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Roles of general versus second language (L2) knowledge in L2 reading comprehension

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Abstract

We examined the roles of metacognitive awareness of reading strategies, syntactic awareness in English, and English vocabulary knowledge in the English reading comprehension of Chinese-speaking university students (n = 278). Results suggested a two-factor model of a General Reading Knowledge factor (metacognitive awareness employed during the English reading process) and a Second Language (L2) Specific Knowledge factor (comprising vocabulary knowledge and syntactic awareness) offered the best fit to the data; 87% of the variance in reading comprehension was explained by the two factors together. L2 Specific Knowledge was a stronger predictor of reading comprehension than metacognitive awareness. A multigroup analysis was conducted using structural equation modeling to compare poor-reader and good-reader groups. The correlation between the L2 Specific Knowledge and metacognitive awareness and their relations to reading comprehension was the same across groups.

Keywords: English as a second language, metacognition, vocabulary, syntax, reading comprehension

Over the past decade, English education in China has become an area of interest and widespread concern for educators and researchers (Lam & Chow, 2001; Nunan, 2003). English has been a compulsory course beginning in grade 3 in all elementary schools since 2001 (Ministry of Education, 2001). Since then, all colleges and universities controlled by the Ministry of Education also have been required to use English as the main teaching language in some specialized courses such as foreign language, foreign trade, law, economics, finance and technology (Nunan, 2003). Hence, college students in China are expected to acquire oral language and literacy skills in English in order to be proficient for the purpose of communication in these academic areas.

As Lesaux, Rupp and Siegel (2007) proposed, the development of second language (L2) literacy skills is arguably more challenging, compared with first language (L1) literacy. Moreover, L2 English reading development appears to be even more challenging for Chinese-speaking learners, given that Chinese and English use different orthography, logographic and alphabetic respectively, to represent word meanings. The L1-L2 orthographic distance has been shown to influence L2 reading development (Akamatsu, 1999; Koda, 1996). Therefore, it is important to establish understanding of the reading skills for this group of L2 learners. However, few studies have empirically examined linguistic or cognitive skills that have influence on adult Chinese-speaking (L1) learners' reading skills in English (L2). To address this gap, the current study examined the role of L2 language skills and metacognitive awareness of reading strategies in predicting L2 reading comprehension and also examined the differences between poor and good Chinese-speaking L2 readers.

Literature Review

Researchers in the field of L2 reading comprehension argue that two major factors account for differences in reading comprehension: a language-specific factor such as L2 vocabulary knowledge or L2 grammar (syntactic awareness) and a general and transferable reading knowledge factor such as metacognitive awareness of reading strategies. Metacognitive awareness is considered a component of general reading knowledge that may be transferred from L1 to L2 reading (e.g., Bernhardt & Kamil, 1995; Schoonen, Hulstijin, & Bossers, 1998). Thus, some researchers claim that good L1 readers should also be good L2 readers (Schoonen et al., 1998). The current study assessed metacognitive awareness in L2 reading as a form of general, transferable reading knowledge. Bernhardt's (2005) theoretical model of the necessary components of L2 reading also emphasizes L2 language-specific factors including vocabulary and syntactic skills as well as comprehension strategies; these components, including reading strategies, operate "synchronically, interactively and synergistically" during the L2 reading process (Bernhardt, 2005, p. 140). Additionally, this model highlighted the importance of L1 literacy skills in fostering or buttressing L2 reading comprehension. Furthermore, Bernhardt (2005) suggested that more empirical research is needed to examine the interplay among syntax, vocabulary and metacognitive awareness of reading strategies in the L2 reading process. In particular, whether reading strategies can compensate for weaknesses in syntax and vocabulary should be tested.

The majority of previous studies investigating L2 reading development were conducted with L2 learners of English, whose native languages were alphabetic such as French and Spanish (e.g., Bernhardt & Kamil, 1995; Schoonen et al., 1998). There is a dearth of research on the role of L2 language knowledge and general reading knowledge in the reading comprehension of the large population of Chinese-speaking L2 learners of English. Thus, in the current study we investigated the roles of language-specific knowledge (i.e., L2 vocabulary knowledge and L2 syntactic awareness) and general reading knowledge (i.e., metacognitive awareness of reading strategies used during L2 reading process) in the L2 reading comprehension of Chinese-speaking (L1) adult learners of English (L2), while controlling for their L1 proficiency and verbal intelligence.

Vocabulary Knowledge

Many empirical studies have demonstrated the importance of L2 vocabulary knowledge in L2 reading comprehension (e.g., Alderson, 1984; Laufer, 1992; Nation, 2001; Qian, 1999). For example, in a study (Qian, 1999) with Korean and Chinese adults attending intensive academic English as a Second Language (ESL) programs, the correlation between the vocabulary knowledge assessing the participants' size of vocabulary (Nation, 1990) and reading comprehension was .78. Correlations between reading comprehension and these two types of vocabulary knowledge (size of vocabulary, lexical richness) ranged from .50 to .75 in similar studies conducted with other adult ESL learners, whose native languages were Hebrew, French or Arabic (Laufer, 1992). These studies indicate that vocabulary knowledge may have different dimensions and each dimension may be associated with reading achievement.

An individual's vocabulary knowledge includes two primary dimensions: breadth and depth. First, breadth of vocabulary mainly refers to the number of words that have some level of meaning to the individual. It focuses on the knowledge of the multiple meanings of words, but not how well each of these words is known to an individual. Numerous studies have attempted to estimate the actual number of words L2 learners need to know to comprehend text. Goulder, Nation and Read (1990) postulated that adult L2 learners needed the same number of words in their lexicon as adult native speakers. About 3,000 word families or 5,000 individual word forms were necessary for L2 learners' minimum comprehension (Laufer, 1997).

Second, depth is conceptualized as the richness of knowledge that the individual possesses about the words that are known. Depth of word knowledge involves knowing the "core meaning of a word and how it changes in different contexts" (Stahl, 1998, p. 82). Moreover, Nation (1990) proposed that word meaning, register, frequency, pronunciation, spelling, syntactic and morphological properties were all considered primary aspects of depth of vocabulary for L2 learners. Qian (2002) added collocational (the restrictions on how words can be used together) and phraseological (how words and phrases are used in speech and writing) properties as components of the depth dimension. In the current study we included measures of both breadth and depth to represent the construct of L2 vocabulary knowledge.

