ISSN e2311 7575

International Journalof Management and Leadership Studies (IJMLS)

IJMLS
International Journal of Management and Leadership Studies (IJMLS)

Volume 3, Issue II, October, 2021

INTERNATIONAL JOURNAL OF MANAGEMENT AND LEADERSHIP STUDIES

International Journal of Management and Leadership Studies (IJLMS)

Corresponding Editor
Dr. John Cheluget
Email: jcheluget@mua.ac.ke

Publisher
The Management University of Africa
P. O. Box 29677 - 00100, Nairobi, Kenya.
Belleview, Popo Road, off Mombasa Road, South C.
Tel:+254 20 2361161
Mobile: +254 722 224193, +254 706 035299

International Journal of Management and Leadership Studies
2021; 3(ii): 20-45
eISSN 2311 7575

MACRO AND MICRO-INVESTIGATION OF THE RELATIONSHIPS AMONG THREE ASPECTS OF LEXICAL KNOWLEDGE

Tohru Matsuo

Osaka Jogakuin University, Japan

ABSTRACT

The purpose of this study is to explore two levels of relationship among three aspects of lexical knowledge: vocabulary size, polysemy and collocational knowledge. The first level is macro relationship, which is general relationship among these aspects of lexical knowledge. The second is micro relationship which is a relationship among the three aspects of vocabulary knowledge of 12 anchored words. The participants were a total of 167 Japanese EFL university students whose English proficiency was relatively low. The results of macro analysis indicated that strong correlations among the Vocabulary Size Measure, the Revised Word Associates Polysemy Test, and the Revised Word Associates Collocation Test, which suggested that vocabulary size and two aspects of depth of vocabulary knowledge are closely related. On the other hand, the results of micro analysis implied that strong item dependency and wide individual variation; thus, no clear hierarchical acquisition pattern was identified for these aspects of lexical knowledge for the EFL learners in this study.

Keywords: lexical knowledge, vocabulary size, polysemy, collocation

INTRODUCTION

Recent research has consistently reported the significant role that lexical knowledge plays in both receptive skills and productive skills. (e.g., Grabe, 2009; Milton, 2009; Nation, 2001, 2013a; Schmitt, 2010). Therefore, developing an adequate quantity and quality of lexical knowledge is crucial for language learners. Most vocabulary researchers have agreed that lexical knowledge consists of a number of multifaceted constructs or several dimensions

(Nation, 2001; 2013a; Qian, 1998, 2002; Daller, Milton, and Treffers-Daller., 2007). Even though different researchers have suggested various frameworks of lexical knowledge, two dimensions, vocabulary size and depth of vocabulary knowledge have been widely common among researchers. Vocabulary size refers to how many words a learner knows, while depth refers to how well a learner knows individual word. This study aims to investigate the relationship among Japanese EFL students' written receptive vocabulary size and depth of vocabulary knowledge, specifically knowledge of polysemy and collocational knowledge. Polysemy refers to words that have more than one related meaning (Crossely, Salsbury, & McNamara, 2010). For this study, knowledge of polysemy is restricted to adjectives (e.g., *bright* and *calm*). Collocation refers to lexical cohesion, which involves a relationship between lexical items that frequently co-occur (Liu, 2010). It is restricted to noun-adjective combination in this study (e.g., *direct flight* and *calm person*).

LITERATURE REVIEW

Even though vocabulary researchers have contrasted vocabulary size and depth of vocabulary knowledge as though they are two distinct dimensions of vocabulary knowledge (e.g., Anderson & Freebody, 1981; Bogaards & Laufer, 2004; Daller et al., 2007; Haastrup & Henriksen, 2000), several researchers have suggested that they are closely related (Milton, 2009; Qian 1998, 2002; Read, 2004). That is, the more words learners know, the more they are likely to know about individual words they encounter or use. Read (2004) argued that this parallel development of vocabulary size and depth makes sense when adopting a network building perspective of depth of knowledge. In this perspective, vocabulary growth means that more extensive linkages are created among words in the mental lexicon.

