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ROLES OF CHINESE READING PROFICIENCY, VOCABULARY KNOWLEDGE, AND METACOGNITIVE KNOWLEDGE IN ENGLISH AS A FOREIGN LANGUAGE READING COMPREHENSION

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ABSTRACT

This study examines the functions of linguistic and non-linguistic knowledge in learning to read English as a foreign language among Taiwanese students in secondary education. Data consisted of two vocabulary tests, two reading comprehension tests, and two questionnaires concerning strategy use for reading Chinese as a first (L1) and English as a second/foreign (L2; FL) language. The results show that knowledge of L2 lexicons acts as a key player while metacognitive knowledge plays a secondary one in promoting L2 reading comprehension. With the increase of vocabulary knowledge, the effect of L1 reading proficiency emerges as a salient factor influencing L2 reading comprehension.

Key Words: bilingualism, reading comprehension, vocabulary knowledge, metacogntion, English as a foreign language

INTRODUCTION

This study aims to investigate the extent of the relationship between reading Chinese as a first language (L1) literacy experience and reading English as a second/foreign language (L2; FL) among adolescents in Taiwanese secondary education. Not only does L1 literacy experience have a lasting impact on the development of the L2, but it also modifies processing procedures in a systemic manner for the extraction of print information in an L2, as Koda (2007) postulates. L2 reading is described as a dual-language processing system that combines L1 and L2 reading resources (Koda, 2005 & 2007). This dual-language system is characteristically 'hybrid' (Grabe, 2009), 'dynamic' (de Bot, Lowie, & Verspoor, 2007), and 'crosslinguistic' (Koda, 2005 & 2007). For the past

four decades, the relationship between L1 and L2 reading development has been examined from the perspective of the following four propositions: the Reading Universals Hypothesis (Goodman, 1970), the Developmental Interdependence Hypothesis (also known as the Common Underlying Proficiency Hypothesis) (Cummins, 1979a, 1979b, & 2000), the Language Threshold Hypothesis (Alderson, 1984), and the Short Circuit Hypothesis (Clarke, 1980).

Goodman (1970) proposed that "the essential characteristics of the reading process are universal" (p. 103). The ways in which one reads an L2 resemble those in which one learns an L1. Subsequently, Cummins (1979a & 1979b) posits a common underlying proficiency that supports both L1 and L2 language learning. In view of these, the transfer of L1 skills to L2 reading development is characteristically automatic. L1 proficient readers are expected to make good progress in acquiring literacy in their L2. Some second language researchers, such as Alderson (1984), Bialystok (2001), Clarke (1980), and Koda (2005), have questioned the assumption of automatic transfer across languages. "Good first-language readers will read well in the foreign language once they have passed a threshold of foreign language ability," postulated by Alderson (1984, p. 4). However, what constitutes a threshold level of L2 reading competence remains a pressing puzzle to be solved.

In both L1 and L2 reading research it has been claimed that vocabulary knowledge can serve as a predictor for reading comprehension (e.g., Nagy & Scott, 2000; Nassaji, 2003; Nation, 1990, 2001; Qian, 2002; Qian & Schedl, 2004). "Learning to read in a second language centrally involves learning words," as contended by Grabe and Stoller (1997, p. 119). Knowledge of word meaning has been correlated with reading comprehension, and the correlation coefficients were in the range of 0.3 and 0.8 in all of this research (e.g., Davis, 1942, 1968; Haynes & Carr, 1990; Schoonen, Hulstijn, & Bossers, 1988; Spearritt, 1972; Sternberg & Powell, 1983; van Gelderen, Schoonen, & de Glopper, 2004; Wang, Cheng, & Chen, 2006). Schoonen and his colleagues (1998) stated that vocabulary knowledge is one of the prominent factors contributing to reading comprehension both in L1 (i.e., Dutch) and L2 (i.e., English). Similar findings have been reported in the studies of Dutch and English bilingual/multilingual adolescent readers (e.g., van Gelderen, et al., 2003; van Gelderen, et al., 2004; van Gelderen, Schoonen, de Glopper, & Stoel, 2007). A moderate correlation (r = 0.37) between vocabulary knowledge and reading comprehension was reported in the study of Taiwanese

college students learning English as a foreign language (Haynes & Carr, 1990). The extent to which vocabulary knowledge is associated with reading comprehension among secondary students learning Chinese as a first language and English as a second/foreign remains unexplored thus far.

In addition to vocabulary knowledge, a reader's metacognitive knowledge is another factor associated with reading comprehension across languages. Flavell (1979) describes *metacognition* as "knowledge and cognition about cognitive phenomena" (p. 906). A reader knows what a given reading strategy is (i.e., "knowing what"), how to perform it in a reading task (i.e., "knowing how"), why and when the strategy is used ("knowing why and when"). Grabe and Stoller (2002) refer to metacognitive knowledge as a fundamental way of understanding a reader's explicit and conscious use of reading strategies, thereby enabling one to plan, regulate, and monitor comprehension. Accordingly, strategic reading can be characterized as deliberate, goal-oriented, and reader-initiated (Chamot & El-Dinary, 1999; Paris, Waski, & Turner, 1996; Rubin, 1987). "Students without metacognitive approaches are essentially learners without direction or opportunity to review their progress, accomplishments, and future directions," as O'Malley and her colleagues (1985, p. 561) posited.

