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Relationship Between Vocabulary Knowledge and Reading Comprehension in Japanese: Effects of Language Proficiency and Text

Abstract

This study investigates whether the relationship between breadth and depth of vocabulary knowledge and reading comprehension is affected by a reader factor (language proficiency) and a text factor (text type). Ninety-one Thai-speaking learners of Japanese as a foreign language (L2) read and recalled two expository texts (one general and one academic). Vocabulary breadth and depth were assessed by using a definition test and a word association test, respectively. Results indicated that as language proficiency increases, both vocabulary knowledge and reading comprehension improve, with the relationship between the two gradually changing. Vocabulary breadth is more highly correlated with reading comprehension than vocabulary depth. For advanced level of proficiency, the contribution of vocabulary depth, especially knowledge of word collocations and cooccurrences, increases especially in academic text comprehension. Implications are made regarding sensitizing students' awareness of the connection between vocabulary and reading and the importance of the word-to-text integration during reading.

Key words

breadth and depth of vocabulary knowledge, reading comprehension, language proficiency, text type, Japanese as a foreign language

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ความสัมพันธ์ระหว่างความรู้คำศัพท์กับความเข้าใจในการอ่าน : อิทธิพลจากความสามารถทางภาษาและข้อความ

บทคัดย่อ

งานวิจัยนี้ศึกษาว่าความสัมพันธ์ระหว่างความกว้างและความลึกของความรู้คำศัพท์กับความเข้าใจในการอ่านได้รับอิทธิพลจากปัจจัยของผู้อ่าน (ความสามารถทางภาษา) และปัจจัยของข้อความ (ประเภทของข้อความ) หรือไม่ ผู้เรียนชาวไทย จำนวน 91 คน ที่เรียนภาษาญี่ปุ่นเป็นภาษาต่างประเทศได้อ่านและจดจำบทความอธิบายสองเรื่อง (เรื่องที่เป็นเนื้อหาทั่วไป และเรื่องที่เป็นเนื้อหาทางวิชาการ) ความกว้างของคำศัพท์ถูกประเมินโดยใช้แบบทดสอบการให้คำนิยาม ขณะที่ความลึกของคำศัพท์ถูกประเมินโดยใช้แบบทดสอบความสัมพันธ์ของคำ ผลการวิจัยพบว่าเมื่อความสามารถทางภาษาสูงขึ้น ทั้งความรู้คำศัพท์และความเข้าใจในการอ่านก็เพิ่มขึ้น โดยความสัมพันธ์ระหว่างทั้งสองค่อยๆ เปลี่ยนแปลงไป ความกว้างของคำศัพท์มีความสัมพันธ์กับความเข้าใจในการอ่านมากกว่าความลึกของคำศัพท์ สำหรับผู้เรียนที่มีระดับความสามารถทางภาษาขั้นสูง บทบาทของความลึกของคำศัพท์ โดยเฉพาะความรู้เกี่ยวกับการใช้คำร่วมกัน (collocations) และการเกิดร่วมกันของคำ (cooccurrences) มีความสำคัญมากขึ้นในการทำความเข้าใจข้อความ โดยเฉพาะข้อความทางวิชาการ การศึกษานี้เสนอแนะแนวทางในการส่งเสริมให้ผู้เรียนตระหนักถึงความเชื่อมโยงระหว่างคำศัพท์กับการอ่าน ตลอดจนความสำคัญของการบูรณาการคำศัพท์เข้ากับเนื้อหาในระหว่างการอ่าน

คำ **สำคัญ**

ความกว้างและความลึกของความรู้คำศัพท์, ความเข้าใจในการอ่าน, ความสามารถทางภาษา, ประเภทของข้อความ, ภาษาญี่ปุ่นในฐานะภาษาต่างประเทศ

1. Introduction

Whether it is a first language (L1) or a second or foreign language (L2), there is an interdependent relationship between vocabulary knowledge and reading comprehension (Anderson & Freebody, 1981; Grabe, 2009; Huckin, Hayes, & Coady, 1993). With richer vocabulary knowledge, a person tends to encounter more familiar words in a text, which, in turn, makes it easier to understand the content. Through experiences with reading comprehension, one can have more opportunities to process words, both known and unknown, in context, facilitating the strengthening and restructuring of existing vocabulary knowledge. Vocabulary knowledge is multifaceted and consists of multiple dimensions or components (Nagy & Scott, 2000; Nation, 1990, 2001). Traditionally, vocabulary ability has been measured in terms of vocabulary size (how many words one knows, i.e., the breadth of vocabulary knowledge). Vocabulary size generally correlates with reading comprehension and is used as a proxy for level of language proficiency (Bernhardt & Kamil, 1995; Nation, 1990, 2001; Qian, 2002). The quality or depth of vocabulary knowledge, however, has been defined in various ways (e.g., Haastrup & Henriksen, 2000; Meara, 2009; Read, 2004; Schmitt, 2014; Wesche & Paribakht, 1996). A particularly useful approach considers how words are connected to each other in the network-like knowledge of word associations called the mental lexicon (Aitchison, 1994; Meara, 2009). In the network knowledge, it is important to distinguish between paradigmatic word association and syntagmatic word association (De Deyne & Storms, 2008; Fitzpatrik & Thwites, 2020). The former concerns with words with similar meanings and that belong to the same category (e.g., hypernyms and hyponyms). The latter concerns with words that collocate or co-occur in the same structure (clause of sentence) and that usually belong to different word classes. Vocabulary breadth or size and vocabulary depth are obviously interrelated, but the relationship between the two is still unclear. Schmitt (2014) based on a conceptual review of previous English-as-L2 studies, concluded that for higher frequency words and for learners with smaller vocabulary sizes, there is often little difference between the two dimensions, whereas for lower frequency words and for learners with larger vocabulary sizes, the development of depth often lags behind the growth of size. The role of vocabulary depth, as opposed to breadth, in reading comprehension in English has attracted increasingly more attention among researchers (e.g., L1: Binder, Cote, Lee, Bessette, & Vu, 2017; L2: Li & Kirby, 2015; Qian, 1999, 2002; Rashidi & Khosravi, 2010). However, there is very little research conducted so far on Asian languages (e.g., Horiba, 2012;. Zhang & Yang, 2016). In addition, the findings of the previous studies are not necessarily easy to compare and consolidate due to differences in methodological and theoretical orientation.

