is smaller than that of the 12-year-old group. It could be a result of the

statistic shown in Figure 1(d) where the GCERTS reading test result of 9-year-old is significantly smaller. This can be attributed to two reasons: firstly, the increase in English subjects and homework results in a decrease in the use of Chinese in the CD group; secondly, the English reading ability (ERA) of CD group from 9 to 12 years old grows faster than Chinese reading ability (CRA), which leads to a further increase in the GCERTS at the age of 12.

Figure 1(b) shows the graphs of the ED group. At the age of 9, the GCERTS increases, and then decreases again by the age of 12. Unlike the other two FLB groups, the GCERTS of 9- and 12-year-old groups are 29 and 25 more than that of the 7-year-old group (22). The possible reason is that there is less Chinese usage and insufficient Chinese vocabulary accumulation. There is a decreasing trend from 7, 9 to 12 years old, the data in Figure 1(c) indicates that their CRA grows faster than ERA, narrowing the GCERTS. The possible cause is the increase in Chinese usage frequency (CUF). We shall further analyze the usage situations in English and Chinese.

2.1.2 Analysis of the Questionnaire Results

The CUF and EUF are calculated using the student questionnaires. The CUF or EUF is the percentage ratio of the statistical value of Chinese or English usage relative to the total used in both Chinese and English. The GCEDUF is the absolute value of the difference between EUF and CUF.

Figure 2(e) shows the graphs of the daily usage frequency (DUF) and gaps comparison between Chinese and English of the students among different ages, whereas Figure 2(f), (g) and (h) show those data for each FLB.

Figure 2

The usage frequency and gap of the usage frequency between Chinese and English with different ages and different family language background

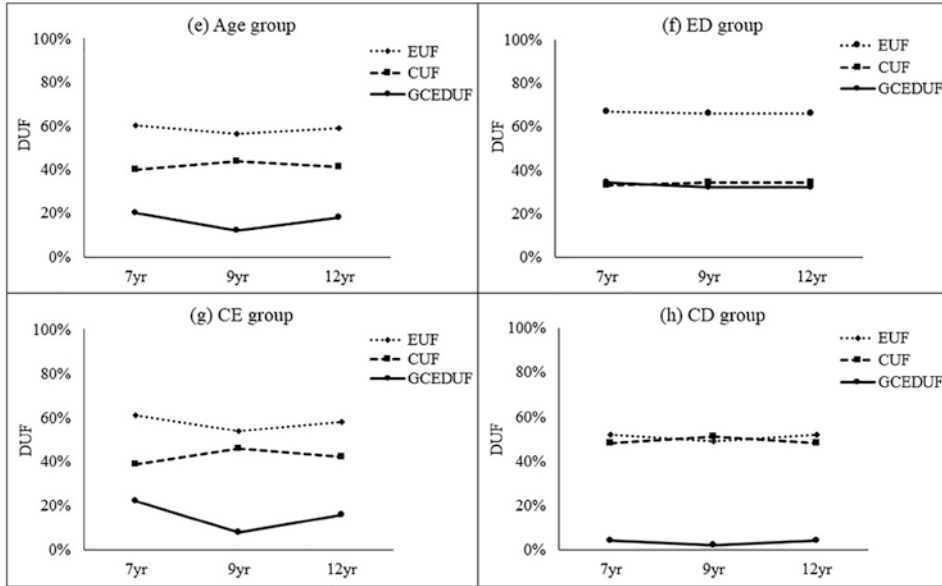


Figure 2(e) shows the CUF of 9-year-old group is higher than both 7- and 12-year-old groups, and its GCEDUF is smaller than both 7- and 12-year-old groups, which is similar to the shape of the GCERTS curve in Figure 1(a). It can be seen from Figure 2(g) and (h) that the increase in CUF is mainly due to the increase in CD and CE groups at the age of 9, and the GCEDUF is significantly smaller than that at ages of 7 and 12. Adding Figure 1 (a) to the analysis, we can deduce the reason for such a change: the parents or teachers have changed the teaching strategy of reading by increasing the CUF at home or classroom to accumulate Chinese vocabulary, thus narrowing the GCERTS during the 9-year-old stage.