Nurweni and Read (1999) explored the vocabulary knowledge of 324 first-year Indonesian university students. The authors employed three instruments to measure the size and depth of their participants' vocabulary knowledge. First, a word translation task was used to measure vocabulary size. One hundred forty-three words were selected from the 2,000 most frequent words in the General Service List (West, 1953), and 57 words were selected from the University Word List (Xue & Nation, 1984). Each item was presented in an English sentence to provide a linguistic context for the word. For assessing depth of vocabulary knowledge, the Word Associates Test (Read, 1993) was used to measure synonym, polysemy, and collocational knowledge. This test consisted of 50 items, each of which had four correct answers for a total of 200 points. In addition, oral interviews were conducted with a randomly

selected 39 students to elicit depth of vocabulary knowledge. The same 50 target words on the Word Associates Test (WAT) were used.

The Pearson correlation coefficient obtained between the word translation test and the WAT was .62 ($p < .05$). In order to investigate whether the relationship between vocabulary size and depth varied according to proficiency level, the participants were divided into three groups (high, middle, and low) based on their scores on a national examination for senior high school students. The relationship between size and depth of vocabulary knowledge was strong for the high proficiency students ($r = .81$, $p < .05$), while the correlation between the two measures was moderate for the middle proficiency students (42% of the participants) ($r = .43$, $p < .005$). Only a weak correlation was obtained between the two measures for the low proficiency students (48% of the participants) ($r = .18$, $p < .05$). Nurweni and Read (1999) argued that the students in the high proficiency group performed well on both tests; thus, these students not only knew most of the target words but also knew them relatively well. On the contrary, most of the students in low proficiency group performed poorly on the both tests; thus, they knew fewer words and their depth of vocabulary knowledge was relatively undeveloped.

One limitation of Nurweni and Read's study was that they employed different types of vocabulary tests. A word translation task was used to measure vocabulary size and the WAT was utilized to measure depth of vocabulary knowledge; these tests present test-takers with different tasks. For instance, a word translation task require the test-takers to access a word that is equivalent in their first language, whereas the WAT is a multiple-choice test that does not always require test-takers to access a precise L1 meaning. Hence, it is unclear whether some of the differences between vocabulary size and depth of vocabulary knowledge were due to different item formats.

Akbarian (2010) investigated the relationship between vocabulary size and depth of vocabulary knowledge with 112 (48 male and 64 female students) Iranian learners of English, who were graduate students at different universities. The Vocabulary Levels Test (VLT)(Schmitt, Schmitt, & Clapham, 2001) was employed to measure vocabulary size. A 40-item version of the WAT (Read, 1993) was used to measure depth of vocabulary knowledge. A linear regression analysis was conducted with the VLT as a predictor and the WAT as the dependent variable. The results indicated that the VLT accounted for about 75% of the variance in WAT scores. These results indicated that the participants' vocabulary size and depth were closely related and they shared substantial variance.

Akbarian (2010) argued that the larger amount of shared variance between the two dimensions for the high proficiency group indicated that vocabulary size and depth are closely related.

However, Akbarian also suggested that the two dimensions are not identical, as 22-30% of the variance in the WAT was not explained by the VLT. Furthermore, the author argued that the findings for the low proficiency group imply that the development of depth of vocabulary lags behind that of vocabulary size. He hypothesized that ESP/EAP Iranian learners tend to first learn a number of words, and then they start acquiring network knowledge; thus, they are likely to acquire additional information about individual words more once their vocabulary has reached a certain size (i.e., 2,000 words). Akbarian concluded that the results are in accordance with those of Nurweni and Read (1999); while vocabulary size and depth of vocabulary knowledge might converge for L2 learners who are relatively advanced, the two dimensions are more distinct for lower proficiency L2 learners.

Gaps in the literature

The research reviewed above provide significant insights about the relationship between L2 learners' vocabulary size and depth of vocabulary knowledge, specifically polysemy and collocational knowledge. However, there are two main gaps. The first is that the participants in Nurweni and Read's study have been ESL students whose English proficiency is higher than the Japanese EFL students in this study. Even though the participants in Akbarian study are EFL students, they are graduate students whose English proficiency is considered to be at an advanced level. Therefore, it is necessary to investigate the relationship between relatively low proficiency Japanese EFL learners' vocabulary size and depth of vocabulary knowledge. The second is that all previous studies investigated the macro relationship between learner's vocabulary size and depth of vocabulary knowledge. No research has explored the micro relationship among vocabulary size, polysemy, collocational knowledge. Hence, it is essential to investigate these relationships within the same words.