For more than two decades, a great deal of research has pointed out the substantial impact of metacognition on learning to read one's first, or second/foreign language, or both (e.g., Baker & Brown, 1984; Paris, et al., 1996; Perfect & Schwartz, 2002; Schoonen, et al., 1998; Sheorey & Mokhtari, 2001; Yau, 2005, 2009a; Zhang & Wu, 2009). A comparative study of native and non-native adult readers of English conducted by Sheorey and Mokhtari (2001) showed that all of the readers were similar in their perceived use of cognitive strategies, which were defined as "deliberate actions readers take when comprehension problems develop" (p. 431). Both L1 and L2 readers with high reading abilities reported using more cognitive and metacognitive strategies than those with low reading abilities did. In addition, support strategies with the purpose of assisting text comprehension (e.g., using a dictionary, taking notes, and highlighting information in the text) were found significant for L1 readers with a high reading ability, as well as for L2 readers with both high and low reading abilities (Sheorey & Mokhtari, 2001). These findings align with those found in the studies of adolescent readers of Chinese as a first language and English as a foreign language (Yau, 2009a; Zhang & Wu,

2009).

Yau (2009a) investigated Taiwanese high school students' knowledge and application of reading strategies across languages. The adolescents reported using metacognitive and cognitive strategies more often when reading Chinese (L1) than when reading English (FL). Yet they reported using more support strategies for L2 reading comprehension than for L1. These findings showed similarities and differences in the use of reading strategies across languages. In addition, the adolescents' self-reported uses of strategies for reading English texts were highly correlated with those for reading Chinese texts (r = 0.73), suggesting an interdependent relationship between them. More importantly, there was a positive and modest correlation between metacognitive awareness of strategy use and L2 reading comprehension (r = 0.23); the strategies significantly associated with L2 reading comprehension were characteristically cognitive and supportive (Yau, 2009a). Similarly, Zhang and Wu (2009) revealed a significant interaction between metacognitive awareness of strategy use and English as a Foreign Language (EFL) proficiency among high school students in China. Those with higher EFL proficiency reported significantly higher frequency in their use of reading strategies than those with lower EFL proficiency. Taken as a whole, these findings put forward the extent of skills transfer across languages as well as the impact of language proficiency on metacognitive awareness with respect to strategic reading. As Alderson (1984) has contended, the ability to apply reading strategies acquired from reading L1 to reading L2 tasks is prominent for L2 reading comprehension.

Aside from vocabulary knowledge and metacognitive knowledge, proficiency in one's first language is another prominent component involved in L2 reading comprehension (Cummins, 1991). Thus far, findings generated from this line of inquiry have been inconclusive. Tregar and Wong (1984) reported a positive and moderate correlation between Chinese (L1) and English (L2) reading comprehension among elementary school students (r = 0.4, p < 0.01), but a low and statistically insignificant relation (r = -0.14, p > 0.5) between them among middle school students. In this study, the subjects were drawn from two hundred Cantonese-speaking students enrolled in American schools from Grade 3 through 8. These students received a relatively similar amount of reading instruction in their two languages each day. It is important to note that the medium of instruction for academic subjects for the middle school students was primarily based on their English proficiency (Tregar &

Wong, 1984). That is to say, the subjects would have received merely one period of Chinese language instruction once they had passed the threshold of English proficiency, which was established by the schools which the subjects attended. Whether this factor could have had an impact on L1 reading development among the middle school students was not explicitly scrutinized. Further examination of the interaction between L1 and L2 reading comprehension in particular among adolescent readers has been called for (Tregar & Wong, 1984). Yau (2009b) reported a positive and moderate relation between Chinese and English literacy performance ($n = 379$, $r = 0.4$, $p < 0.001$) among Taiwanese senior high school students. Similarly, Haynes and Carr (1990) indicated a positive and modest connection between Chinese and English reading comprehension among college students in Taiwan ($n = 60$, $r = 0.23$, $p < 0.05$). The findings from the latter two studies are indicative of a reciprocal relationship between comprehension in Chinese as a first language and comprehension in English as a foreign language.

There are two reasons why the current study is important. It has been hypothesized that linguistic knowledge of a second language along with literacy knowledge in the first language are two prominent factors that can contribute to the acquisition of a high level of reading comprehension in a second language (Durgunoğlu, 1997; Koda, 1994). Previous research has shown a positive effect of Chinese language reading experience on EFL acquisition, in particular among students in high school (Yau, 2009b) and college (Haynes & Carr, 1990). Nevertheless, Tregar and Wong (1984) reported a minor effect of first language proficiency on second language reading acquisition among English language learners of Chinese in middle schools. The extent to which first language reading proficiency has an impact on second/foreign language reading deserves further investigation, in particular for younger adolescents in secondary education. Additionally, Laufer (1997) hypothesized that "the level at which good L1 readers can be expected to transfer their reading strategies to L2 is 3,000 word families, or about 5,000 lexical items" (p. 24). That is to say, strategic transfer will be impeded if one's knowledge of L2 words is below 3,000 word families (or 5,000 lexical items). Thus far, very few studies have examined the roles of linguistic knowledge (i.e., vocabulary knowledge) and nonlinguistic knowledge (i.e., metacognitive knowledge) in first and foreign language reading comprehension, in particular regarding two languages which are orthographically distinctive in nature, that is, Chinese, with a logographic script and English, with an alphabetic one.

This study, in response, intends to look into the scope of the associations among three salient factors in the reading process, namely, vocabulary knowledge, metacognitive knowledge concerning strategy use, and reading comprehension across two languages and two initial stages of learning to read a foreign language. The questions that frame this study are as follows:

1. To what extent are vocabulary knowledge, metacognitive knowledge concerning the use of reading strategies, and reading comprehension associated with each other across languages and ages?
2. To what extent do vocabulary knowledge, metacognitive knowledge concerning the use of L2 reading strategies, and L1 reading proficiency contribute to L2 reading comprehension?

METHOD

The following section discusses the selection of the participating students, use of instruments, procedures of administration, scoring, methods of data analysis and interpretation.