Syntactic Awareness

There also is compelling research indicating the importance of L2 syntactic awareness in acquisition of L2 reading skills (Gelderen, Schoonen, Glooper, Hulstijin, Simis, Snellings, Smith, & Stevenson, 2003; Kirajima, 1997; Verhoeven, 1990). Syntactic awareness refers to the ability to understand the grammatical structures of language within sentences (Tunmer & Hoover, 1992) as well as the ability to "reflect on the syntactic structure of language and regard it objectively and separately from the meaning conveyed by language" (Blackmore, Pratt, & Dewsbury, 1995, p. 405). These conceptualizations of syntactic awareness are considered low-level syntactic awareness (Layton, Robinson, & Lawson, 1998). In addition, syntactic awareness also includes two high-level abilities that reflect greater conscious awareness of language: (a) the ability to formulate the rules of syntax and to identify what the rules are, and (b) the ability to intentionally control and reflect on one's knowledge of syntactic rules or one's performance on task testing syntactic knowledge (Layton et al., 1998). The current study tapped both low- and

high-level syntactic awareness to represent the construct of syntactic awareness.

The presence of a relationship between L2 syntactic awareness and L2 reading comprehension has been well indicated in empirical studies (Gelderen et al., 2003; Kirajima, 1997; Verhoeven, 1990). For example, limited syntactic knowledge and a basic unawareness of syntactic boundaries can impede adult L2 learners' reading process (Kirajima, 1997). Whether verbal intelligence is controlled seems to affect the correlation between syntactic awareness and reading comprehension. Failure to control for verbal intelligence can cause problems of interpretation, because verbal IQ may produce a spurious relation between syntactic awareness and reading ability. Syntactic awareness may not make a unique contribution to predicting reading ability not already explained by verbal intelligence (Tunmer, Herriman, & Nesdale, 1988). Some researchers have argued that it is inappropriate to use an English test for measuring L2 learners' intelligence (Gunderson & Siegel, 2001), given that L2 learners vary in their knowledge of English and such variance has important consequences for their performance in intelligence assessments. Moreover, some previous studies have included verbal intelligence as measured by students' L1 language skills as a component of L2 learning (Pimsleur, 1966; Sparks, Patton, Ganschow, Humbach, & Javorsky, 2006). Thus, in the current study we controlled for verbal intelligence and Chinese proficiency level using participants' scores on the Matriculation Chinese test (MCT), a component of National University Matriculation (NUM) examinations in China which is similar to the Scholastic Aptitude Test (SAT) used for U.S. college admissions.

Metacognitive Awareness

In the domain of L2 reading research, recent trends have led to an increasing emphasis on the role of metacognitive awareness of one's cognitive and motivational processes in reading (Barnett, 1988; Bernhardt, 2005; Gelderen et al., 2003). Metacognition is defined as "knowledge about cognitive states and abilities that can be shared among individuals while at the same time expanding the construct to include affective and motivational characteristics of thinking" (Paris & Winograd, 1990, p. 15). The term "metacognitive awareness" refers to the same thing as metacognition. Applied to reading research, metacognitive awareness is conceptualized as the "knowledge of the readers' cognition relative to the reading process and the self-control mechanism they use to monitor and enhance comprehension" (Sheorey & Mokhtari, 2001, p. 423), which is a critical component of skilled reading.

The importance of metacognitive awareness in L2 reading comprehension has been recognized in previous correlational studies (Barnett, 1988; Gelderen et al., 2003; Schoonen et al., 1998). Barnett (1988) investigated the relationships among reading comprehension, strategy use, and perceived strategy use and found that all three were significantly correlated for cognitively mature university-level readers of French as L2. She concluded, "students who effectively consider and remember context as they read (i.e., strategy use) understand more of what they read than students who employ this strategy less or less well" (p. 156). Thus, for L2 learners, metacognitive awareness related to reading strategies plays an important role in L2 reading comprehension. Many researchers have concluded that metacognitive awareness grows with the age of the reader; older and more successful readers are more likely to approach different genres in different ways and utilize more reading strategies (Baker & Brown, 1994; Paris, Wasik, & Turner, 1991). However, compared with L1 speakers, L2 learners have greater awareness of

cognitive processes, as suggested by Hosenfeld (1978). This is consistent with the view proposed by Vygotsky (1962) that learning a foreign language is "conscious and deliberate from the start" (p.109). The fundamental difference is that L2 learners utilize additional reading strategies, such as translation and cognate awareness, which is the ability to use cognates (i.e., words in two languages that share a similar meaning, spelling, and pronunciation) in a primary language as a tool for understanding L2, during the reading process.

In addition, it is worth noting that L2 learners' metacognitive awareness in reading is related to their cultural backgrounds and to their different L1 literacy experiences (Parry, 1996). For example, Chinese L2 readers' metacognitive awareness is greatly influenced by the logographic writing system of the Chinese language and Chinese culture. Just as Field (1985) reported, Chinese L2 readers could not use the more abstract, process reading strategies (e.g., guessing from contextual meaning) to read English materials fluently because of the difficulties in transferring the reading skills from Chinese to English and sociocultural interference. Nonetheless, the extent research findings are inconclusive in determining the importance of metacognitive awareness in English reading comprehension for L2 learners whose L1 is Chinese.

Comparison of Poor and Good L2 Readers

The findings from studies comparing good and poor L1 readers have indicated that semantic problems are connected with poor reading; specifically, poor L1 readers have difficulty with receptive vocabulary (Bishop, Byers-Brown, & Robson, 1990), comprehending figurative language (Seidenberg & Berstein, 1986) and defining word meanings (Snow, Cancino, Gonzales, & Shriberg, 1989). Furthermore, poor L1 readers also have been documented to have more problems in syntactic awareness tasks, which require them to detect and repair sentences with grammatical errors (Tunmer, Nesdale, & Wright, 1987) and tasks of complex syntax (Mann, Shankweiler, & Smith, 1984).

In contrast, fewer studies examined the difference between poor and good L2 readers. L2 reading skills were compromised when language-specific knowledge (L2 vocabulary and grammar) are insufficiently developed to support understanding (Schoonen et al., 1998). Based on this premise, we argue that poor L2 readers are more likely to have underdeveloped skills in these areas. Therefore, the importance of language-specific knowledge and general reading knowledge-metacognitive awareness in predicting L2 reading may be different across poor and good reader groups. Establishing the predictors of L2 reading comprehension and examining whether these predictors differ across poor and good readers, deserves significant attention from L2 researchers.