The study reported in this paper was carefully designed to investigate how breadth and depth of vocabulary knowledge is related to reading comprehension in the context of Japanese as a foreign language and to extend inquiry by examining how the relationship may be affected by a

reader-related variable (level of language proficiency) and a text-related variable (type of text).

2. Background

Recognition of multidimensionality of vocabulary knowledge has produced a new line of research on English reading (e.g., L1: Binder, Cote, Lee, Bessette, & Vu, 2017; Ouellette, 2006; L2: Li & Kirby, 2015; Qian, 1999, 2002; Rashidi & Khosravi, 2010), but this line of research on other languages is scarce (Horiba, 2012; Zhang & Yang, 2016). In the field of applied linguistics, a pioneering work Qian (2002) investigated the relationship between breadth and depth of vocabulary knowledge and reading comprehension for ESL students from a testing perspective. A heterogeneous group of 217 students enrolled in an intensive ESL program at a Canadian university were administered three vocabulary tests and a reading comprehension test. Vocabulary depth (synonyms, polysemy, and collocations) was assessed using the revised Word Associates Test (WAT) (Read, 1993). Vocabulary breadth was assessed using the Test of Vocabulary Levels (VLT) (Nation, 1990) and a standardized vocabulary test (e.g., TOEFL Vocabulary). In addition, reading comprehension of academic texts was assessed using a standardized reading comprehension test (TOEFL-RBC). It was found that the three vocabulary measures correlated with each other and with reading comprehension. Furthermore, both breadth and depth accounted for substantial variance in reading comprehension, with depth accounting for more variance than breadth.

Likewise, Rashidi and Khosravi (2010) examined 38 Iranian EFL university students who were selected as Intermediate (out of 81 students) based on a standardized test (Longman TOEFL). Both vocabulary depth assessed via the revised WAT (Read, 1993) and vocabulary breadth assessed via the revised VLT (Smitt, Schmitt, and Clapham, 2001) had correlations (partially independent) with reading comprehension (TOEFL consisting of five passages), generally confirming the findings of Qian (2002).

In the study of Li and Kirby (2015), a total of 246 students enrolled in an English immersion program in junior high school were administered several tests. Vocabulary depth was assessed using three different tests (definition, polysemy, and morpheme awareness). Vocabulary breadth was assessed using a synonym selection task for target words in phrases or short sentences. For reading comprehension, two measures were used. In the standardized reading comprehension test (Gates-MacGinitie reading test), 12 short texts were presented with multiple-choice questions. In the summary writing test, students read an expository text (254 words) and wrote a summary of the text. In addition, non-verbal abilities, Chinese reading comprehension, and English word reading efficiency were assessed. It was found that vocabulary breadth and depth (polysemy) were moderately correlated, and that although both aspects contributed to word comprehension, breadth had a stronger effect than depth. Furthermore, vocabulary breadth significantly predicted multiple-choice

reading comprehension, whereas vocabulary depth was a significant predictor of summary writing. Li and Kirby interpreted these findings as indicating that vocabulary breadth contributes to general comprehension of the text, whereas vocabulary depth contributes to deeper text processing.

The differences in findings between Qian (2002) and Rashidi and Khosravi (2010) and Li and Kirby (2015) are presumably due to differences in learner factors (i.e., age, language proficiency), text factors (i.e., text type and genre) and measurement factors. For example, the summarization task in the Li & Kirby study (2015) which required explicit use of words to produce sentences in writing might have affected or possibly strengthened the 'measured' contribution of the depth dimension of vocabulary knowledge to reading comprehension.

There are only few studies conducted so far to investigate the relationship between breadth and depth of vocabulary knowledge and reading comprehension in Asian languages. For example, Zhang & Yang (2016) examined 21 learners (from various backgrounds) of Chinese as L2 studying at a university in China. Vocabulary depth was assessed by a word association test (paradigm or syntactic relations) using 20 target words (designed based on Read's WAT). Vocabulary breadth was assessed by a picture selection task using 30 target words. Reading comprehension was assessed using two tasks. In the short text task, 15 narrative texts (each consisting of a few sentences) were presented, followed by multiple-choice inference questions for each. In the long text task, four long texts (average 432 characters) were presented, followed by five multiple-choice questions for each. In addition, a grammaticality judgment test (selecting the correct sentence for each of 10 pairs) and a spelling processing test (selecting the correct word for each of 20 pairs) were used. With the effects of spelling and grammar knowledge being statistically controlled, it was found that both vocabulary breadth and depth contributed independently to reading comprehension. Moreover, in the long-text task (a more traditional reading comprehension test), vocabulary size was the more important predictor whereas in the short-text task, which presumably emphasized inferencing, vocabulary depth was the more important predictor.