Participants

The participating students were drawn from two grade levels: the second year of junior high school education (Grade 8; G8); and the sophomore year of high school education (Grade 11; G11). The rationale in selecting these two grade levels was to explore the extent to which first language reading experience and L2 linguistic knowledge had an impact on two phases of learning to read a foreign language in Taiwanese secondary education. The selection of participants was guided by the following procedure. Permissions from each school and its homeroom teachers were initially sought. Three junior and four high schools, situated in working- and/or middle-class communities in the northern region, participated in this study. Next, the students in the participating schools were invited to take part in the study. The G8 participants were drawn from seven classes from the three participating schools; three classes were deemed to be higher performing and the rest lower performing on the basis of the overall academic performance of their schools. Additionally,

the G11 participants were selected from both a precollege and a vocational program provided by the participating schools. Those in the precollege program were considered as higher performing and those in the vocational program as lower performing. Among the four participating high schools, one admitted relatively high achieving students in its precollege program. Initially, 245 G8 and 239 G11 students participated. The group of participants that completed all of the tasks required for this study included 243 eighth graders (108 male and 135 females), and 207 eleventh graders (138 males and 69 females). The ranges of their ages were 14.0-14.9 years for the eighth graders and 17.0-17.9 for the eleventh, respectively.

Most children in Taiwan learn to speak, read, and write Mandarin from the first grade in spite of the fact that one or more of dialects of Chinese, such as Min and Hakka, may be widely spoken in their households. All Taiwanese who are literate use the same writing system, regardless of their first spoken dialect or language. In other words, learning to read and write Mandarin Chinese is the students' first literacy experience, which is officially provided in first grade in Taiwanese schools. Roughly speaking, the participating students in this study have practiced the written form of Chinese for seven to ten years. In a similar vein, they received English literacy instruction offered by their schools two periods a week for three years for G8 students and six for G11 ones. English, both spoken and written forms, is regarded as an L2 and an FL, primarily because it is acquired after Mandarin Chinese and for contact outside the community. The length of EFL learning at school and/or private language institutions among the G8 participants ranged from three to seven years, and the length among the G11 students was from seven to ten. It is noted that over 90 percent of the participants acknowledged having received additional English literacy support offered either by their schools, private educational institutions or both prior to this study.

Instruments Used

The instruments used for each grade consisted of two vocabulary and two reading comprehension tests, one each for Chinese (L1) and English (FL); along with two surveys, one each for the use of L1 reading strategies and the use of L2 reading strategies. Altogether there were four tests and two surveys. The subsequent section presents the instruments applied in this study:

Assessing word knowledge

Following Qian's (2002) and Qian and Schedl's (2004) model, two vocabulary tests for each grade were designed to gauge the students' depth and breadth of Chinese word knowledge along with that of English word knowledge in a multiple-choice format. Each test contained three components, namely, synonyms, antonyms, and collocations. The selection of vocabulary items — both Chinese and English words — was based on the curriculum benchmarks of the language arts for Grades 7-12 established by the Ministry of Education in Taiwan, Republic of China (n.d.). The English words on the G8 test were taken from a list of the 1,000 most frequent lemmas, published by the Ministry of Education in Taiwan (2004) as a benchmark for English language arts. Similarly, those on the G11 test were mostly the 3,000 most frequent lemmas, which are in accordance with word frequencies in British and American English (e.g., Davies & Gardner, 2010; Johanson & Hofland, 1989; Hofland, 1982). A lemma is described by Nation and Meara (2002) as "a set of related words that consists of the stem form and inflected that are all the same part of speech" (p. 36).

All the tests were piloted prior to being administered to the participating students. Rasch analysis, performed using WINSTEPS (Linacre, 2006), was employed to estimate item difficulty and student ability. The G8 Chinese vocabulary test contained 30 items and the G11 one 33. The English vocabulary test for both the G8 and G11 students included 30 items each. Overall, these items showed acceptable levels of 'fit'; that is to say, the scores of the items were in the range of the mean ± twice the standard deviation of the mean square statistic (McNamara, 1996, p. 181). The internal consistency of the tests measured by Cronbach's alpha ranged from 0.78 to 0.84.

Assessing reading comprehension

The procedures for assessing reading comprehension were similar to those for assessing vocabulary knowledge. Each reading comprehension test, generally speaking, contained three levels of reading proficiency: the first level referred to understanding information explicitly stated; the second to understanding information implicitly stated, along with ideas woven into the content; and the last to understanding the main point or important information in the text, recognizing a writer's purpose, tone,

and mood, and synthesizing and evaluating the information read. The difficulty of the passages and the accompanying questions increased with grade level. It was assumed that the readers' cognitive processing loads increase with maturation and reading experience (Alexander & Fox, 2011).

The test each involved the reading of a number of narrative and expository texts of different lengths. Six Chinese and four English passages were selected for the G8 students, and nine Chinese and six English passages for the G11 students. Among them, the same four Chinese and three English passages appeared in the G8 and G11 tests, respectively. The lengths of the Chinese passages chosen for the G8 students ranged from 20 to 820 characters and those for the G11 students from 20 to 620 characters. In the G8 Chinese test, only one passage was written in a classical literary style and the rest were written in contemporary literary styles. Four were written in classical literary styles in the G11 test. A text written in a classical literary style of Chinese is deemed challenging to modern Chinese readers partially because of its concise and compact use of language. The lengths of the passages in the G8 English test ranged from 74 to 252 words and those in the G11 test from 74 to 268. Infrequent words such as 'glare,' 'dazzle,' 'insect,' and 'mosquitoes' were provided with Chinese equivalents in the G8 test only. The rationale for providing the L1 translation equivalent is that the high school entrance examinations held in Taiwan, generally speaking, offer this additional support for examinees.