The Current Study

The first purpose of this study was to explore the respective contributions of L2 vocabulary knowledge, L2 syntactic awareness and metacognitive awareness in L2 reading comprehension. We used latent variables to represent L2 vocabulary knowledge, L2 syntactic awareness, metacognitive awareness and L2 reading comprehension, with two indicators for each latent variable. For this purpose, two research questions were posed:

1.1. Are L2 vocabulary knowledge, L2 syntactic awareness and metacognitive awareness distinguishable psychological constructs? Confirmatory factor analysis was used to address this question.

1.2. What is the strength of the relation between each construct and reading comprehension? Structural equation modeling was used to address this question.

The second goal of this study was to examine whether the relation of L2 vocabulary, L2 syntactic awareness and metacognitive awareness to L2 reading differ across poor and good L2 readers. Two research questions addressed this second purpose:

2.1. Are the correlations among L2 vocabulary knowledge, L2 syntactic awareness and metacognitive awareness of reading strategies different across poor L2 readers and good L2 readers?

2.2. Does the relation between each of three constructs (i.e., L2 vocabulary knowledge, L2 syntactic awareness and metacognitive awareness) to L2 reading comprehension differ across the poor-reader and good-reader groups? Multigroup analysis conducted with structural equation modeling was used to address both questions.

Method

Participants

The participants were 278 undergraduate students enrolled as English Education majors at three universities in the north east of China. Their major courses were taught in English. Their ages ranged from18 to 23 (M = 20.72, SD = .959). This sample consisted of 235 females (84.5%) and 43 males (15.5%). They were all native Mandarin speakers. Participants were identified as less skilled versus more skilled in reading ability on the basis of scores on the Test of English as a Foreign Language (TOEFL) reading comprehension test. TOEFL test scores are intended to represent the level of English proficiency of nonnative speakers. The test developers rarely use rigid cutoff scores to evaluate students' performance on TOEFL (Educational Testing Service, 1996). Thus, in the current study, participants with reading scores at the top 25% of the sample on TOEFL were identified as good readers (n = 89), while those with reading scores at the bottom 25% of the sample were identified as poor readers (n = 74). As shown in Table 1, the mean of good readers on TOEFL reading test was 35.36 (SD = 3.92), suggesting that most of the good readers achieved 72% accuracy in TOEFL reading. By contrast, the mean of the poor readers was 11.11 (SD = 1.60), which suggested that most of the poor readers in our sample achieved 22% accuracy on the TOEFL reading test.

Table 1. *Means and standard deviations of all measures for both the good and poor reader groups*

Variable	Good L2 Reader (*n*=89)		Poor L2 Reader (*n*= 74)	
	M	*SD*	*M*	*SD*
VS	68.35	12.24	51.38	17.97
DVK	96.79	28.69	73.16	28.95
TOAL	8.74	2.40	8.07	2.53
SAQ	7.08	2.58	5.46	2.53
MRSQ	32.69	5.47	30.56	6,26
MRAI	12.09	4.20	9.91	3.37
TOEFL	35.36	3.92	11.11	1.60
GRST	38.57	10.43	27.12	12.01

Note. VS = Vocabulary Level Test; DVK = Depth of Vocabulary Measure; TOAL = Sentence Combination Subtest of TOAL-4; SAQ = Syntactic Awareness Questionnaire; MRSQ = Metacognitive Reading Strategies Questionnaire; MRAI = Metacognitive Reading Awareness Inventory; TOEFL = TOEFL Reading Comprehension Subtest, GRST = Gray Silent Reading Tests

Chinese Proficiency and Verbal Intelligence Measure

One subtest of the NUM examinations in China was used. NUM Examinations are the national standardized tests used for the purpose of selecting students for entrance into higher education. It is composed of Chinese, English, Mathematics, Science and Social Science tests (Yang, Chang, & Ma, 2004). The MCT, one subtest of NUM, was used to control for the participants' Chinese proficiency level and their verbal intelligence in the current study. The participants' scores of MCT were self-reported on demographic questionnaires.

L2 Vocabulary Measures

Two tests of vocabulary knowledge (breadth and depth) were administered in their original English language versions to each participant. The Vocabulary Level Test (Nation, 1990) was used to assess the breadth of L2 vocabulary knowledge. The Depth of Vocabulary Knowledge Measure (DVK; Qian & Schedl, 2004) was used to measure the depth of L2 vocabulary knowledge.

Vocabulary Level Test. This vocabulary test (Nation, 1990) has been considered a reliable measure for the vocabulary size (VS) of L2 learners by many researchers (Laufer & Paribakht, 1998; Yu, 1996). It includes five parts, each representative of different vocabulary levels; the 2,000 word-family level, the 3,000 word-family level, the 5,000 word-family level, the 10,000

word-family level, and the university word list level. The 2,000 word-family level covers high-frequency words in English.

At each vocabulary level, there are six items, each containing six words and three definitions. The participants are required to match each of the three definitions with the correct word and put the number associated with that word in the blank. It takes most adult L2 learners 35 minutes to finish this test. The internal consistency reliability of this measure was .96 for the current study's sample.

DVK. DVK (Qian & Schedl, 2004) was developed based on the format of word associate tests developed by Read (1998) to assess the depth of vocabulary knowledge. DVK is group-administered test that mainly assesses two aspects of the depth of vocabulary knowledge: (a) word meaning, particularly polysemy, which is defined as the association of two or more related meanings with a single phonological form (Nerlich, 2003) and synonymy, and (b) word collocation, which means "the word's associational patterns with other words in domains of knowledge and use" (Qian & Schedl, 2004, p. 37). DVK is composed of 40 test items, each consisting of a stimulus word that is an adjective and two boxes that each contains four words. The internal consistency reliability of this measure was .97 for the current study's sample.

L2 Syntactic Awareness Measures

Two tests of syntactic awareness also were administered in their original English language versions to each participant. The Sentence Combination Subtest of the Test of Adolescent and Adult Language - Fourth Edition (TOAL-4; Hammill, Brown, Larsen, & Wiederholt, 2007) was used to measure low-level syntactic awareness. The Syntactic Awareness Questionnaire (SAQ; Layton et al., 1998) was used to assess high-level syntactic awareness.