As for L2 Japanese, Horiba (2012) examined 50 Chinese-speaking L2 learners and 20 Korean-speaking L2 learners who were enrolled in the intermediate-advanced level course either at a language school or in a language program at a university in Japan. In addition, 40 native speakers of Japanese (undergraduate students) participated as the baseline. Vocabulary breadth was assessed with a definition matching test (design adapted from Nation's VLT), and vocabulary depth was assessed with a word association test (paradigm relation, syntactic relation, analytic relation) (design adapted from Read' WAT). The same 48 target words were used in these vocabulary tests. Reading comprehension was assessed using a L1 recall task and a summary completion task with two expository texts (747 and 962 characters). It was found that vocabulary breadth and depth were correlated with reading comprehension for L2 learners but not for native speakers. Vocabulary

breadth was a stronger predictor of reading comprehension for both Chinese and Korean students. However, the relative contribution of the types of word associations differed between the two L2 groups. Knowledge of syntactic associations was particularly important to reading comprehension for Chinese students (i.e., L1 is an isolating SVO language), but not for Korean students (i.e., L1 is an agglutinative SOV language similar to Japanese). Horiba discussed the findings in terms of the possible effects of language status and L1-L2 linguistic distance on vocabulary knowledge development and reading comprehension.

The findings of these studies altogether provided some insights into the relationship between breadth and depth of vocabulary knowledge and L2 reading comprehension. However, it is not easy to compare and synthesize the findings of these studies because of differences in methodology -- i.e., learner factors (e.g., language proficiency level, L1 background, grouping), text factors (e.g., text type and genre) and measurement factors (i.e., how reading comprehension and vocabulary knowledge are measured). In particular, the interpretation of the findings of breadth versus depth of vocabulary to reading comprehension seems rather problematic when different measures were used for different texts in a single study (i.e., a possible confounding).

3. Research questions

The present research examined the effects of a reader-related variable (level of language proficiency) and a text-related variable (text type) in a single study in order to scrutinize the relationship between breadth and depth of vocabulary knowledge and reading comprehension. The study recruited L2 learners who had the same L1 background and were from three levels of L2 proficiency. In order to dissociate the effect of language proficiency from the effect of measurement, we used the same measure (i.e., written recall in L1) for two reading passages (a general text and an academic text). The following questions were prepared for this study.

1. How does breadth and depth vocabulary knowledge differ between L2 learners from different language proficiency levels?

2. How does vocabulary knowledge differ between L2 learners from different language proficiency levels and between different types of texts?

3. Does the relationship between reading comprehension and breadth and depth of vocabulary knowledge differ between L2 learners from different language proficiency levels and between different types of texts?

4. Methodology

Participants: The participants were 91 students majoring in Japanese as a foreign language at a university in Thailand. They were all native speakers of Thai and consisted of 24 second-year,

25 third-year, and 42 fourth-year level students based on their course enrollment. They were considered as Intermediate, Intermediate-high, and Advanced in the program, respectively. According to the responses to the background questionnaire, they consisted of 14 men and 77 women, and none of them had been living in Japan for more than one year at the time of the study.

Materials and Measures: Vocabulary knowledge: The vocabulary tests were developed in an earlier research project.[1] There were a total of 156 target words used which consisted of 60 nouns, 60 verbs, 24 adjectives, and 12 adverbs. The target words were equally distributed across four levels of frequency (I–IV; I: highest, IV: lowest). The same target words were used in the two vocabulary tests. The target words in the three high(er) frequency levels (i.e., I, II, and III) were selected from the vocabulary corpus for the fourth/third, second, and first *kyu* level of the JLPT (Japan Foundation, 2002), respectively. The target words in the lowest frequency level (i.e., IV) were selected from outside sources in order to assess vocabulary knowledge at the superior or near- native level.

The vocabulary breadth test consisted of 52 items. For each item, six words were listed on the left and three simple "definitions" or descriptions were listed on the right. The test format was adapted from Nation's VLT (2001). The test taker was asked to match between a word and its meaning (definition). The six words for each item were chosen from the same frequency level and word class, but they differed in terms of semantic domain. The "definitions" were written using simple words (i.e., words from the same or higher frequency levels). The vocabulary depth test consisted of 156 items. In each item, a target word was presented with six words in the box below. The words in the box were from the same or higher frequency level than the target word. The test format was adapted and modified from Read's WAT (1993, 1998) because it allows L2 learners to use knowledge of word associations without processing sentences and discourse. The test taker was asked to select one word that has meaning similar to the target word (i.e., paradigmatic association and two words, each of which is often used together with the target word in a sentence (i.e., syntagmatic association). For example, for a target word りんご (/ringo/ "an apple"), くだもの (/kudamono/ "fruit"), 赤い (/akai/ "red"), and食べる (/taberu/ "to eat") are to be selected. In each the two tests, all *kanji* characters were presented with *kana* syllabaries to indicate pronunciation because it was not intended to assess *kanji* knowledge. Some examples were provided with simple explanations to help them understand the task instructions. The items were sequenced gradually from easy to hard. There were two versions created for each test using the same items with a random presentation order (within the same word class, within the same frequency level).