METHODOLOGY

Research Questions

1. What is the relationship among Japanese EFL learners' vocabulary size, polysemy, and collocational knowledge?
2. Is there any hierarchical acquisition pattern for these three aspects of lexical knowledge?

Participants

The participants in this study were 94 first-year and 72 second-year university students majoring in law. The first-year students were in four intact classes and were enrolled in three

English classes per week. They were streamed into their classes based on the results of the TOEIC Bridge test. Their English reading proficiency was from novice to low-intermediate, as they were mostly capable of performing reading tasks from novice to low-intermediate level according to the guidelines set by the American Council on Teaching of Foreign Language (1986). General English Course 1A, which met for two 90-minute lessons per week, was taught by a Japanese English teacher, and the Communicative English course, which met for one 90-minute lesson per week, was taught by a native speaker of English. General English Course 1A was focused on TOEIC preparation and on developing reading skills, such as scanning and skimming, and the Communicative English course was focused on listening and speaking skills and on learning vocabulary and multi-word expressions useful for engaging in short conversations in English.

The second-year students were in three intact classes. Their English reading proficiency ranged from high-novice to mid-intermediate; thus, they were mostly capable of performing reading tasks in these levels set by the American Council on Teaching of Foreign Languages (1986). They were assigned to their classes based on the results of the IP TOEIC test they had taken the previous academic year. They were enrolled in two English courses: General English 2A and 2B and a Basic Writing course, both of which met for once per week for 90 minutes. These students were expected to further develop reading strategies, such as guessing words from context, categorizing information, skimming, and scanning, and to prepare for the TOEIC test.

Instruments

Vocabulary Size Measure

The Vocabulary Size Measure was based on Form 1 of the Vocabulary Size Test (Nation, 2008). The words included on the Vocabulary Size Test are based on twenty 1,000 BNC word lists developed by Nation (2006). Two changes were made. First, the total of 12 original items (three items x four word frequency levels) were replaced with three new items in the first through fourth 1,000 word frequency bands. These 12 original items were selected based on the following rules. First, adjectives were selected because all 12 target words were adjectives. Second, problematic items such as *nil* and *basis* were deleted based on the pilot study, which was conducted the previous year with participants at a similar English proficiency. Third, a table of random numbers was used to select the remaining original target words. For each of the 12 new target items, a stem sentence and four options were created following the test specifications and guidelines for the Vocabulary Size Test (See Nation, 2013b for detail).

Twelve words were added to the Vocabulary Size Measure and they served as anchor items across the three instruments, the Vocabulary Size Measure, the Revised Word Associates Polysemy Test, and the Revised Word Associates Collocation Test. The anchored words were included to investigate whether the three aspects of lexical knowledge—vocabulary size, polysemy, and collocational knowledge—formed a hierarchy of acquisition. These new items were checked with three native English speakers who hold doctoral degrees in the field of education (TESOL). The original items in Vocabulary Size Test and 12 anchor words are shown in Table 1.

Table 1: Original Items in Vocabulary Size Test and Anchor Items Across Three Lexical Instruments

Frequency band	Original target words	New target words
First 1,000	poor, figure, basis	even, brief, direct
Second 1,000	upset, nil, pro	calm, fresh, bright
Third 1,000	dinosaur, rove, lonesome	bare, vague, remote
Fourth 1,000	candid, tummy, quiz	ripe, ample, and modest

Second, the number of items on the original Vocabulary Size Test was truncated from 140 to 60 items. The new test was made up of 10 words per frequency level from the first to sixth 1,000 levels. In a pilot test administered to 150 students, the items from the first 1,000 to the eighth 1,000 word frequency levels were used to estimate the participants' knowledge of written receptive vocabulary. The results of the pilot test indicated that most learners' vocabulary sizes were between 3,000 and 4,000 words and that they rarely knew items beyond the sixth 1,000 word frequency level.