Sentence Combination Subtest of TOAL-4 (Hammill et al., 2007). This subtest was designed to measure spoken and written language abilities of adolescents and young adults, with varying degrees of knowledge of the English language. One subtest, sentence combination, which is used to assess low-level syntactic awareness, was used in the current study. The sentence combination subtest asks the participants to write one grammatically correct sentence from the given two or more sentences. For example, "We ate lunch" and "It was an hour ago" can be combined into "We ate lunch an hour ago" (Hammill et al., 2007, p. 6). For the current study's sample, the internal consistency reliability of this measure with all the items was very low at .51, so an item analysis was conducted. Item-total correlations were examined, as were the alpha levels that would result if specific items were removed. According to this criterion, 14 bad items were deleted. The remaining 16 items were found to be discriminating and the internal consistency reliability for these items for the current study's sample was .60.

SAQ. The SAQ, which was developed by Layton et al. (1998), is an 11-item questionnaire assessing high-level syntactic awareness. It has two parts: (a) Part 1 of the SAQ (Questions 1 to 7) assesses the syntactic ability (i.e., the ability to formulate the rules of syntax and to identify what the rules are), and (b) Part 2 of the SAQ (Questions 8 to 11) assesses the syntactic ability (i.e., the ability to reflect on one's knowledge and performance in relation to syntax). An example of a Part 1 question is "What kind of a job do nouns do in a sentence?" (Layton et al.,

1998, p. 22). An example of a Part 2 question is "What rules are hardest to remember?" (Layton et al., 1998, p. 23). For the current study, the internal consistency reliability of SAQ with the original 12 items was .52. After item analysis, 4 items with low item-total correlations were deleted, which increased the alpha level. The internal consistency reliability of the remaining 8 items for the current study's sample was .62.

Metacognitive Awareness Measures

The two metacognitive awareness measures used were translated into Chinese from their original language, English. The back-translation method was employed, which is considered the preferred method of obtaining a culturally equivalent instrument (Berberoglu & Sireci, 1996; Erkut, Alarcon, Garcia, Tropp, & Vazquez Garcia, 1999). This method requires two independent translators. The first translator (the first author) produced the Chinese-language version from the original. The second translator (a doctoral student majoring in Multilingual and Multicultural Education) used the Chinese-language version to produce an English-language version of the instrument. After independent translation, the two translators consulted with each other to adjust any discrepancies and inconsistencies. For the purpose of this study, these two measures tapped the reading strategies that participants employed during the English reading process.

Metacognitive Reading Strategies Questionnaire (MRSQ). This 22-item, timed, group-administered questionnaire developed by Taraban, Kerr and Rynearson (2004) was used to measure college students' awareness of the uses of reading strategies in the reading process. Participants are asked to rate how frequently they use the strategies listed on a five-point Likert scale (Never Use, Rarely Use, Sometimes Use, Often Use, & Always Use). An example of one strategy is, "I search out information relevant to my reading goals" (Taraban et al., 2004, p. 75). Taraban et al. reported that MRSQ had two components based upon exploratory and confirmatory factor analyses: analytic-cognitive, which focuses on cognitions aimed at reading comprehension and pragmatic-behavioral, which refers to behaviors aimed at studying and academic performance. Consistent with Taraban et al.'s study, the exploratory factor analysis conducted with the MRSQ data from the current study also showed that there were two components accounting for 36.41% of the variance. Only the analytic-cognitive component was significantly correlated with students' expected reading skills in Taraban et al.'s study. Therefore, the analytic-cognitive component was selected for statistical analysis in the current study. Cronbach's alpha coefficients for the current study's sample were .87 for all items, .83 for the analytic-cognitive component and .80 for the pragmatic-behavioral component.

Metacognitive Reading Awareness Inventory (MRAI). MRAI was designed by Miholic (1994) to assess college students' concrete and conscious awareness of reading strategies. It has 10 items, representing four domains of metacognitive awareness including regulation, conditional knowledge of strategy application, planning the cognitive event and evaluation of process. For each item, there are four answers from which participants are to choose. Each item may have more than one correct answer. For example, given the question "What do you do if you don't know what an entire sentence means?" there are four answers to choose from: "a) read it again, b) sound out all the difficult words, c) think about the other sentences in the paragraph, and d) disregard it completely" (Miholic, 1994, p. 85). There are no published reports of this measure's

reliability. The internal consistency reliability was .82 for the current study's sample.

L2 Reading Comprehension Measures

The TOEFL Reading Comprehension Subtest (TOEFL-RBC) and the Gray Silent Reading Tests –Third Edition (GSRT-3: Wiederholt & Blalock, 2000) were used to assess reading comprehension and were administered in their original English language versions to each participant. Although the two measures have similar response formats, there are differences in number and content of passages. GSRT-3 has more passages than the TOEFL. The GSRT-3 generally consists of the literacy and informational text, while TOEFL consists of the passages focused on academic matters.

TOEFL-RBC. This is a standardized multiple-choice reading comprehension test (Schedl, Thomas, & Way, 1995). It is a reading comprehension subtest of the 2006 institutional TOEFL Test and contains five passages, reflecting general academic matters, and 30 questions. Participants read the passages silently and answer the questions by choosing one from multiple choices. The internal consistency reliability of this measure was .90 for the current study's sample.

GSRT-3. This test consists of 13 developmentally sequenced reading passages with five multiple-choice questions (Wiederholt & Blalock, 2000). Form A was chosen as the measure of reading comprehension for the current study. The internal consistency reliability of this measure was .92 for the current study's sample.

Procedure

The demographic questionnaire (written in Chinese) was first distributed to all the participants. Then the previously described measures were administered to the participants. Testing of each participant was completed in four group sessions totaling 2 hours and 45 minutes. The metacognitive awareness measures were administered after the reading comprehension measures, so that readers would not be prompted to use strategies during the reading comprehension tests that they might not typically use. During Session 1, GSRT-3 and MRAI were administered. During Session 2, the TOEFL-RBC and the MRSQ were administered. During Session 3, the VS and SAQ were administered. During Session 4, DVK and the Sentence Combination Subtest of TOAL-4 were administered.