Reading comprehension: Reading comprehension was measured using a recall task in which participants read a short text and then recalled what they had understood in their native

language without looking at the original text. The reading materials were two expository texts adapted from Horiba (2012). One was a so-called argumentative essay that appeared in the newspaper Asahi. In this 'general' text (consisting of 23 sentences, 747 characters), the author talks about the thrill of traveling in foreign countries based on his own experiences. The other was an excerpt from an academic book written for general audience by a zoologist. In this 'academic' text (consisting of 24 sentences, 962 characters), the author describes "cultural" behaviors of Japanese monkeys based on his observation study. The texts were written in the *wakachigaki* writing using kanji characters and kana syllabaries. All kanji characters were presented with kana syllabaries for readings, because this was not a test of kanji characters.

Prior to reading a text, participants were informed of a later recall task. Ten minutes were allocated for reading. Upon finishing reading, the text was collected by the proctor. Immediately before the recall task, an intervening task (i.e., arithmetic problems) was given that would erase the content of the readers' short-term memory so that their recall performances would be based on their long-term memory. Participants were asked to recall what they understood of the content of the text and write it down as much as possible using their L1. All participants read and recalled both texts. They first read and recalled the general text, and after a ten min. break, read and recalled the academic text.

In this study, a recall task in L1 was used to measure reading comprehension. Recall is one of the most frequently used measures of text comprehension in cognitive psychology. Because we were interested in the representation of the content of a text in the reader's long-term memory, participants were asked to write down everything that they remembered of the content in their fluent language L1. Prior research provided ample evidence that recall in L1 tends to be greater than recall in L2 for majority of L2 learners. A typical technique in L2 testing, MC questions in L2, was not used because the given questions and alternatives provide additional information that is not in the original text, whereby influencing the students' text memory.

Procedure: Data collection was conducted in classrooms at the institution to which the participants belonged. After one researcher explained the overall purpose and general procedures of the study, the participants filled out a background questionnaire and took three tests in the following order, vocabulary breadth test, reading comprehension test, and depth test. All explanations and instructions were provided in the participants' native language.

Analysis: ***Vocabulary knowledge:*** Responses to the vocabulary tests were scored as 1 point per correct answer, and then the percentage scores were calculated. Multiple regression and analysis of variance analyses (and Tukey-HSD test) were conducted to examine the effects of language proficiency and vocabulary knowledge components on the vocabulary test scores. Correlations between vocabulary knowledge component scores were also analyzed.

Recall: First, each text was analyzed in terms of statements or events (equivalent to clauses) (c.f., Trabasso, Secco, & van den Broek, 1984) and a list of events was created. The number of events contained were 65 for the general texts and 66 for the academic texts. Using this list as template, each participant's recall rate was calculated by scoring whether each statement/event was recalled in the reader's recall protocol. Two raters (Japanese language teachers whose native language is Thai) scored all recall protocols. Upon interrater agreement of 97% being met, discrepancies were resolved by another scoring by one of the raters. Multiple regression and analysis of variance analyses (and Tukey-HSD test) were conducted to examine the effects of language proficiency and text type on recall sores. In addition, correlations between vocabulary knowledge components and recall were analyzed for language proficiency and text type.

5. Results

Breadth and depth of vocabulary knowledge:

Table 1 shows the descriptive statistics of the percentage scores of the vocabulary knowledge tests. Descriptively speaking, on vocabulary breadth, Advanced students scored highest (M = 51.2), followed by Intermediate-high students (M = 38.9), and Intermediate students scored lowest (M = 31.0). Similarly, on vocabulary depth, Advanced students performed best (Paradigmatic: M = 66.1, Syntagmatic: M = 60.5, Total: M = 62.3), followed by Intermediate-high students (Paradigmatic: M = 62.5, Syntagmatic: M = 60.5, Total: M = 62.3 and then Intermediate students (Paradigmatic: M = 51.2, Syntagmatic: M = 50.5, Total: M = 50.7). *MR* analysis was conducted on vocabulary scores to examine the effects of knowledge components (breadth, paradigmatic, syntagmatic) and proficiency level (Total model: *R2* = .585, *Adj-R2* = .573, F = 46.596, $p < .0001$). There were significant effects of proficiency level (F = 67.65, p < .0001, η^2 = .21) and knowledge component (F = 115.66, $p < .0001$, η^2 = .36), and the effect of interaction between proficiency and knowledge component was also significant (F = 3.90, p = .005, η^2 = .02). In order to examine the effect of language proficiency more closely, separate analyses were conducted for knowledge component. On vocabulary breadth, Advanced students outperformed Intermediate students (mean difference = 20.18, *±95%CI* = 14.10/26.26, $p < .0001$) and Intermediate-high students (mean difference = 12.22, *±95%CI* = 6.22/18.22, $p < .0001$) while Intermediate-high students outperformed Intermediate students (mean difference = 7.96, *±95%CI* = 1.17/14.75, $p < .05$).