The following is a sample item.

soldier: He is a **soldier**.

a. person in a business
b. student
c. person who uses metal
d. person in the army

Word Associates Test

The Word Associates Test (Read, 1998) was designed to assess two aspects of depth of vocabulary knowledge, polysemy and collocational knowledge. The test is made up of 40 target

items, all of which are adjectives. The following shows a sample item from the original Word Associates Test (Read, 1998).

common

Complete	light	ordinary	shared	boundary	circle	name	party

As shown in this example, the test consists of one target word, *common* in this example, and eight options divided into two sets of four words. Two of the adjectives in the left box are synonyms of the target word (*common-ordinary, common-shared*). The right box contains nouns, two of which are collocates of the target item (c*ommon boundary, common name*). There are four correct options, and in this example, the correct answers are evenly divided between the two boxes (i.e., two in the left box and two in the right box). However, the correct options can also be distributed with one in the left box and three in the right box or three in the left box and one in the right box to make guessing more difficult. The main advantage of this format is that it can assess both knowledge of polysemy and collocations simultaneously. In the original test, each correct answer is awarded 1 point and the scores for polysemy and collocational knowledge are summed; thus, the maximum possible score is 160 (4 points per item x 40 items = 160 total points).

However, pilot studies indicated that having more than two correct answers per item is problematic because that format did not reliably distinguish between low and high ability test-takers' depth of vocabulary knowledge (Matuso, 2012). Furthermore, the two aspects of vocabulary knowledge measured by the test, polysemy and collocational knowledge, formed different constructs, which suggests that they should be tested and scored separately (Matsuo, 2012). The two instruments designed to measure polysemy and collocational knowledge are described in the following two sections.

Revised Word Associates Polysemy Test

The Revised Word Associates Polysemy Test is designed to measure knowledge of polysemy. Due to the above-stated problems, the original Word Associates Test was revised and a traditional multiple-choice format in which there is only one correct answer was used. In addition, the test was divided into two tests so that test-takers' knowledge of polysemy and collocation were assessed separately. Because the original Word Associates Test was revised, this test was named Revised Word Associates Polysemy Test. In the Revised Word Associates Polysemy Test, test-takers are required to choose the option that shares the closest meaning to

that of a headword. In the sample item shown below, the headword is *general* and the correct answer is *b*, *whole*.

general

a. closed

b. whole

c. different

d. same

Even though both the Vocabulary Size Measure and the Revised Word Associates Polysemy Test are based on form-meaning relationships, the Revised Word Associates Polysemy Test differs from the Vocabulary Size Measure in two ways. First, while the Vocabulary Size Measure items assess the primary meaning of the target words, 42 items (out of 60 items) in the Revised Word Associates Polysemy Test measure the secondary meaning of the target words. For example, *bright* is defined as *a lot of light* in Vocabulary Size Measure, but *clever* on the Revised Word Associates Polysemy Test. Another difference is that the Vocabulary Size Measure generally tests whether test-takers know the definition of the target word, whereas the Revised Word Associates Polysemy Test is designed to measure knowledge of a word that shares a meaning of the target word.

In order to make the Revised Word Associates Polysemy Test consistent with Vocabulary Size Measure, ten stimulus words were selected from each of the first six 1,000 word frequency levels. Thus, there were a total of 60 items on this test (six word frequency levels x 10 items per level = 60 total items). For the selection of the target items, 29 items were employed from the Read's original Word Associates Test, and 31 items were added. The 31 items were selected from the first 4,000 high frequency words of JACET 8,000 word list (Aizawa, Ishikawa, & Murata, 2005) based on the following procedure. First, because the target words were adjectives, only adjectives were chosen. Then, each adjective was checked using the Thesaurus.com webpage to ensure that it has a clear secondary meaning. Because Read's original Word Associates Test had one to three correct answers for each target item, 71 words were employed from Read's original Word Associates Test, and 169 words were added. These words were also selected from the first 3,000 high frequency words of JACET 8,000 word list so that each target item had one correct answer with three distractors. The options were selected from the words whose frequency levels were the same or higher than those of the target words.

Revised Word Associates Collocation Test

The original Word Associates Test was revised and divided into two tests. Therefore, this test was called the Revised Word Associates Collocation Test. In the Revised Word Associates Collocation Test, test-takers are required to choose the option that collocates with the

headword. In the sample item below, the headword is *general* and the correct option is b, *idea* (i.e., The collocation is *general idea*).

general .

a. country

b. idea

c. return

d. street

In order to make this instrument consistent with the Vocabulary Size Measure and the Revised Word Associates Polysemy Test, ten stimulus words were selected from each of the first six 1,000 word frequency levels. Thus, there were a total of 60 items on this test (six word frequency levels x 10 items per level = 60 total items). Because the same target items as the Revised Word Associates Polysemy Test were used, and procedures of creating options were identical to those of the Revised Word Associates Polysemy Test; 59 words were employed from Read's original Word Associates Test, and 181 words were added from JACET 8,000 word list (Aizawa et al., 2005).