In addition to the selected passages, there were 15 items in the G8 and 10 items in the G11 English test, respectively, designed to measure understanding at a sentence and discourse level. In total, there were 32 items each for the grade 8 Chinese and English reading comprehension tests, respectively, whereas there were 31 items for the grade 11 Chinese reading comprehension test and 35 for the English test. Similar to the vocabulary tests, these items showed acceptable levels of 'fit.' The internal consistency of the tests as measured by Cronbach's alpha ranged between 0.8 and 0.9.

Assessing metacognitive awareness of reading strategies

Two relatively similar sets of questionnaires were administered to the participating students; one was mostly taken from the Metacognitive Awareness of Reading Strategies Inventory (MARSI) and the other was

the Survey of Reading Strategies (SORS). The MARSI was designed as a tool for measuring native readers' awareness and perceived use of reading strategies as they read academic or school-related materials (Mokhtari & Reichard, 2002), and SORS was specifically used for measuring ESL students' strategy use (Mokhtari & Sheorey, 2002). The rationale for the selection of these two was their reasonably comprehensive description of content in respect to a reader's metacognitive knowledge about L1 and L2 reading.

Moreover, statements concerning the uses of mental translation in the reading process were added to the original MARSI and SORS, respectively. The term *mental translation* in this study specifically refers to intra-language (i.e., paraphrasing) and inter-language translation (English and Chinese). Kern (1994) asserted that mental translation is a processing strategy that assists readers in staying focused long enough for meaning to be integrated so that they are provided with a sense of accurate comprehension, particularly when reading a challenging text in second language. In addition, Yau (2012) reported a positive association of mental translation with reading classical Chinese as a first language and English as a foreign language among Taiwanese adolescent readers. Texts written in the classical literary styles on average made up 25% of the Chinese language arts curriculum for junior high school students (Grades 7-9), and 65% for high school students (Grades 10-12), according to the Ministry of Education in Taiwan, Republic of China (n.d.). The participants in the current study were asked how often they paraphrased when reading texts written in classical literary styles of Chinese and how often they mentally translated when reading English texts, for instance.

Overall, three types of reading strategies were included in the survey: global, cognitive, and support. The global strategies involved those oriented toward an inclusive analysis of text; the cognitive strategies aimed to solve problems when text becomes difficult to read; and the support strategies involved using outside reference materials, taking notes, writing a summary, and the like (Mokhtari & Reichard, 2002; Mokhtari & Sheorey, 2002). In total, there were thirty-three items in the L1 survey, of which thirteen were characteristically global strategies, nine cognitive, and eleven support, respectively. In the L2 survey, there were thirty-two items, of which thirteen were global strategies, eight cognitive, and eleven supportive, respectively. All of the items on the L1 and the L2 surveys were translated into the participating students' first language, namely, Mandarin Chinese. Each item used a five-point scale ranging from 1 ("I

never or almost never do this") to 5 ("I always or almost always do this"). As proposed by Oxford and Burry-Stock (1995), three types of usage were identified: high (mean of 3.5 or higher), medium (mean of 2.5 - 3.4), and low (2.4 or lower).

Administration, Scoring, and Interpretation

The procedure for administrating the tests and questionnaires, methods of scoring, and data analysis and interpretation are presented and discussed in the subsequent section.

Administration of the tests and questionnaires

The procedure for the administration of the reading tests was identical to that for the strategy surveys. The purpose of the inventory and the administration procedure were explained in students' familiar language, namely, Mandarin Chinese. Each reading test was administered as a group test to the whole class. The time for the vocabulary test was approximately 20 minutes, one hour for each reading comprehension test, and between 12 and 15 minutes for the survey.

In addition, there were two separate test sessions on different days for the two grades. The following outline delineates the steps taken when administering the tests and surveys: (1) copies of the inventory were distributed to each student; (2) they were requested to provide identifying information (e.g., grade level, gender, dialect/language spoken at home) in the space provided; (3) the directions were read aloud; (4) the explanation of the response options was given so that the students understood the rating scale; (5) they were asked if anyone had any questions about any aspect of the inventory; (6) they were instructed to read each statement carefully and to circle the appropriate responses; and (7) they were encouraged to work at their own pace.

Scoring

First, the scores obtained for each test were transferred to the scoring sheet. After the individual scores were recorded, they were added up in each column to obtain a total score. The scores for these tests were the number of the test items answered correctly. Skipped items in a test were scored as "incorrect." Dissimilarly, a skipped item in the reading strategy

survey was replaced by the mean of the cohort group. Tests that were missing more than one third of the items were excluded from the analyses. Students who did not participate in all of the four tests and complete the designated surveys were excluded from analyses.

Statistical procedure and analysis

Various approaches were taken to analyze the data. First of all, means, standard deviations, and score ranges were computed and examined. Next, correlation analyses were employed to obtain a statistical estimate of the strength of the relationships between the variables. As a rule of thumb, correlations smaller than 0.3 are deemed as low or weak, those in the range of 0.4 to 0.6 as moderate, and those greater than 0.7 as strong or high (Bryman & Cramer, 2004). Third, the data were subjected to a two-factor ANOVA to determine if there was a difference in self-reported frequencies of strategy use across languages concerning grades and reading comprehension performances. Multiple comparisons were performed using the Tukey procedure, and a significant level of 0.05 was set up.