It is worth noting that at the age of 12, the GCEDUF has increased, and the CUF has decreased. Similarly, this is caused by a decrease in the CUFs of the CE and CD groups, possibly due to an increase in English subjects and homework. This also caused the GCERTS of the CD group to increase in this period. Because their CRA development had peaked during the 7 to 9 years old, the subsequent development slows down at the ages of 9 to 12. Coupled with the increase in the

EUF and their better coordination of the relationship between CR and ER than the age before 9, their ERA during the ages of 9 and 12 grows faster than CRA.

Interestingly, as seen from Figure 2(g), the CUF in the CE group increases from the age of 9, causing decrease in the GCEDUF, while Figure 1(c) shows their GCERTS has decreased, which illustrates that their CRA have a more substantial increase than their ERA. We can therefore conclude that increasing CUF leads to a better development of CRA. They maybe have the inability to coordinate the relationship between CR and ER in the early stages, which leads to slower development of CRA than expected. However, at the age of 12, they are able to coordinate the relationship between CR and ER better than before, which leads to faster CRA progress than before.

Figure 2(f) shows that there is almost no change in the EUF of the ED group. The GCEDUF slightly decreases. It may be the adjustment of parents and/or teachers in the reading strategies, which increases the CUF. However, considering Figure 1(b), we find that their CR and ER still have a significant increase from 9 to 12 years old, and the GCERTS significantly reduces. This is not only caused by the increase in CUF and vocabulary accumulation, but also could be related to the positive reinforcement of CR due to ER.

2.1.3 Relationship of Bilingual Reading between Chinese and English

The data is standardized to carry out a simple linear regression analysis of the relationship between CR and ER test results. The dependent variable is set to CR test score (y), and the independent variable is set to ER test score (x). The study explores how the results of CR of these students have changed with the increase of ER scores.

Table 3

Simple linear regression model of CR test score against ER test score with different ages

Age group	Simple LRM	R ²	Beta coefficient	Direction
7-year-old	$y = -0.25x - 0.79$	0.99	-0.25	Negative
9-year-old	$y = 0.04x - 0.08$	0.99	0.04	Positive
12-year-old	$y = 0.15x + 0.15$	0.99	0.15	Positive

Table 3 shows a simple linear regression model for the age groups. For the age of 7, 9 and 12, the partial regression coefficient (β) are -0.25, 0.04 and 0.15 respectively ($R^2 = 0.99$).

Figure 3(i) shows the graph of the relationship between CR and ER of the students of different ages. The data in Figure 3(i) illustrates that at the age of 7, the CR achievement decreases by 25% while the ER score increases by 100%. At the ages of 9 and 12, their CR score increases by 4% and 15% respectively with the increase of ER score. At the age of seven, the direction of the relationship between CR and ER is negative, then it begins to change at the age of nine, and becomes positive at the age of twelve. With the increase of age, they are able to better coordinate the relationship between CR and ER than their early stages. It implies that there is interference between CR and ER at age 7, the key transition period is at age 9, and the mutual promotion is at age 12.

Figure 3

The β coefficients of Chinese and English reading abilities with different ages and different family language background