Procedure

All the instruments were administered during scheduled class period. The first-year participants completed the Vocabulary Size Measure, and two days later they completed the Revised Word Associate Polysemy Test. Five days later, they completed the Revised Word Associate Collocation Test. The second-year participants completed the Vocabulary Size Measure, and the following week, they completed the Revised Word Associate Polysemy Test. In the following week, they completed the Revised Word Associate Collocation Test. Most of the participants completed each of the three tests in around 30 minutes.

The three instruments were administered in the above sequence to minimize learning effects; the participants were unlikely to check the secondary meanings of the target words after taking the Vocabulary Size Measure, and they were unlikely to check collocations after taking the Revised Word Associates Polysemy Test. If the order was changed, the participants would have been more likely to check a dictionary, which might have helped them answer the items on the following test.

The data from the three completed tests were entered into an Excel spread sheet, exported to WINSTEPS 3.69 (Linacre, 2010) in order to assess the validity and reliability of these tests using the Rasch dichotomous model (Rasch, 1960). Rasch model provides a way to construct person measures and item difficulty estimates and which orders persons and items on the same

interval logit scale (logarithm of odds unit). The Rasch model also provides a way to investigate the fit of items and persons to model expectations. For instance, misfitting items can indicate a bias or problems in the items, while test-takers who mistfit the model can indicate numerous problems, such as not answering test items seriously. In addition, the Rasch model also provides a way to investigate dimensionality of the data through analyzing the item residuals. The results of Rasch Analysis indicated that vast majority of the items for the three vocabulary tests fulfill the criteria of good measurement, they adequately fit the Rasch model, they formed a fundamentally unidimensional construct, and there was a high degree of measurement invariance.

Results

Macro-analysis

Research question 1 asked what the relationship among the three aspects of lexical knowledge is. Pearson correlation coefficients were calculated to determine the degree to which the participants' vocabulary size, knowledge of polysemy, collocational knowledge, are related to one another. Table 2 shows the results of the Pearson correlation analysis among the Vocabulary Size Measure, the Revised Word Associates Polysemy Test, the Revised Word Associates Collocation Test. The strongest correlation was between the Vocabulary Size Measure and the Revised Word Associates Polysemy Test (r = .71, p < .001), and between the Revised Word Associates Polysemy Test and the Revised Word Associates Collocation Test (r = .70, p < .001). The correlation coefficient between the Vocabulary Size Measure and the Revised Word Associates Collocation Test was also strong (r = .62, p < .001). These results indicate that participants who know the primary meaning of more words tend to have greater knowledge of polysemy and collocations.

Table 2: Inter correlations for Three Instruments for Measuring Lexical Knowledge (N = 164)

Measure	1	2	3
1. Vocabulary Size Measure	—		
2. The Revised WAT Polysemy Test	.71**	—	
3. The Revised WAT Collocation Test	.62**	.70**	—

Note. ** = coefficients are significant at p < .001.