On vocabulary depth-total, Advanced students outperformed Intermediate students (mean difference = 11.58, *±95%CI* = 7.71/15.46, $p < .0001$) and Intermediate-high students (mean difference = 4.82, *±95%CI* = 0.99/8.65, $p < .01$) while Intermediate-high students outperformed Intermediate students (mean difference = 6.77, *±95%CI* = 2.44/11.10, $p < .001$). The patterns were different between paradigmatic association and syntagmatic association. On paradigmatic association, Advanced

students outperformed Intermediate students (mean difference = 14.87, *±95%CI* =9.59/20.15 *p* < .0001) and so did Intermediate- high students (mean difference = 11.26, *±95%CI* =5.36/17.16 *p* < .0001), but Advanced students did not perform significantly better than Intermediate-high students (mean difference = 3.61, *±95%CI* = -1.61/8.83, *n.s.*). On syntagmatic association, Advanced students outperformed Intermediate students (mean difference = 9.94, *±95%CI* = 5.32/14.56, *p* < .0001) and Intermediate-high students (mean difference = 5.42, *±95%CI* = 0.86/9.99, *p* < .05), but Intermediate-high students did not score significantly better than Intermediate students (mean difference = 4.52, ±95%CI = -0.64/9.68, n.s.).

Table 1 Descriptive statistics for vocabulary knowledge measures by proficiency level

Country	Knowledge component	Mean	SD	Minimum	Minimum
Intermediate	Breadth	31.0	8.9	15.0	60.0
	Paradigmatic	51.2	9.2	36.5	67.3
	Syntagmatic	50.5	8.1	29.8	60.6
	Depth (P+S)	50.7	7.1	32.7	62.8
Intermediate-high	Breadth	38.9	10.7	23.3	63.3
	Paradigmatic	62.5	6.9	48.1	71.1
	Syntagmatic	55.0	7.7	37.5	66.4
	Depth (P+S)	57.5	5.9	42.3	64.7
Advanced	Breadth	51.2	10.1	26.7	73.3
	Paradigmatic	66.1	9.3	48.1	88.5
	Syntagmatic	60.5	7.2	45.2	76.9
	Depth (P+S)	62.3	6.2	46.2	76.9

Paradigmatic, S: Syntagmatic

Correlations between components of vocabulary knowledge were examined (Table 2). Intermediate students showed moderate correlations between breadth and paradigmatic (*r* = .400, *p* < .06) and between breadth and depth-total (*r* = .382, *n.s.*), but correlations between breadth and syntagmatic were lower (*r* = .281, *n.s.*). They also showed moderate correlations between paradigmatic and syntagmatic (*r* = .389, *p* < .07). Intermediate-high students showed moderate correlations between breadth and paradigmatic (*r* = .376, *p* < .07) and breadth and depth-total (*r* = .313 *n.s.*), but the correlations between breadth and syntagmatic (*r* =.190, *n.s.*). They showed low correlations between paradigmatic and syntagmatic (*r* = .128, *n.s.*). Advanced students showed relatively high correlations between breadth and paradigmatic (*r* = .509, *p* < .001) and between breadth and depth-total (*r* = .556, *p* < .001) and moderate correlations between breadth and syntagmatic (*r* =.384, *p* < .05). They had low correlations between paradigmatic and syntagmatic (*r* = .172, *n.s.*).

Table 2 Correlations between vocabulary knowledge components by proficiency level

		Breadth	Depth-P	Depth-S	Depth(P+S)
Intermediate	Breadth	1			
	Paradigmatic	.400(*)	1		
	Syntagmatic	.281	.389(*)	1	
	Depth (P+S)	.382(*)	.721****	.919****	1
		Breadth	Depth-P	Depth-S	Depth(P+S)
Intermediate-high	Breadth	1			
	Paradigmatic	.376(*)	1		
	Syntagmatic	.190	.128	1	
	Depth (P+S)	.313	.503*	.921****	1
		Breadth	Depth-P	Depth-S	Depth(P+S)
Advanced	Breadth	1			
	Paradigmatic	.509***	1		
	Syntagmatic	.384*	.172	1	
	Depth (P+S)	.556***	.636****	.869****	1

(*) .05 < p < .09; * p < .05; ** p < .01; *** p < .001; **** p < .0001 P: Paradigmatic, S: Syntagmatic

Recall:

The means and standard deviations of percentage of events recalled (as index of reading comprehension) are shown in Table 3. As expected, students had a better understanding of the content of the general text (Advanced: M = 24.3, Intermediate-high: M = 18.3, Intermediate: M =14.7), compared with the academic text (Advanced: M = 14.8, Intermediate-high: M = 6.7, Intermediate: M =1.5). Descriptively speaking, Advanced students recalled more content of a text than Intermediate-high students and Intermediate-high students recalled better than Intermediate students.