Fourth, this study employed path analysis in a Structural Equation Model (SEM) framework by using LISREL 8 (Jóreskog & Sórbom, 1993). Path analysis is believed to allow evaluation of theoretical relationships among a set of variables (Wright, 1921, 1934, 1960). This study specifically looked into the relations between L2 reading comprehension (L2RC; a dependent variable or an endogenous variable), and L2 vocabulary knowledge (L2VK), metacognitive knowledge concerning the use of L2 reading strategies (L2MK), and L1 reading proficiency (L1RP) measured by understanding meanings from a word to a text. L2VK, L2MK, and L1RP were independent variables or exogenous variables. The analysis of the relationships was based on the model depicted in Figure 1. In this model, it is assumed that L2 vocabulary knowledge, metacognitive knowledge, and L1 reading proficiency each contribute to L2 reading comprehension.

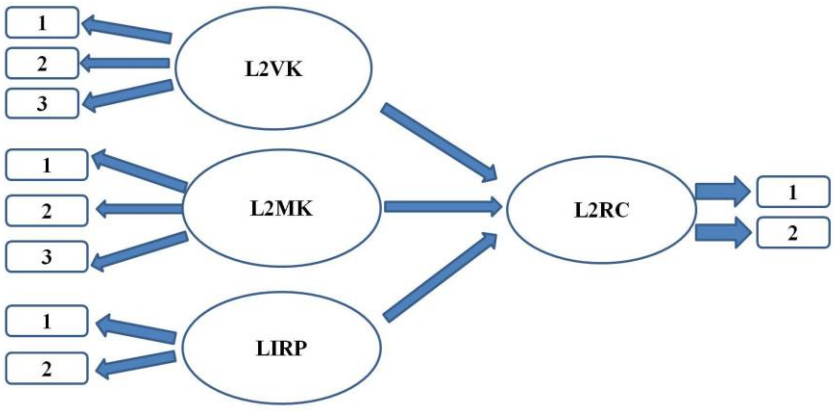

Figure 1: The Hypothesized Path Diagram

Last, but equally important, several measures were applied to assess the overall model fit. First of all, the normed chi-square (X^2), degree of freedom (df), and p-value are reported. An X^2/df ratio of less than 3 indicates a good fit to the data. In addition, the following goodness-of-fit statistics were also used to evaluate the fit of the models: the goodness-of-fit (GFI), comparative fit index (CFI), the Root Mean Square Error of Approximate (RMSEA), and the Standardized Root Mean Square Residual (SRMR). The GFI is an index of the relative amount of observed variance and covariance accounted for by the model, and the CFI assesses how much better the model fits to the hypothesized model. According to Hoyle and Panter (1995), 0.90 is the critical value for the overall fit indices for GFI and CFI. The RMSEA refers to the lack of fit, per degree of freedom, of the model to the population covariance matrix. A cut-off value close to 0.06 for RMSEA indicates a good fit (Hu & Bentler, 1995). In addition to the RMSEA, the SRMR is the average of the standardized residual of the predicted covariance matrix from the observed covariance matrix. A cut-off value close to 0.08 indicates a good fit (Hu & Bentler, 1995).

RESULTS

Descriptive Statistics

Table 1 illustrates descriptive statistics including means, standard deviations, ranges, and reliabilities for the following variables: L2 vocabulary knowledge (L2VK), L2 reading comprehension (L2RC), metacognitive knowledge of the use of L2 reading strategies (L2MK), L1 vocabulary knowledge (L1VK), L1 reading comprehension (L1RC), L1 reading proficiency (L1RP; a combined score of L1VK and L1RC), and metacognitive knowledge of the use of L1 reading strategies (L1MK).

Table 1. Descriptive Statistics of Vocabulary Knowledge, Metacognitive Knowledge, and Reading Comprehension Across Grades and Languages

	Grade 8				Grade 11			
Variables	M	S.D.	range	α	M	S.D.	range	α
L2VK	15.15	6.09	1 - 30	0.84	10.24	5.05	1 - 26	0.78
L2RC	13.30	6.40	2 - 31	0.85	19.29	7.81	1 - 35	0.90
L2MK	3.14	0.80	1 - 5	0.96	3.22	0.68	1 - 5	0.93
L1VK	20.59	4.94	7 - 30	0.80	18.50	5.13	5 - 30	0.78
L1RC	20.67	6.58	5 - 31	0.89	22.68	4.36	4 - 30	0.79
L1RP	41.26	10.52	16 - 59	0.91	41.18	8.40	11 - 59	0.83
L1MK	3.10	0.67	1 - 5	0.93	3.31	0.59	1 - 5	0.93

Note. Values in L1MK and L2MK are average scores.

Relations Between the Variables Across Languages and Ages

Table 2 displays correlations among the six variables, including

L1VK, L2VK, L1RC, L2RC, L1MK, and L2MK. It is worth noting that the correlations between the variables were significantly correlated with each other, and that they ranged from low to high (from 0.15 to 0.80).

Table 2. Correlations of Variables in Grade 8 (above the diagonal) and in Grade 11 (below the diagonal)

	L1VK	L1RC	L1MK	L2VK	L2RC	L2MK
L1VK	1	0.66***	0.21***	0.54***	0.45***	0.31***
L1RC	0.57***	1	0.32***	0.49***	0.50***	0.33***
L1MK	0.22**	0.23**	1	0.25***	0.27***	0.78***
L2VK	0.48***	0.36**	0.15*	1	0.75***	0.35***
L2RC	0.50***	0.48***	0.16*	0.61***	1	0.39***
L2MK	0.23**	0.20**	0.72***	0.35***	0.38***	1

*p < 0.5. ** p < 0.01. *** p < 0.001

Among the relation between variables, the relations between L1MK and L2MK were the highest (r = 0.78 in G8 and 0.72 in G11). More specifically speaking, the correlations for the three sub-categories of strategies, i.e., global, cognitive, and support, across languages were 0.75, 0.74, and 0.70 each in G8, whereas they were 0.70, 0.63, and 0.67 each in G11. All of the correlations reached a significant level ($p < 0.001$). These findings suggest a fairly strong link between the self-perceived use of L1 and L2 reading strategies. Correspondingly, the relations between vocabulary knowledge and reading comprehension were the second highest across languages and grade levels. The correlation coefficients ranged from high to moderate; the highest relation appeared in Grade 8 (r = 0.75, $p < 0.001$). More importantly, moderate relations between L1VK and L2VK in both grades (r = 0.54 in G8 and r = 0.48 in G11) were uncovered. In a similar fashion, there was also a moderate relation between L1RC and L2RC each in both grades (r = 0.5, $p < 0.001$ in G8; r = 0.48, $p < 0.001$ in G11).