Results

Data Issues and Descriptive Statistics

The data were examined for outliers, skewness, kurtosis and missing data. Seventeen univariate outliers (three for VS, four for SAQ, and ten for MRAI) were identified and recoded to be no greater than or less than two interquartile ranges from the median. No bivariate outliers were found by the inspection of scatter plots. To determine whether multivariate outliers existed, Mahalanobis distance (one method of detecting multivariate outliers) was used to sort all the

cases. A probability estimate, $p < .001$, for a case being an outlier was used (Tabachnick & Fidell, 2001). This procedure did not show any multivariate outliers. All the skewness and kurtosis values fell within the acceptable ranges.

Means, standard deviations, reliabilities, and intercorrelations are shown in Table 2. All correlations among the individual measures of vocabulary knowledge, syntactic awareness, metacognitive awareness and reading comprehension were significant except the correlations between the measures of syntactic awareness and those of metacognitive awareness.

Table 2. *Descriptive statistics and intercorrelations for all observed variables*

Variable	1	2	3	4	5	6	7	8
1. VS	_____							
2. DVK	.48**	_____						
3. TOAL	.17**	.22**	_____					
4. SAQ	.25**	.30**	.13*	_____				
5. MRSQ	.19**	.13*	0.04	0.04	_____			
6. MRAI	.18**	.25**	0.08	0.05	.29**	_____		
7. TOEFL	.43**	.35**	.13*	.27**	.15*	.24**	_____	
8. GRST	.43**	.37**	.13*	.13*	.18**	.28**	.39*	_____
M	58.60	81.51	8.25	6.02	31.74	10.65	21.59	33.17
Sample Range	16-94	16-143	1-14	1-11	10-44	4-19	7-47	9-56
SD	19.10	30.88	2.60	2.34	5.82	3.97	10.06	12.24
Reliability	0.96	0.9	0.6	0.62	.87[a]/.83[b]	0.82	0.90	0.92
Skewness	-0.52	-0.364	-0.11	0.09	-0.62	0.72	0.47	-0.27
Kurtosis	0.07	-0.60	-0.32	-0.31	0.85	-0.55	-1.00	-0.96

Note. $n = 278$; VS = Vocabulary Level Test; DVK = Depth of Vocabulary Measure; TOAL =Sentence Combination Subtest of TOAL-4; SAQ = Syntactic Awareness Questionnaire; MRSQ = Metacognitive Reading Strategies Questionnaire; MRAI = Metacognitive Reading Awareness Inventory; TOEFL = TOEFL Reading Comprehension Subtest; GRST = Gray Silent Reading Tests; * $p < .05$; ** $p < .01$; [a] reliability of two components; [b] reliability of analytic-cognitive component.

When handling missing data, traditional methods such as listwise deletion, pairwise deletion, mean substitution and regression-based single imputation may produce substantial bias and increase type II error rates. Thus, a multiple imputation method is preferable, even with the small amount of missing data (Graham, Cumsille, & Elek-Fisk, 2003). For the missing pattern in the current study, some participants did take part in the measurement sessions, but for whatever reason did not respond to some questions in some measures (item nonresponse). If fewer than 25% items were missing in one measure, a person-specific estimate (mean of the non-missing items) was substituted for the missing items. If the participant did not respond to 25% or more of the items in any measure, however, their score on that measure was considered missing data. Thus, the total score for this measure was imputed, rather than imputing the individual items. Using the Schafer (2000) NORM program, 20 completed data sets were created using multiple

imputation process to compute the total scores for missing measures. The percentage of missing measures in the current study ranged from 0.72% to 2.16% across all the measures. Amos 6.0 was used to estimate each of the hypothesized models from the multiple imputed data sets then average parameter estimates and obtain combined standard errors.

In order to remove the effect of verbal intelligence and Chinese proficiency level, we obtained residual scores for the individual measures of vocabulary knowledge, syntactic awareness, metacognitive awareness and reading comprehension, after conducting simple regression analyses in which the Matriculation Chinese test score was considered the independent variable, with each measure subsequently as the dependent variable. The standard residual scores of all the measures were used for the following statistical analyses.

Research purpose 1: The respective roles of the three constructs in reading comprehension

Research question 1.1. Confirmatory factor analyses (CFAs) were conducted to establish the measurement model (three-factor model: L2 vocabulary, L2 syntactic awareness and metacognitive awareness for the current study). Initially, CFAs were conducted to confirm the fit of the data to the proposed three-factor model of Vocabulary Knowledge, Syntactic Awareness and Metacognitive Awareness of reading strategies. Additional nested models were tested to determine if any two-factor model or one-factor model offered a better fit to the data than the three-factor model. The Amos program produces a range of goodness of fit indices. The value is a likelihood ratio test statistic evaluating the fit between the restricted hypothesized model and the unrestricted sample data. The model would be accepted if the value is small and nonsignificant. However, a large sample size generates the problem of good-fitting data being rejected, according to the value of Chi-square (χ^2; Marsh, 1994). Therefore, for this study other statistics were used, such as the Tucker Lewis Index (TLI), Comparative Fit Index (CFI), and the root mean squared error of approximation (RMSEA). TLI and CFI are incremental fit indices which measure "the proportionate improvement in fit by comparing a target model with more restricted, nested baseline model" (Hu & Bentler, 1999, p. 2). RMSEA is an absolute fit index that measures "how well an a priori model reproduces the sample data" (Hu & Bentler, 1999, p. 2). All of these fit indexes are used to evaluate model fit and supplement the test. A cut-off value (TLI) of .95, or greater, indicates a close fit. The same standard holds for the CFI (Hu & Bentler, 1999). Brown and Cudeck (1993) recommended that for RMSEA a value of .05 or less represents a close fit. Concerning the value of Chi-square (χ^2) divided by degree of freedom, 2 to 1 or less suggests a close fit. The fit indices for all the models are shown in Table 3. The fit indices indicated that both the three-factor model and two-factor model, which combined vocabulary with syntactic awareness and metacognitive awareness of reading strategies as separate factors, provided a good fit to the data.

To compare the model fit of the three two-factor models and the one-factor model to three-factor model, difference tests were conducted. Non-significant difference tests would demonstrate that the constraints imposed on the three-factor model to obtain the two-factor or one-factor models provide a better fit to the data than the three-factor model. The results in Table 3 demonstrated that the two-factor model of L2 vocabulary knowledge combined with L2 syntactic awareness and metacognitive awareness offered the best fit to the data, indicating that vocabulary knowledge was so highly correlated with syntactic awareness that they were not separate

psychological constructs in the current study. Thus, the factor of vocabulary knowledge combined with syntactic awareness is the L2 language factor. The two-factor model is illustrated in Figure 1, with standardized regression weight and error variances.