MR analysis was conducted on recall scores to examine the effects of text and proficiency level (Total model: R^2 = .525, *Adj-*R^2 = .511, F = 38.87, p < .0001). There were significant main effects of proficiency (F = 42.04, p < .0001, η^2 = .23) and text (F = 108.53, p < .0001, η^2 = .29), andthe effect of interaction between proficiency and text was not significant (F = 1.06, *n.s.*). In order to examine the effect of language proficiency more closely, separate analyses were conducted for text. On the general text, Advanced students recalled significantly more content of the text than Intermediate students (mean difference = 9.64, *±95%CI* = 5.06/14.23, p < .0001) and Intermediate-high students (mean difference = 5.98, *±95%CI* = 1.46/10.51, p < .01), but Intermediate-high students were not significantly different from Intermediate students (mean difference = 3.66, *±95%CI* = -1.46/8.78, *n.s*). On the academic text, Advanced students outperformed Intermediate-

high students (mean difference = 8.16, *±95%CI* = 4.05/12.27, p < .0001), and Intermediate-high students outperformed Intermediate students (mean difference = 5.15, *±95%CI* = 0.51/9.80, *p* < .05. There were significant moderate correlations between recall of the general text and recall of the academic text for Advanced students (*r* = .364, *p* < .05), suggesting that those who understood the content of one text better were also better able to process the other text. Intermediate-high students also showed a similar trend to a smaller degree (*r* = .194 *n.s.*). Intermediate students had zero correlations between the two texts; the academic text was just too difficult for these students.

Table 3 Descriptive statistics for reading comprehension measures by proficiency level

Proficiency levely	Text	Mean	SD	Minimum	Minimum
Intermediate	General	14.7	8.2	3.1	36.9
	Academic	1.5	2.2	0	9.1
Intermediate-high	General	18.3	9.2	1.5	33.9
	Academic	6.7	5.2	0	16.7
Advanced	General	24.3	5.8	12.3	33.9
	Academic	14.8	9.0	3.0	42.4

Relationship between vocabulary knowledge and reading comprehension:

In order to examine the relation between vocabulary knowledge components and reading comprehension, correlational coefficients between vocabulary scores and recall scores were analyzed (Table 3). As for Intermediate students, recall of the general text had a significant moderate correlation with vocabulary breadth (*r* = .547, *p* < .01) and the correlations with vocabulary depth were lower (paradigmatic: *r* = .307; syntagmatic: *r* = .169; total: *r* = .259, all *n.s.*) than with vocabulary breadth. Compared with the general text, recall of the academic text had a lower correlation with vocabulary breadth (*r* = .278, *n.s.*) and with paradigmatic (*r* = .170, *n.s.*). As for Intermediate-high students, recall of the general text had a significant moderate positive correlation with vocabulary breadth (*r* = .406, *p* < .05), and the correlations with depth were lower (paradigmatic: *r* = .149; syntagmatic: *r* = .113; total: *r* = .156, all *n.s.*). Their recall of the academic text had a significant moderate correlation with vocabulary breadth (*r* = .516, *p* < .01) and a lower correlation with paradigmatic (*r* = .261, *n.s.*). As for Advanced students, recall of the general text had a significant low correlation with vocabulary breadth (*r* = .317, *p* < .05), as well as near-significant lower correlations with syntagmatic (*r* = .299, *p* < .06) and depth-total (*r* = .290, *p* < .07). Their recall of the academic text had a moderate correlation with vocabulary breadth (*r* = .509, *p* < .001). There were also significant medium correlations found with syntagmatic (*r* = .439, *p* < .01) and depth-total (*r* = .476, *p* < .002) and a lower correlation with paradigmatic (*r* = .263, *p* < .10).

Table 4 Correlations between vocabulary knowledge and reading comprehension for proficiency level and text

Proficiency levely	Text	Vocabulary knowledge components			
		Breadth	Paradigmatic	Syntagmatic	Depth(P+S)
Intermediate	General	.307	.169	.259	36.9
	Academic	.170	-.004	.070	9.1
Intermediate-high	General	.149	.113	.156	33.9
	Academic	.261	-.177	-.052	16.7
Advanced	General	.112	.299(*)	.290(*)	33.9
	Academic	.263	.439**	.476**	42.4

(*) .05 < p < .09; * p < .05; ** p < .01; *** p < .001 P: Paradigmatic, S: Syntagmatic

6. Discussion

Breadth and depth of vocabulary knowledge: The results of the vocabulary knowledge tests suggest that as students gain more experiences in learning the target language, their vocabulary knowledge develops both quantitatively and qualitatively. Between the two dimensions, development of vocabulary breadth or size is more aligned with development of language proficiency. These results seem to corroborate with previous research (Nation, 1990, 2001; Schmitt, 2000). In addition, the results suggest that as language proficiency increases, the depth dimension of vocabulary knowledge becomes more differentiated regarding type of word associations and that knowledge of syntagmatic associations may develop more slowly than knowledge of paradigmatic associations. These results are in line with the previous research (Greidanus, Beks, & Wakely, 2005; Greidanus & Nienhuis, 2001; Horiba, 2012; Schmitt, 2014). The breadth of vocabulary test assessed the "shallow" knowledge of form-meaning connections. The depth of vocabulary test assessed how the words are semantically related to each other in the network knowledge of word associations. To recognize a paradigmatically related word, one needs to access the "deep" knowledge of how words are categorically/conceptually related to each other (noun-noun, verb-verb, adjective/adverb-adjective/adverb). To recognize a syntagmatically related word, one needs to access the sequential knowledge of how words collocate or cooccur in the same structure (noun-adjective/verb, verb-noun/adverb, adjective/adverb-noun/verb).