Micro-analysis

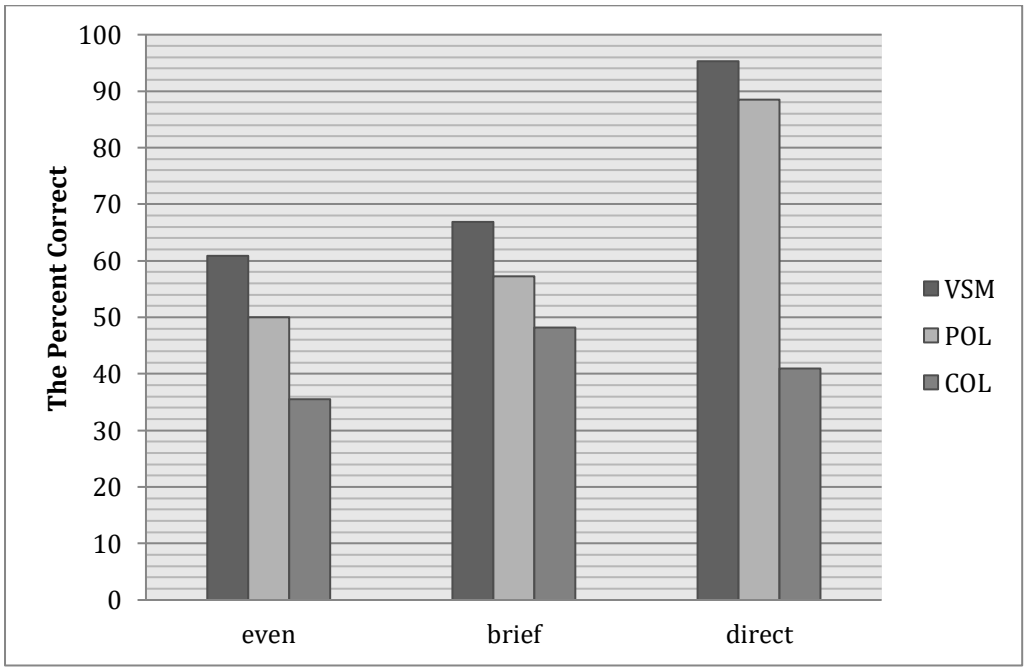
Research question 2 asked if any hierarchical acquisitional pattern for the three aspects of lexical knowledge. The percent of participants who correctly answered each of the 12 anchor words on the Vocabulary Size Measure, the Revised Word Associate Polysemy Test, and the Revised Word Associates Collocation Test, was calculated in order to investigate whether there was an acquisitional hierarchy. Table 3 displays the percent of participants who correctly answered the 12 anchor words on the three instruments. The three anchor words at the first 1,000 word frequency level—*even*, *brief*, and *direct*—displayed a similar pattern. The percent of Vocabulary Size Measure was higher than that of The Revised Word Associates Polysemy Test. In turn, the Revised Word Associates Polysemy Test was higher than that of the Revised Word Associates Collocation Test.

Table 3: Percentage of Participants Who Correctly Answered 12 Anchor Words on Three Aspects of Lexical Knowledge

Target words	Frequency	VSM	POL	COL
even	1K	60.84	50.00	35.54
Brief	1K	66.87	57.23	48.19
Direct	1K	95.28	88.55	40.96
Calm	2K	60.84	19.88	57.23
Fresh	2K	79.52	80.12	90.96
Bright	2K	57.83	63.86	73.94
Bare	3K	39.76	50.60	30.12
Vague	3K	45.78	54.22	57.83
Remote	3K	80.12	54.22	37.95
Ample	4K	16.87	25.90	39.76
Ripe	4K	49.40	16.27	32.53
Modest	4K	28.31	18.67	48.80

Note. Freq = Frequency; VSM = Vocabulary Size Measure; POL = The Revised Word Associates Polysemy Test; COL = The Revised Word Associates Collocation Test;the unit of the score is percentile; 1K = the first 1,000 word frequency level; 2K = the second 1,000 word frequency level; 3K = the third 1,000 word frequency level; 4K = the fourth 1,000