Table 3. *Model fit indices*

Model	x^2	*df*	*p*	x^2/df	RMSEA	TLI	CFI	χ^2_{diff}
1. Three-factor model: VC, SYTA, META	3.831	6	0.699	0.639	0	1.035	1.000	
2. Two-factor model : VC/SYTA, META	5.618	8	0.689	0.702	0	1.029	1.000	(2 vs 1) 1.787
3. Two-factor model: VC, SYTA/META	23.818	8	0.003	2.977	0.085	0.811	0.899	(3 vs 1) 19.987**
4. Two-factor model: VC/META, SYTA	23.701	8	0.003	2.963	0.084	0.812	0.899	(4 vs 1) 19.87**
5. One-factor model: linguistic knowledge	23.867	8	0.003	2.652	0.077	0.842	0.905	(5 vs 1) 20.04**

Note. n = 278. VC=Vocabulary Knowledge; SYTA=Syntactic Awareness; META=Metacognitive Awareness; RMSEA= Root Mean Squared Error of Approximation; TLI=Tucker-Lewis Index; CFI=Comparative Fit Index; ** $p < .01$.

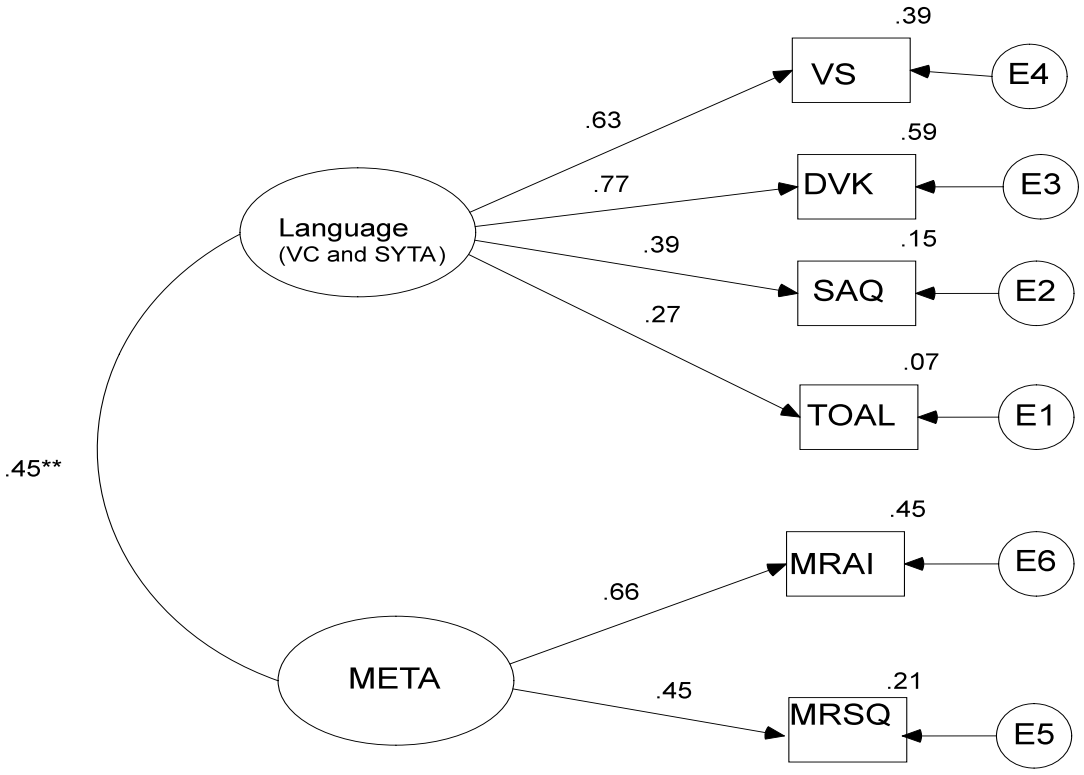

Figure 1. Two-factor measurement model.

Note. * $p < .05$; ** $p < .001$; VC = L2 Vocabulary Knowledge; SYTA = L2 Syntactic Awareness; META = Metacognitive Awareness; Rdg = L2 Reading Comprehension; VS = Vocabulary Level Test; DVK = Depth of Vocabulary Measure; SAQ = Syntactic Awareness Questionnaire; TOAL = Sentence Combination Subtest of TOAL-4; MRAI = Metacognitive Reading Awareness Inventory; MRSQ = Metacognitive Reading Strategies Questionnaire.

Research question 1.2. Structural equation modeling was used to examine the contribution of the two factors (L2 language and metacognitive awareness) to reading comprehension outcomes of adult L2 learners (See Figure 2). The results showed that the structural portion of the model provided a good fit to the data, since $p = .44$; TLI = .10; CFI = .10; RMSEA = .009. The structural portion of the two-factor model is presented in Figure 2.