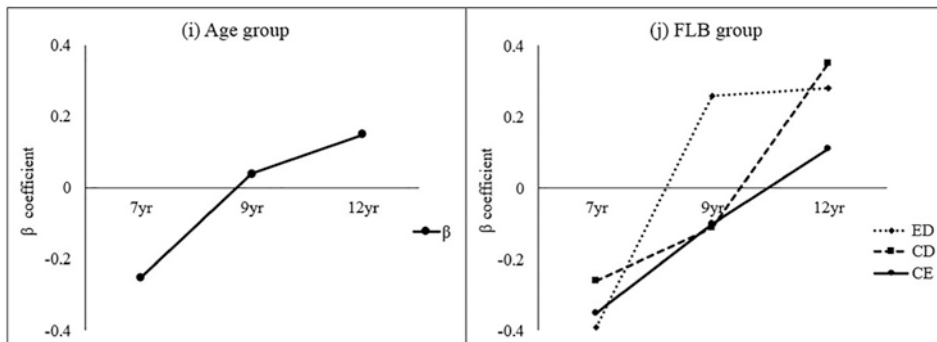


Figure 3(j) shows the graph of the relationship between CR and ER for each FLB. The data of these three FLB groups show negative linear relationship between CR and ER at the age of 7, with the ED group showing the largest extent of the negative relationship. This is consistent with the previous results that ED group achieves the lowest scores in CR and ER at the age of 7, and the GCERTS of 7-year-old group is

20 which is larger than both 9- and 12-year-old groups as shown in Figure 1(a).

There is a strong positive linear relationship between CR and ER for ED group at the age of 9, while the weak negative linear relationships between CR and ER in both CD and CE groups. This illustrates that the ED group has a big improvement at the age of 9 to achieve good English scores. The ED group can develop in the coordination between CR and ER earlier compared to the other two groups.

The students are able to better handle the coordinated development of reading ability in both Chinese and English at the age of 12. There is a strong positive linear relationship for the CD group, which is consistent with the result shown in Figure 1(a) and Figure 1(d). The coordination relationship between CR and ER of the CE group also turns positive at the age of 12, which is consistent with the analysis shown in Figure 1(c) and Figure 2(g).

2.2 The Analysis of Interview and Observation Results

2.2.1 The cases of CCS and MVCS

The study has selected ten cases, of which eight cases are CCS and two cases are MVCS.

Table 4

The situation of CCS and MVS cases with different age and FLB

Case No.	AGE	FLB	ER Scores	CR Scores	GCERTS
Case 1	12	CD	96	95	1
Case 2	12	CD	93	95	2
Case 3	12	CE	79	79	0
Case 4	12	CE	85	79	6
Case 5	9	CE	85	78	7
Case 6	7	CE	89	85	4
Case 7	12	ED	93	85	8
Case 8	9	ED	85	84	1
Case 9	12	ED	85	10	75
Case 10	9	ED	58	18	40

Table 4 shows that the students from ED group in case 9 and 10 have a significant gap between ERA and CRA. In the other cases, the CR and ER scores of the students are above 75, and the GCERTS are between 0 and 8.

2.2.2 Analysis of interview transcriptional data

The interview had been conducted with six parents and three teachers, which lasted 1 to 1.5 hours each. The focus of the interviews is to discuss the interviewees' experiences of success in helping to develop their children/students' Chinese-English bilingual reading ability.

The successful experiences of parents and teachers

Firstly, the key factor of strong Chinese-English bilingual reading ability is the increase in CUF at home to accumulate vocabulary. Secondly, the vocabulary accumulation is a critical factor in the development of reading ability. Interviewees believe that reading in both Chinese and English languages in a family context is conducive to the cultivation of bilingual reading ability. Lastly, the key factor of reading ability of the students from ED group depends on the success of teaching vocabulary in class.

The main difficulty in CR as reflected by parents and teachers

As the CUF is very low for Case 9 and Case 10 with ED background, their CR performance deteriorates and the gap of CRA and ERA increases with age.

The information as reflected by parents of the CD and CE backgrounds

After the age of 9, students' CUF decreases due to the gradual increase of English subjects and homework. This is consistent with the results shown in Figures 1(a) and 1(d).

The views from parents and teachers on the relationship between CR and ER

The interference between Chinese and English leads the students to make code switching (from Chinese to English or vice versa) difficult at earlier stage of

of negative competence scores indicates a good consistence to the consensus model.