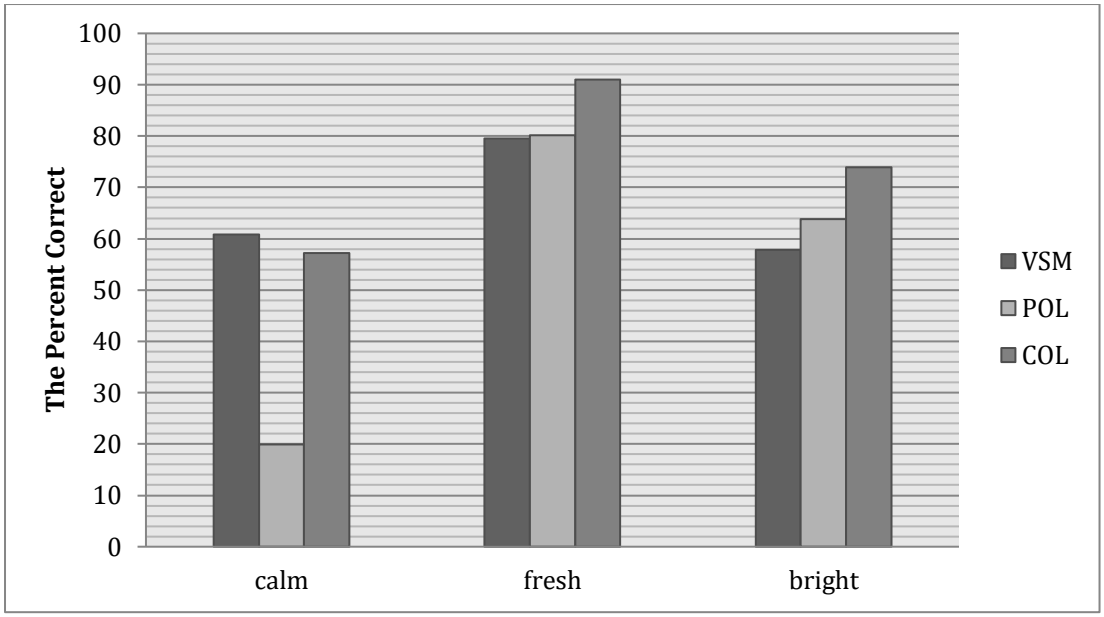
Figure 1 graphically displays the percent of the three anchored words in the first 1,000 word frequency level. Figure 1 shows the order of difficulty for the three aspects of lexical knowledge. In addition, the figure shows that *direct* was much easier than *even* and *brief*, especially in terms of vocabulary size and polysemy. However, *fresh* and *bright* in the second 1,000 word frequency level showed a reverse order compared to those in the first 1,000 word frequency level. That is, the percent of these words on the Revised Word Associates Collocation Test was higher than that on the Revised Word Associates Polysemy Test. In turn, the percent on the Revised Word Associates Polysemy Test was higher than that on the Vocabulary Size Measure. For the word *calm*, the percent correct on the Vocabulary Size Measure was higher than that on the Revised Word Associates Polysemy Test, while the percent correct on the Revised Word Associates Polysemy was extremely low.



Note: *VSM = Vocabulary Size Measure; POL = The Revised Word Associates Polysemy Test; COL = The Revised Word Associates Collocation Test; the unit of the score is percent correct.*

Figure 1: Percentile of the three anchor words in the first 1,000 word frequency level on the three aspects of lexical knowledge.

Figure 2 shows the percent correct of the three anchor words on the second 1,000 word-frequency level. *Fresh* was much easier than other two items for all three aspects of lexical knowledge. In addition, Figure 2 indicates that the individual anchor words on the three aspects of lexical knowledge behaved very differently from one another; thus, there were no predictable patterns regarding the anchor words in the second 1,000 word frequency level.

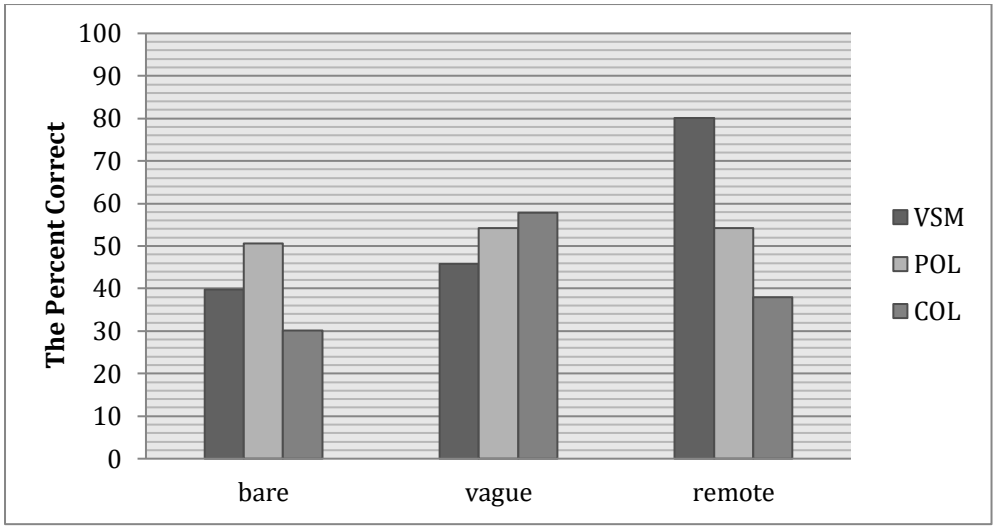


Note: *VSM = Vocabulary Size Measure; POL = The revised Word Associates Polysemy Test; COL = The revised Word Associates Collocation Test; the unit of the score is percent correct.*

Figure 2: The percentile of the three anchor words in the second 1,000 word frequency level on the three aspects of lexical knowledge.