Interactions Between Metacognitive Knowledge and Reading Comprehension

The result of a two-way ANOVA shows that there was no interaction effect for the grades and the levels of reading comprehension proficiency across languages. In other words, there was no interaction effect between the two grades and the three levels of Chinese reading comprehension proficiency in the self-perceived use of L1 reading strategies, $F(2, 444) = 0.84$, $p = 0.43$. Neither was there an interaction effect between the two grades and the three levels of English reading comprehension proficiency in the self-perceived use of L2 reading strategies, $F(2, 444) = 1.36$, $p = 0.26$. On the contrary, the main effect for the three levels of reading comprehension proficiency was significant in the self-perceived use of reading strategies across languages. That is to say, those with the highest reading ability in Chinese reported a higher frequency of reading strategy use than those with intermediate and lowest reading abilities in Chinese, $F(2, 444) = 17.47$, $p < 0.001$, partial $\eta^2 = 0.05$. In a similar fashion, those with the highest reading ability in English also reported a higher frequency of use of reading strategies than those with intermediate and lowest reading ability in English, $F(2, 444) = 39.35$, $p < 0.001$, partial $\eta^2 = 0.15$. Additionally, the main effect for grade level was also significant in the self-perceived use of strategies for the reading of Chinese texts, $F(1, 444) = 9.68$, $p = 0.002$, partial $\eta^2 = 0.05$, and yet the main effect for grade level was not significant in the self-perceived use of strategies for the reading of English texts, $F(1, 444) = 1.77$, $p = 0.18$. The Grade 11 students reported a higher frequency of strategy use than Grade 8 students in their reading of Chinese texts, and the difference was statistically significant. Although Grade 11 students also reported a higher frequency of strategy use in their reading of English texts than Grade 8 students, the difference did not reach a significant level.

Effects of L2VK, L2MK, and L1RP on L2RC

A summary of the total and direct effects of L2VK, L2MK, and L1RP each on L2RC are displayed in Table 3. The direct effects of the three factors on L2 reading comprehension in each grade level are shown in Figure 2 and Figure 3. Path analysis shows that the direct effects of L2VK on L2RC were robust and significant in both grades (ß = 1.00, $t = 10.68$ in G8; ß = 0.47, $t = 4.45$ in G11). Its effect on the performance of L2RC slightly declined among the students in Grade 11. A direct path linking

L2MK with L2RC emerged as significant as well in both grades (ß = 0.14, *t* = 2.68 in G8; ß = 0.14, *t* = 2.08 in G11).

Table 3. Total and Direct Effects of L2VK, L2MK, and L1RP on L2RC

Model	Path Diagram	Total Effect	Direct Effect	t value
Grade 8	L2VK → L2RC	0.99 (100%)	1.00 (100.7%)	10.68
	L2MK → L2RC	0.09 (100%)	0.14 (56%)	2.68
	L1RP → L2RC	0.09 (100%)	-0.05 (-56%)	-0.55
Grade 11	L2VK → L2RC	0.52 (100%)	0.47 (91%)	4.45
	L2MK → L2RC	0.38 (100%)	0.14 (36%)	2.08
	L1RP → L2RC	0.42 (100%)	0.35 (84%)	3.47