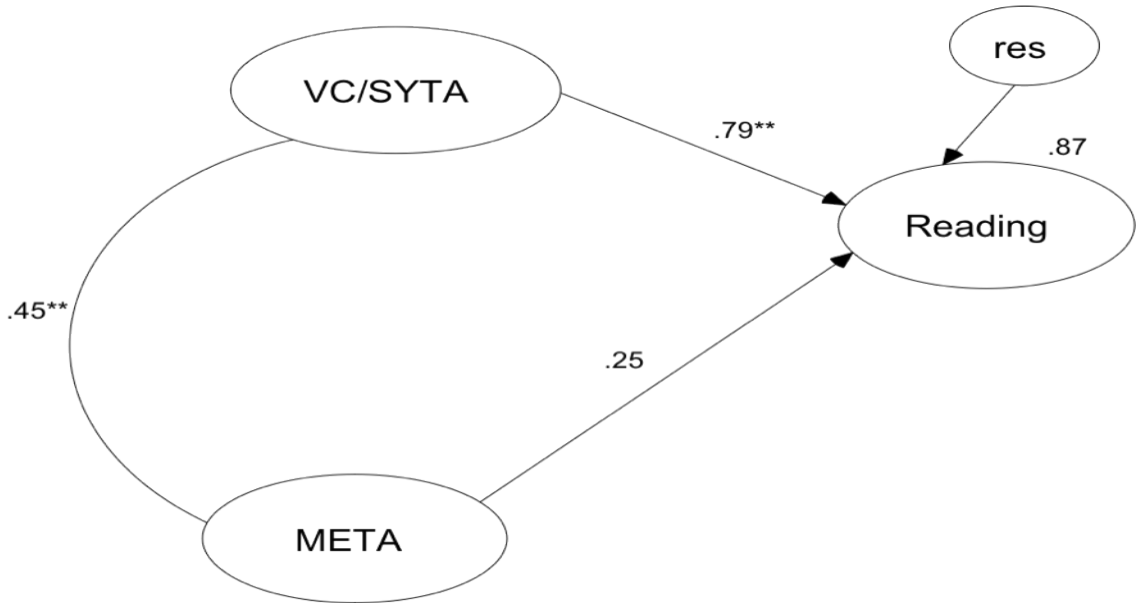

Figure 2. Two-factor structural model predicting L2 reading.

Note. * $p < .05$; ** $p < .001$; VC = L2 Vocabulary Knowledge; SYTA = L2 Syntactic Awareness; META = Metacognitive Awareness; Reading = L2 Reading Comprehension; RES = Residuals

The path from the L2 language to L2 reading comprehension was significant. However, the path from metacognitive awareness of reading strategies to L2 reading was not significant. In addition, correlations of L2 language and metacognitive awareness with L2 reading comprehension were both high ($r = .90$, $p < .01$; $r = .61$, $p < .01$). For the two-factor model, 87% of variance in reading comprehension was explained by the L2 language and metacognitive awareness of reading strategies factors taken together.

Research Purpose 2: The Difference between Poor and Good Readers

Research question 2.1. To examine whether the relation between L2 language and metacognitive awareness of reading strategies differs across the two groups, multigroup analyses were used to test the structural model in Figure 2 (Bryan, 2001; Kline, 2005). We first tested the unconstrained model with both poor and good readers simultaneously and then defined the model by imposing equal constraints on some parameters across both groups (constrained model). The significance of chi-square changes with respect to changes in degree of freedom was examined to determine the extent to which constraint was tenable, as the constrained model was nested within the unconstrained model. More specifically, if the chi-square difference statistic does not reveal a significant difference between the unconstrained model and the constrained model, it could be concluded that the model holds across groups. As to the correlation of L2 language and metacognitive awareness, the measurement invariance test was conducted by constraining this correlation to be equal across the two groups. The value of the chi-square for unconstrained model was 42.694, $df = 34$, $p = .16$; the value of chi-square for the constrained model was 42.746, $df = 18$. As a result, the chi-square test of invariance was .052, $df = 1$, $p = .82$. This result demonstrated that the association between L2 language and metacognitive awareness

was the same across the poor-reader and good-reader groups in our sample.

Research question 2.2. We tested whether the associations of the two latent constructs, L2 language and metacognitive awareness, with reading comprehension would differ across the poor-reader and good-reader groups. First, unconstrained models were analyzed in each of two groups. In the model for the good-readers, the L2 language construct significantly predicted L2 reading comprehension, *SE* = .075, *z* = 2.178. A z-value (associated with the unstandardized weight) greater than 1.96 is considered significant at the .05 level (Bentler, 1995). In the good-reader model, however, the metacognitive awareness construct did not make a unique contribution to predicting L2 reading comprehension, *SE* = .099, *z* = .693. In the poor-reader model, neither the path from L2 language nor from metacognitive awareness to L2 reading comprehension was significant. L2 language was not a significant predictor, *SE* = .034, *z* = -.458. Similarly, metacognitive awareness did not contribute significantly to reading comprehension, *SE* = .014, *z* = -.366. That none of paths were significant may be due to suppression (Tabachnick & Fidell, 2001). High correlation between the two constructs may have suppressed their true relations with reading comprehension, because the correlation between L2 language and metacognitive awareness was large (.68) for the poor L2 reader group.

Next, the extent to which L2 language or metacognitive awareness, as measured here, was necessary for predicting reading comprehension was tested. A model in which the two predictors were allowed to vary freely in predicting reading comprehension was compared with ones in which either the L2 language construct or the metacognitive awareness construct was constrained to equal 0 in both the poor-reader and good-reader groups. Comparing the fit of each constrained model to the unconstrained model can give insight into each predictor's unique contribution. More specifically, if either constrained model leads to a poorer fit than the basic model, it means that the predictor constrained to zero adds more to the prediction beyond what has been already explained by the other predictor (Schoonen et al., 1998). Table 4 summarizes the changes across two groups when L2 language or metacognitive awareness was removed from the model. The relative contributions of L2 language and metacognitive awareness to L2 reading comprehension were the same across the good reader and poor reader groups.

Table 4. *Chi-square tests constraining models*

	Language	Metacognitive Awareness
Good-reader group	5.23*	0.46
Poor-reader group	4.11*	2.68

Note. * $p < .05$.

Whether the correlations of the two latent constructs, L2 language and metacognitive awareness, with L2 reading comprehension would significantly differ across the poor-reader and good-reader groups has not yet been demonstrated. To do this, the alternate models were tested across the two groups simultaneously. First, the path of the construct of L2 language to reading comprehension was constrained to be equal across poor-reader and good-reader groups. In this constrained model, the results suggested adequate fit of the data with the equal constraint, = 44.95, *df* = 35, *p* = .13. The comparison with the unconstrained model (= 42.694, *df* = 34, *p* = .16), yielded a chi-square difference value of 2.256, *df* = 1, *p* = .13. Thus, the construct of L2

language predicted reading comprehension similarly across the poor-reader and good-reader groups.

Using the same method, the path of metacognitive awareness to reading comprehension was constrained to be equal across the two groups. The model fit indices for this constrained model showed that the model fit the data very well, = 43.095, *df* = 35, *p* = .18. A comparison of this model with the above unconstrained model yielded a chi-square difference value of .041, *df* = 1, *p* = .84. This result demonstrated that the metacognitive awareness construct predicted reading comprehension similarly across the poor-reader and good-reader groups. Taken together, across the poor-reader and good-reader groups, there were no significant differences in the correlations of L2 language and metacognitive awareness with reading comprehension.