Thus, the findings from the vocabulary knowledge tests altogether can be interpreted as follows. L2 students with limited language proficiency possess vocabulary knowledge which contains a small number of words and connections between words. Although their vocabulary knowledge may contain some tightly connected words that were acquired through repeated practice in classroom, it is not well developed as system and does not have dimensions and components

clearly differentiated. L2 students with higher level of language proficiency possess vocabulary knowledge which contains a large number of words and many more connections between and among words. As vocabulary knowledge becomes more sophisticated as system, its dimensions and components (breadth and depth, paradigmatic and syntagmatic word associations) are more differentiated to serve to functional use of the language in contexts.

Reading comprehension: The results of recall indicated that as students have more experiences with L2 learning, they become more adept at reading a text written in the language develop. The findings that students at all proficiency levels recalled the academic text significantly more poorly than the general text and that there were reliable correlations between recall of the general text and recall of the academic text only for advanced level students suggest that the academic text was difficult and unable to differentiate among less proficient students in terms of how much content of the text they understood.

Although the two texts used in this study are written for general audience in Japan, the effects of the texts on reading comprehension for these L2 students were strikingly obvious. The general text is a short essay that appeared in a column of the Asahi newspaper. The topic, joy of travel and cross-cultural experience, may be somewhat familiar to the readers including this study's participants. The academic text is an essay from a book written by a primatologist. The topic, 'cultural' behaviors of Japanese monkeys and the author's interpretations of them, is likely to be unfamiliar to most readers including this study's participants. As such the text requires the readers pay close attention to what is explicitly asserted in the text (i.e., linguistic input), which had a severe impact on the reading for L2 students with limited language proficiency.

Relationship between breadth and depth of vocabulary knowledge and reading comprehension:

The findings that regardless of level of language proficiency, vocabulary breadth was reliably correlated with recall of both the general text and the academic text suggest that vocabulary size is critically important to reading comprehension of expository texts in L2, confirming previous research findings (Horiba, 2012; Qian, 1999, 2002). Knowledge of basic meanings of words as well as form-meaning connections makes it easier to recognize individual words in a text. Efficiency in word recognition allows working-memory resources to be allocated to the processing of larger chunks of information (e.g., phrases, clauses and sentences), facilitating integration of meaning. Therefore, the benefit from vocabulary size or breadth of vocabulary knowledge is a general one that is applicable to all kinds of texts for all readers.

The results also suggest that the relationships between breadth and depth of vocabulary knowledge and reading comprehension may differ depending on the reader's level of language proficiency and the type of text. As for the general text, the results showed that vocabulary breadth

was significantly correlated with recall for all proficiency groups and that the correlations were greater for less proficient students than for more proficient students. Recall of the general text had near-significant correlations with vocabulary depth (syntagmatic and total) only for the advanced students. These findings suggest that the relative importance of vocabulary size in the reading comprehension of a general text gradually diminishes as students develop general language proficiency. Students at a higher level of proficiency are expected to possess richer grammar knowledge and better processing skills of the target language. Because of the availability of various knowledge sources and processing skills, vocabulary breadth or size plays a smaller role (relatively speaking) in the reading comprehension of a general text for highly proficient students.

As for the academic text, it was found that vocabulary depth (syntagmatic and total), in addition to vocabulary breadth, had significant correlations with recall for the advanced students. These results suggest that in addition to knowledge of basic meanings of words, knowledge of word associations plays an important role when L2 students read an academic text which is linguistically and propositionally complex, confirming the previous studies (Horiba, 2012; Qian, 1999, 2002). It is reasonable to conceive that because knowledge of syntagmatic word associations concerns with word collocations or cooccurrences, this knowledge is relevant to the process of extracting propositions from sentences in a text. A proposition is a smallest unit of meaning which is verifiable. For example, a sentence "A black cat chased a white mouse" consists of three propositions: [CHASE CAT MOUSE], [MOD CAT BLACK] , and[MOD MOUSE WHITE]. With the support of general world knowledge, propositions act as building blocks for the construction of a mental representation of events and the situation described in the text (Kintsch, 1998). In this connection, some ideas of the role of vocabulary knowledge in cognitive-oriented reading research may be useful. According to Perfetti (2007; Perfetti and Stafura, 2014), quality of lexicon or vocabulary knowledge affects not only word identification and recognition but also the word-to-text integration processes that are involved in connecting ideas between sentences or short stretch of text as comprehension emerges with the construction of a mental model of the text.

7. Conclusion

This study examined the effect of language proficiency and the effect of text in a single study for Thai-speaking learners of Japanese. The findings about the relation between breadth and depth of vocabulary knowledge were discussed from a cognitive perspective. These findings also shed light on reading comprehension. The following conclusions were drawn. First, breadth and depth of vocabulary knowledge develop in line with general language proficiency. Dimensions and components of vocabulary knowledge become more distinct for students with higher level of language proficiency. Second, students' reading comprehension abilities appear differently

depending on the type of text (i.e., general vs. academic). Third, breadth of vocabulary knowledge is important to reading comprehension for students at all proficiency levels and for both general and academic texts. For advanced level students, knowledge of syntagmatic word associations as well as knowledge of basic word meanings is important to reading comprehension of an academic text.