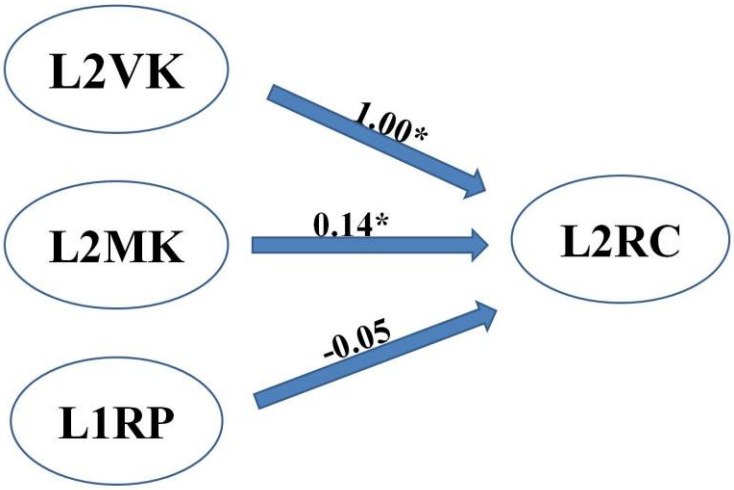

Figure 2: Grade 8 Path Diagram

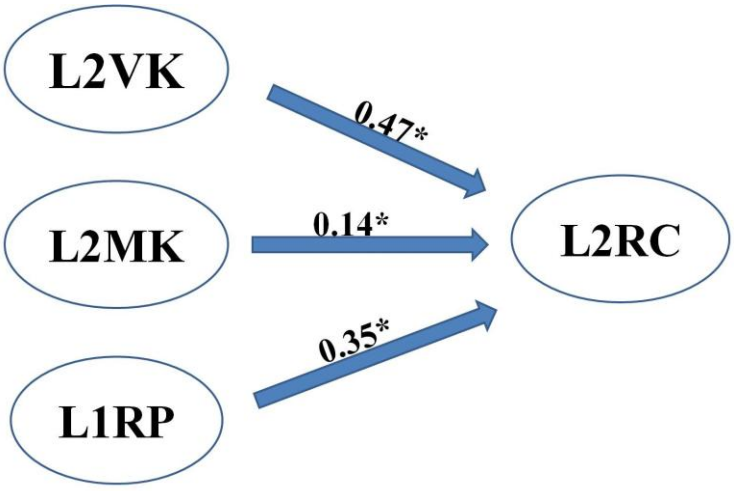

Figure 3: Grade 11 Path Diagram

In addition to vocabulary knowledge and metacognitive knowledge, L1 reading proficiency, which was measured by vocabulary knowledge and text comprehension, was significantly and moderately correlated with L2 reading comprehension across grades (r = 0.54, p < 0.001 in G8; r = 0.56, p < 0.001 in G11). Nonetheless, it is noted that the direct effect of L1RP on L2RC in Grade 8 was close to zero (ß = -0.05, t = -0.55). This suggests a suppressor effect of L2VK and L2MK on the L1RP in this particular cohort. To further scrutinize the occurrence of the suppressor effect, the L2VK, which appeared to have the highest effect on L2RC, was excluded from the designated Grade 8 model. The results show that the direct effect of L1RP on L2RC considerably increased (ß = 0.61, t = 7.21) in the Grade 8 cohort. Additionally, the direct effect of L1RP on L2RC was shown to be significant among older and more experienced readers, in this case, the Grade 11 students (ß = 0.35; t = 3.47). Altogether the three variables—L2VK, L2MK, and L1RP—explain 100% of the variance in L2RC in the Grade 8 cohort, while explaining 67% of that in the Grade 11 cohort. It is worthwhile noticing that the two variables made up of L2MK and L1RP accounted merely for 59% of variance in the L2RC as L2VK was excluded from the analysis of the model hypothesized for Grade 8 (see Figure 1).

Table 4 illustrates the results of the assessment of goodness of fit. The model for each of the two grade levels appears to be adequate to describe the data under investigation. The data fit indexes: the chi-square/df ratios were each smaller than the usually recommended value of 3 (i.e., 1.44 in G8 and 1.52 in G11); the p-values were 0.06 and 0.04, respectively. Additionally, the other indexes indicated very good fit (i.e., SRMR < 0.08; RMSEA < 0.07; CFI > 0.9; and GFI > 0.9).

Table 4. Fit Indexes for Grade 8 and Grade 11 Models

	Model Fit Indexes					
Models	X^2	p-value	SRMR	RMSEA	GFI	CFI
Grade 8	41.80	0.06	0.028	0.043	0.97	0.99
Grade 11	44.16	0.04	0.034	0.050	0.96	0.99

Note: The degree of freedom for both models is 29.

DISCUSSION AND IMPLICATIONS

This study looked into the functions of linguistic knowledge and non-linguistic knowledge in learning to read a foreign language among adolescent readers enrolled in Taiwanese secondary education. The salient findings are extensively discussed in the following section. The outline of these findings includes prominent functions of vocabulary knowledge and metacognitive knowledge across languages and grade levels, along with the impact of first language competence on second language reading comprehension. Finally, the limitations of and implications for this study are also addressed.

Functions of Vocabulary Knowledge

Positive and moderate correlations between Chinese and English vocabulary knowledge—measures of synonyms, antonyms, and collocations—are indicative of a cross language transfer of associative learning skills such as forming analogies, recognizing similarities, and identifying distributional tendencies. These associated learning skills are deemed crucial for developing word recognition and reading efficiency (Grabe, 2009). Knowledge of Chinese characters or words is correlated with that of English words in spite of orthographical differences between the two languages (non-alphabetical script versus alphabetical script). Experience and knowledge acquired from learning words in one's first language appear to have a positive association with those learned in a second language. These findings are in line with those found in studies of bilingual children of Chinese and English, either flowing from L1 to L2 or from L2 to L1 (e.g., Gottardo, Yan, Siegel, & Wade-Woolley, 2001; McBride-Chang & Ho, 2005; Wang, et al., 2006). They provide a piece of evidence to support the linguistic interdependent hypothesis (Cummins, 1979a, 1991).

Furthermore, L2 vocabulary knowledge serves as a key predictor for L2 reading comprehension. This phenomenon is much more salient among novice EFL readers, namely, Grade 8 students. It is noted that word knowledge in the second/foreign language acts as a relatively dominant force in reading comprehension, in particular for emergent readers. This is evident by a remarkably strong direct effect of L2 vocabulary knowledge on L2 reading comprehension ($\beta = 1.0$) in the Grade 8 cohort. These findings correspond with those reported in second/foreign language acquisition: vocabulary knowledge is a strong

predictor for reading comprehension (Nation, 2001; Qian & Schedl, 2004).