Discussion and Conclusion

Our main goal was to investigate the respective roles of L2 vocabulary knowledge, L2 syntactic awareness (two indicators of more language-specific knowledge) and metacognitive awareness (an indicator of more general reading knowledge) in explaining the English reading comprehension of adult L2 learners. The purpose of this study was twofold: (a) to examine whether L2 vocabulary knowledge, L2 syntactic awareness and metacognitive awareness were three separate psychological constructs and how these constructs related to reading comprehension, and (b) to ascertain any differences between poor readers and good readers in the relations of those constructs to reading comprehension.

Results addressing the first research purpose indicate that a two-factor model of L2 language including vocabulary knowledge and syntactic awareness and metacognitive awareness provides the best fit to the sample data. These results are consistent with the earlier studies and theory suggesting that two major factors are responsible for differences in L2 reading comprehension (when L1 proficiency or verbal intelligence is controlled for): (a) more language-specific factors, measured here with L2 vocabulary or grammar tests, and (b) more general reading factors, measured here with a metacognitive knowledge of reading strategies survey (e.g., Bernhardt & Kamil, 1995; Schoonen et al., 1998). The data from the language-specific measures used in the current study support the notion of a larger language-specific factor: vocabulary knowledge was so highly correlated with syntactic awareness in the current study that neither of them could be distinguished as separate factors explaining reading comprehension. Performance on syntactic awareness measures may partially depend on vocabulary knowledge (Tunmer et al., 1987). For example, in order to write one grammatically correct sentence from two or more given sentences, L2 learners need to know the word class associated with each word and the syntactic structures that individual words can enter. Thus, it makes sense that vocabulary knowledge was highly correlated with syntactic awareness, which is supported by the many previous research studies reporting high correlations between them (e.g., Gelderen et al., 2004; Shiotsu & Weir, 2007).

This finding, however, may appear to contradict other findings from previous studies suggesting that vocabulary knowledge and syntactic awareness are separate psychological constructs (Shiotsu & Weir, 2007). Contradictory results might be caused by the difference in the methods of measuring syntactic awareness and vocabulary knowledge. Shiotsu and Weir (2007) pointed

out that "a test of syntactic knowledge should attempt to reduce the need for semantic processing as far as possible and keep contextualization to a minimum" (p. 106). The measures of syntactic awareness in the current study involved the ability of vocabulary knowledge. The participants, L2 learners with limited vocabulary knowledge, may have difficulty in combining sentences and articulating what the rules of syntax are in English. Thus, this is a likely reason why vocabulary knowledge and syntactic awareness were not distinguished as separate factors in the current study.

We also examined the relations among L2 language, metacognitive awareness, and L2 reading comprehension in the current study. We found that L2 language made a significant unique contribution to explaining the variance of reading comprehension. These results add to the large body of evidence that language or linguistic knowledge (mainly L2 vocabulary) is important for successful L2 reading, as Alderson (1984) and Gelderen et al. (2004) suggested. In contrast, metacognitive awareness did not make a unique contribution to predicting L2 reading comprehension. The correlation between metacognitive awareness and L2 reading comprehension, however, was substantial, which suggests that metacognitive awareness is also important for L2 reading comprehension. The absence of a unique contribution may indicate that individual differences in metacognitive awareness and L2 language knowledge (vocabulary knowledge and syntactic awareness) are interdependent or that L2 language knowledge is the more powerful predictor.

The second purpose was to explore whether the relations among L2 language, metacognitive awareness and L2 reading comprehension would differ across poor and good L2 readers. We found that these relations remained the same across the poor-reader and good-reader groups. These results together with the results just discussed support the conclusion that reading is primarily a linguistic skill (Frost, 1998). For both good and poor L2 readers, language-specific skill (vocabulary and syntactic awareness) was more important factor in predicting L2 reading comprehension than general reading knowledge (metacognitive awareness). This finding provides evidence for the so-called "threshold hypothesis" (Alderson, 1984), which holds that general reading knowledge (e.g., awareness of reading strategies) cannot be transferred to L2 reading comprehension, if L2 language knowledge remains below a particular threshold. Based on this assumption, most of the Chinese-speaking L2 learners in our study apparently had L2 language knowledge below the "threshold". Thus, it was hard to transfer their general reading knowledge to L2 reading processes. This may explain the absence of a significant predictive role for metacognitive awareness in L2 reading comprehension in the current study.

Limitations

There are some limitations to the current study that should be pointed out, with these providing directions for future research in this area. First, since this was a correlational study and all the measurements were collected within a short period of time, one cannot assume claims and conclusions concerning causal relations. Future longitudinal and experimental studies may shed more light on the estimation of causal influence.

Second, L2 vocabulary knowledge and L2 syntactic awareness were not adequately measured as separate constructs, prompting questions about the construct validity of the L2 vocabulary

knowledge and L2 syntactic awareness measures. Possibly, the measures chosen for the constructs of vocabulary knowledge and syntactic awareness did not measure these constructs as well as other measures that might be developed. That is to say, the syntactic awareness measures in the current study involved the processing of visually presented and contextualized text, which may require vocabulary and reading skills beyond only syntactic awareness. Model indices were used to determine whether model fit would be improved if additional paths between the measures within each theoretical construct were added. These indices showed that if the path was added from DVK to TOEFL-RBC, the model fit would improve. Similarly, if the path was added between SAQ and GSRT, the model fit would also improve. These results appear to indicate that these two measures (DVK and SAQ) may be assessing other constructs that are related to reading comprehension, which are different than those assessed by their companion measures. Thus, another direction of future research is to develop syntactic awareness measures for L2 learners, which would allow vocabulary knowledge and syntactic awareness constructs to be separately identified.

Conclusion

The current study found that L2 language-specific knowledge (vocabulary and syntactic awareness) was a significant predictor of L2 reading comprehension; however, general reading knowledge (metacognitive awareness) was not a significant predictor of L2 reading comprehension for either L2 good or poor readers. These findings suggest that well-developed general knowledge of reading strategies cannot compensate for a lack of L2 language proficiency, as long as the latter is below "the threshold" (Schoolen et al., 1998). Despite many years of English instruction, most of the students in our sample still apparently found themselves below the "threshold." We argued that many Chinese-speaking L2 learners still stand a good chance of profiting from instruction focused on English language skills.

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