There were some limitations of the study and implications for future research. First, the relation between breadth and depth of vocabulary knowledge and reading comprehension in L2 Japanese was examined by utilizing vocabulary tests and recall scores. Research is needed to investigate how different components of vocabulary knowledge may be used online when L2 readers progress through the processing of a text. Second, the academic text was difficult and unable to analyze the effect of depth of vocabulary knowledge on reading comprehension for lower proficiency level students. Use of multiple texts with linguistic difficulty comparable to the students' proficiency level is recommended for future research. Third, the present study assessed reading comprehension by using a recall-in-L1 task when students read a text for a general purpose. This research should be extended to investigate the relation between vocabulary knowledge and reading comprehension in the context of the goal-oriented reading where students process single or multiple texts with various goals. Finally, some educational implications can be drawn based on the study's findings. First of all, teachers need to have a better understanding of how different dimensions and components of vocabulary knowledge may develop and contribute to reading comprehension of texts in L2. Decisions they make regarding the design and selection of vocabulary learning and reading activities should be based on updated professional knowledge.

Secondly, teachers need to recognize the fact that the so-called 'linguistic distance' or differences between the student's L1 and the target language exists at multiple levels, from orthography to lexicon and morphosyntax and discourse. One can say that Japanese is a truly foreign or 'distant' language for L1 Thai speakers. The Japanese uses a combination of a logographic system called kanji (i.e., Chinese characters) and two sets of syllabaries called kana (i.e., hiragana and katakana). Morphosyntactically, the Japanese is as agglutinative SOV language that employs a case-marking system. Thai is an isolating SVO language, and its orthography employs the abugida system of writing (or alphasyllabaries). This leads to the following recommendations.

As for the orthographic level, L2 students need to acquire knowledge of kanji and kango (words written in kanji) that is needed to process written sentences in Japanese. A kanji character represents a morpheme or a word. It is used for the core part of a word while hiragana is used for the stem part of the word (e.g., 歩く: /aru-ku/ meaning 'to walk') as well as for case-marking particles. Kanji characters are also used in combination to represent a word (e.g., 歩 /ho/ "to walk" + 行 /koo/ "to go" = 歩行: /ho-koo/ meaning 'walking'). The proportion of kanji/kango contained

in a text increases as L2 students progress in their language learning and are encouraged to process more authentic materials. Receptive vocabulary knowledge relevant to reading tends to be highly correlated with kanji knowledge (Matsushita et al., 2021). As for the lexical level, vocabulary learning must go beyond the heavy reliance on a list of L2 word and its L1 translation. It is because the boundaries between words in the same semantic domain tend differ in different languages (especially in linguistically distant languages). The differences in semantic boundaries or mapping further complicate the learning of word collocations or cooccurences (i.e., syntagmatic relations) and category-case relations (i.e., paradigmatic relations) in a second language. For example, regarding temperature related adjectives, 暑い (/atsui/ "hot"), 暖かい (/atatakai/ "warm"), and 寒い (/samui/ "cold") are used for a day as in 暑い or 暖かい or 寒い日 ("a hot, warm, or cold day"). However, 熱い (/atsui/ "hot), ぬるい (/nurui/ "lukewarm"), and 冷たい (/tsumetai/ "cold") are used for coffee as in 熱い or ぬるい or 冷たいコーヒー ("hot, lukewarm, or cold coffee"). Regarding "wear/put-on" related verbs, 着る (/kiru/ "to wear/put-on") is used for a coat and a shirt as in コートor シャツを着る ("to put on a coat or a shirt"), whereas はく (/haku/ "to wear/put-on") is used for a skirt and shoes as in スカート or 靴をはく ("to put on a skirt or shoes"). However, かぶる (/kaburu/ "to wear/put-on") is used for a hat as in 帽子をかぶる ("to put on a hat").

Therefore, as part of vocabulary instruction, students need to be sensitized about the semantic relations between and among words. For example, students can benefit from word sorting activities in which they are asked to identify words in category-case relations (i.e., paradigmatic relations) or they are asked to identify pairs of words that tend to collocate or cooccur in sentences (i.e., syntagmatic relations). This type of activities is believed to be more effective when students work on a group of words that are already 'known' to them. Another useful activity is the analysis of a text after reading (thus whose content is generally understood) in terms of how words are used in relation to one another within and between sentences in the text. Identification of word collocations and cooccurrences in the structure is related to the extraction of propositions that represent events and ideas described in the text. Explicit attention to word collocations and cooccurrences is partly supported by grammatical knowledge but it may also facilitate the development of morphosyntactic knowledge. On the other hand, identification of words that are paradigmatically related in a text is related to the understanding of case-category or case-case relations in the text. For example, the general text used in the present study contains 面白さ (/omoshirosa/ "fun") and 醍醐味 (/daigomi/ "thrill"), and 興奮する (/kouhun-suru/ "get excited") and びっくりする (/bikkuri-suru/ "get astonished") as paradigmatically related words, respectively. Explicit attention to paradigmatic word relations in the text may help students become more aware of topical development and coherence of the text.

Notes

1 Data obtained from the Thai students in an earlier study (c.f., Horiba, 2022) were used and reanalyzed for the purpose of the present study. The reliability of the breadth and the depth test was verified based on the data from L2 learners (approximately 300 people) (breadth test: Cronbach-α = .95, depth test: Cronbach-α = .82).

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Received: 2025/02/24

Received: 2025/04/02

Revised: 2025/04/03