The social network structure of Figure 4 shows the highest level of consensus among respondents with regards to vocabulary accumulation, and therefore the core factor is vocabulary accumulation. If parents and teachers can successfully guide vocabulary accumulation, the children's reading ability in Chinese and English will greatly improve. It means that the vocabulary accumulation is the critical factor in the development of CRA and ERA.

2.2.4 The situation of observations in Chinese reading

The observations for case 9 and case 10 show that the students could pronounce some Chinese characters but did not understand their meanings due to the lack of CUF. Here, the disconnection of form and meaning in Chinese character recognition is obvious. This hinders their ability to accumulate Chinese vocabulary effectively.

We also found that the students' parents do not attribute their children's poor Chinese reading performance to the low CUF in their daily lives. Therefore both parents and children felt helpless when they witness their GCERTS continued to worsen despite trying their best.

2.2.5 Cross-case comparison analysis

The students in cases 7, 8, 9 and 10 are from the same FLB group. In case 7, the Chinese teacher increased their CUF in order to form holistic connection of 'form-phonetics-meaning' of a Chinese word, so as to effectively accumulate vocabulary, the parents did the same in case 8. Students in the cases 9 and 10 have neither Chinese teachers nor parents do such kind of effort.

The development of CRA is seriously affected by three key factors: CUF, holistic connection of 'form-phonetics-meaning' and vocabulary accumulation. Increasing the CUF and strengthening the holistic connection of 'form-phonetics-meaning' will enhance vocabulary accumulation. The vocabulary accumulation plays an exceptionally important role in the development of CRA. The parents or teachers, who focuses on these key factors, can help students reduce the gap

between CRA and ERA and successfully develop bilingual reading ability in both Chinese and English languages.

2.3 Discussion

2.3.1 The summary of the findings of our research is as follows:

- (1) The results from Chinese reading comprehension show that the students from CD achieve the best results, followed by those from CE group, and subsequently those from ED group.
- (2) The students' Chinese and English reading abilities interfere with each other at the age of 7. Then, 9 years old is the key transition period. Finally, students of all three language backgrounds become better at coordinating the reading comprehension in both English and Chinese at 12 years of age.
- (3) Through social network analysis, the study discovers that the key factor for bilingual reading development is vocabulary accumulation. As evidenced by those cases from ED family, the students have weak holistic connection of 'form-phonetics-meaning' due to little CUF which affected their vocabulary accumulation, therefore their CRA performances are lower.

2.3.2 Discussion of the findings

The reading test results show that for the students who speak more Chinese at home, they will achieve better scores in Chinese reading. Data collected indicates that there is a direct relationship between speaking and reading abilities. Recent researches show that the children's abilities to produce spoken vocabulary can directly impact to their word recognition (Liu, Tao, 2007), and the children's speaking abilities in Chinese directly affect their reading abilities; if their speaking abilities in Chinese is weak by preschool, the level of their reading abilities will lag behind when they reached primary school (Shu, Peng, McBride-Chang, 2008; Hao,

Chen, Dronjic, Shu, Anderson, 2011; Shu & Li, 2014). These research results are consistent with the findings of reading tests in our study.

In the early development of reading ability, CR and ER interfere with each other, and the data of the students from ED group show a significant gap between Chinese and English scores due to seldom using Chinese. The small value of CUF leads to a stagnation of Chinese word and vocabulary accumulation, as well as a disconnection of meaning and character. Han character recognition is the foundation for vocabulary accumulation. In turn, the degree of literacy directly affects the students' reading comprehension ability. Tse (2002) believes that reading and literacy are very closely related – the reading ability can be enhanced by a high degree of literacy. For a Han character to be considered truly “read”, its form, phonetics and meaning need to be identified, and a link need to be established among the three aspects (Yang, 1982; Ke, 1991; Tse 2002). As the impact of vocabulary prediction in reading is higher than in writing, an incomprehensible word reading will definitely affect comprehension (Bai & Dai, 2013). The most effective solution to this problem is to increase the CUF and strengthen the holistic connection of ‘form-phonetics-meaning’ to accumulate Chinese vocabulary effectively. Some suggestions include text discussion, encouragement to read, finger-point-reading, watching video with subtitles, and so on.