Functions of Metacognitive Knowledge

Aside from the relatively consistent influence of vocabulary knowledge, the functions of metacognitive knowledge of strategy use in L2 reading comprehension are also consistent among the adolescents at the two initial stages of learning to read a foreign language. The analyses of correlations show a positive and modest relationship between the self-perceived use of reading strategies and reading comprehension across languages and ages. The associations found between the metacognitive knowledge of strategy use and L1 reading comprehension are in line with those reported in the studies of first language readers of English (e.g., Baker & Brown, 1984; Paris, et al., 1996), those of Dutch (e.g., Schoonen, et al., 1998; van Gelderen, et al., 2004), and those of Chinese (e.g., Yau, 2005, 2009b). Additionally, path analysis shows a direct effect of metacognitive knowledge on L2 reading comprehension in both grades. Again, this is evidence of the impact of metacognitive knowledge about strategic reading on L2 reading comprehension. The link found between metacognitive knowledge and L2 reading comprehension is correspondent with those reported in the studies of Dutch readers learning English as a foreign language (Schoonen et al., 1998; van Gelderen et al., 2003, 2004, 2007), those of Chinese learners of EFL in Taiwan (Yau, 2009a) and China (Zhang & Wu, 2009), respectively, as well as non-native readers of English from the United States (Sheorey, & Mokhtari, 2001). More importantly, relatively strong correlations ($r > 0.7$) were found between metacognitive knowledge about the use of L1 and L2 strategies at both grade levels. The coupling between the self-perceived uses of L1 and L2 reading strategies appears to support Cummins' (1979b) assertion – that first and second cognitive/academic language proficiencies are manifestations of the same underlying dimension.

Functions of L1 Reading Competence

With the growth of L2 vocabulary knowledge, one's linguistic experience and competence developed from learning to read a first language comes into play. Across two grade levels, there are positive and

moderate relationships ($0.4 > r < 0.6$) between L1 and L2 vocabulary knowledge, between L1 and L2 reading comprehension, and relatively strong correlations between self-perceived uses of L1 and L2 reading strategies ($r > 0.7$). More importantly, all of the relationships reach a significant level. The consistent results across age and educational experience are a manifestation of an interdependent relationship between L1 and L2 reading development.

In addition, a direct effect of L1 reading competence, as gauged by understanding a written form of Chinese from a word to a text level, on L2 reading comprehension is salient among the high school students in this study ($\beta = 0.35$, $t = 3.47$). This finding is indicative of the application and contribution of the skills and abilities acquired from understanding meaning from a word to a text in one's first language as one reads a second/foreign language. This phenomenon would have been present with younger EFL readers if the impact of L2 vocabulary knowledge on L2 reading comprehension had been excluded; that is, the direct effect of L1 reading competence on L2 reading comprehension would have become robust ($\beta = 0.61$, $t = 7.21$). Nonetheless, a suppressor effect emerges, which points out the pivotal role that vocabulary knowledge plays in comprehending a foreign language (i.e., English) among the younger readers of Chinese and English in this study.

It is speculated that with a much limited size of L2 word knowledge (i.e., within 1000 word families), one's knowledge and skills developed in first language reading may be undermined when reading a second/foreign language. A low level of language proficiency will "short-circuit" the reader's reading system (Clarke, 1980). In this case, limited L2 vocabulary knowledge appears to short-circuit the L1 reading system possessed by the Grade 8 students. In comparison, the older adolescents (i.e., the high school subjects) appear to have reached an initial threshold of L2 language proficiency so that their L1 reading knowledge and skills can be utilized as they read English texts. These findings support the Short Circuit Hypothesis proposed by Clarke (1980) and the Language Threshold Hypothesis proposed by Alderson (1984).

Limitations and Implications

The current study has some limitations. First of all, the younger participants in this study were provided with an additional support (i.e., L1 translation equivalents for infrequent English words) on the reading

comprehension test. The extent to which such kind of support has an impact on language processing and reading performance needs further examination. Next, many participants reported receiving literacy supports outside of the school context. Factors influencing literacy development within the full context of home, school, and community lives need to be explored as well. It is suggested that the insights to be gained from understanding the contexts in which literacy learning takes place can strengthen a teacher's ability to create a reading program which is culturally and linguistically congruent for second language learners (Yau, 2008). Third, readers' grammatical knowledge was not explicitly measured. Grammatical knowledge, as proposed by researchers such as Alderson (1984), van Gelderen and his colleagues (2004, 2007), is considered influential for reading comprehension. A reader's knowledge of sentence structure in a native and a target language thus should be added in future studies when investigating what else contributes to L2 reading comprehension. Fourth, longitudinal studies on the growth of linguistic and non-linguistic factors (e.g., vocabulary knowledge, grammatical knowledge, and knowledge and application of reading strategies), alongside their contributions to reading comprehension, are called for. Last, but equally important, the instruments used in this study for measuring L1 and L2 strategy use were the revised MARSI and SORS. A more comprehensive measure of strategy use including a variety of genres across differing domains should be devised, as Cromley and Azevedo (2006) have proposed.

In short, this study examined the extent of the relationships among three salient factors influencing second language reading comprehension, namely, vocabulary knowledge, metacognitive use of reading strategies, and first language reading proficiency. At the two initial phases of learning to read a second/foreign language examined in this study, specific linguistic knowledge, i.e., knowledge of L2 lexicons, acts as a key player for L2 reading comprehension. Non-linguistic knowledge i.e., metacognitive knowledge concerning strategy use, likewise plays a secondary role in promoting L2 reading comprehension. It is noted that an individual's ability to transfer knowledge and skills from one language to the other can be constrained by insufficient linguistic knowledge in a target language. With increasing linguistic knowledge in the target language, the L2 reading system possessed by older and more mature bilingual readers develops; in turn, the application of one's first language competence acquired from understanding meanings beyond the

word level can be activated. As Alderson (1984) postulates, knowledge of a target language along with the ability to apply reading strategies acquired from reading L1 to L2 are two influential factors for L2 reading comprehension. As the findings of this study indicate, vocabulary learning and strategic transfer are crucial for second language reading development, and thus effective instruction for promoting linguistic knowledge (e.g., vocabulary and grammar) and strategic transfer (a flow from L1 to L2 or L2 to L1) should be devised, in particular at the early phases of learning, to read a second/foreign language.

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