Krashen (1989) proposes that the more we read in a second language the greater our vocabulary will be. He believes that it is important to involve reading in the language classroom in order to increase knowledge of the language. It is important for a second language reader to accumulate vocabulary in reading. Our research further shows that vocabulary accumulation is critical in the development of reading ability and the key to enhancing reading ability and literacy. Therefore, teaching reading is mainly on the vocabulary teaching. The interference between ER and CR takes place mainly at the age of 7. After 9 years old, the improvement of ERA can help children understand Chinese vocabulary. ER and its vocabulary accumulation also play an important role in CR for the understanding of Chinese vocabulary.

2.4 Implications

Some important revelations can be drawn from this study. Our bilingual education needs to pay more attention to the bilingual interference between Chinese and English of the students at the age of nine. In addition, strengthening the effectiveness of their bilingual vocabulary accumulation is essential to facilitate the development of their bilingual reading abilities in primary education stage. Future researches can further explore the pedagogy, effectiveness and efficiency of bilingual vocabulary accumulation.

3 Conclusion

The test and questionnaire of PIRLS and PIRLS-Literacy reading comprehension in Chinese and English for 903 students, the semi-structured interviews and structured observations for selected cases have been conducted in this research.

The effects of age, family language background, usage frequency of language on the development of the reading ability have been analyzed. The results show that there is larger interference between English and Chinese on the early development of vocabulary accumulation. The relationship between Chinese reading and English reading progresses from negative to positive with age increase. Nine years old is the critical period of transformation. The critical factor affecting reading ability is vocabulary accumulation. For the teaching of Chinese vocabulary accumulation, teachers can pay more attention to the establishment of a holistic connection of ‘form-phonetics-meaning’, and increase the usage frequency of Chinese, especially for students from English dominant background. The development of bilingual reading ability depends on the development of children’s bilingual vocabulary accumulation and expansion of bilingual mental lexicon.

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Appendix 1: The terms, abbreviations and symbols of this research

Terms	Abbreviation / Symbol
Family language background	FLB
Chinese dominant	CD
Bilingual in Chinese and English	CE
English dominant	ED
Chinese reading ability	CRA
English reading ability	ERA
Critical case sampling	CCS
Maximum variation case sampling	MVCS
Simple linear regression model	SLRM
Holistic connection of ‘form-phonetics-meaning’	HCFPM
Chinese reading	CR
English reading	ER
Gap between Chinese and English reading test scores	GCERTS
Daily usage frequency	DUF
Usage frequency of Chinese	CUF
Usage frequency of English	EUF
Gap of the daily usage frequency between Chinese and English	GCEDUF
Beta coefficient	β

小学生在双语阅读测试中的表现及其相关因素分析

胡向青、陈志锐、林伟业、谢锡金

摘要

大数据时代和机器学习，推动人工智能的发展，各种语言各类电子阅读平台迅速增长，多语或双语阅读能力变得很重要。新加坡实行双语教育，华族学生拥有中英双语背景，从小就同时进行中英文阅读教育。在他们中英双语阅读能力发展中，什么因素起重要作用呢？我们试图对不同年龄和不同家庭语言背景的新加坡华族学生进行阅读测试和问卷调查，据此对关键案例抽样学生的家长和老师进行访谈，并观察了最大差异案例抽样学生的中文认读情况，进一步分析影响中英文阅读能力发展的关键因素，就是词汇积累。研究发现早期阅读能力发展阶段存在中英干扰，且随年龄增长而减弱，九岁是关键转折期。增加学生中文词汇的使用，有利于改善中英文阅读的关系，促进他们中英文阅读能力的平衡发展。

关键词：英文 双语 阅读能力 词汇积累

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