The three anchor words in the third 1,000 word frequency level also behaved differently from one another. The percent correct on the Revised Word Polysemy Test was highest for *bare*, and it was followed by the Vocabulary Size Measure, which was higher than that of the Revised Word Collocation Test by about 9%. V*ague* was answered correctly more frequently on the Revised Word Associates Collocation Test compared to the Revised Word Polysemy Test, although the difference was only about 4%. The Vocabulary Size Measure had the lowest percent correct. On the contrary, for *remote*, the Vocabulary Size Measure was higher than the Revised Word Polysemy Test, which was higher than the Revised Word Collocation Test. This pattern was similar to the anchor words in the first 1,000 word-frequency levels.

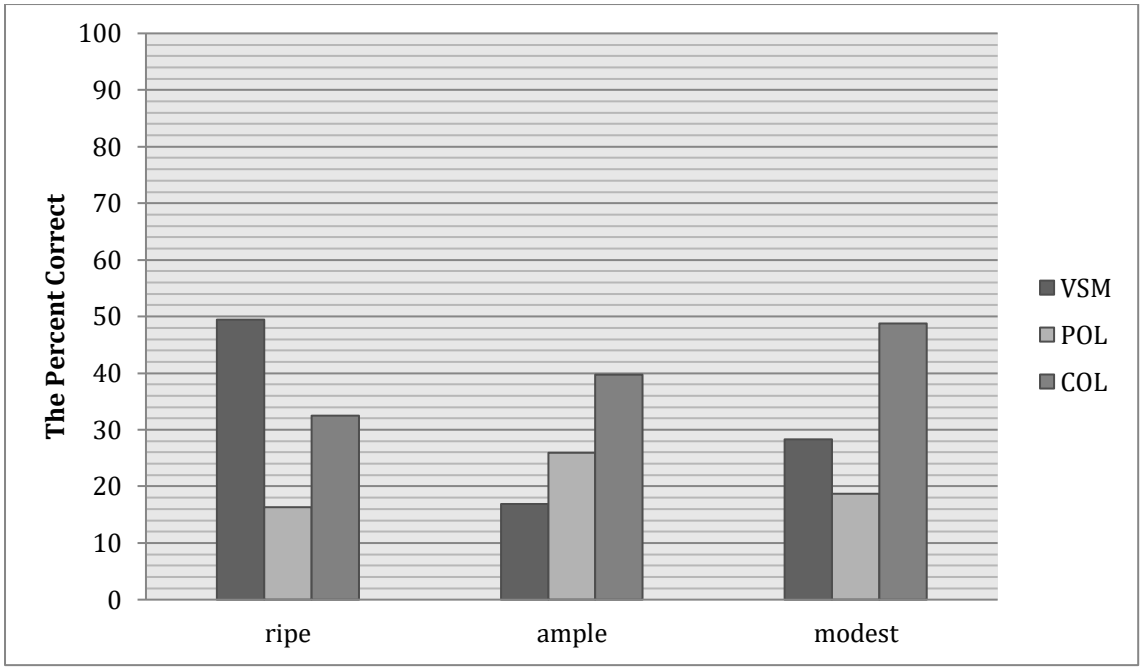
Figure 3 graphically displays the percent correct for the three anchor words in the third 1,000 word frequency level on the three instruments. *Remote* was easier than other two words on the Vocabulary Size Measure. In addition, similar to the second 1,000 word frequency level, Figure 3 shows that the three aspects of each anchor word behaved differently; thus, no pattern regarding the difficulty order for the three aspects of lexical knowledge emerged.



Note: *VSM = Vocabulary Size Measure; POL = The revised Word Associates Polysemy Test; COL = The revised Word Associates Collocation Test; the unit of the score is percent correct.*

Figure 3: The percentile of the three anchor words in the third 1,000 word frequency level on the three aspects of lexical knowledge.

The three anchor words in the fourth 1,000 word frequency level also behaved differently from one another. *Ample* had a lower percent correct on the Vocabulary Size Measure than on the other two instruments, while the Revised Word Associates Polysemy Test had a higher percentage than the Revised Word Associates Collocation Test. On the contrary, *ripe* was answered correctly more frequently on the Vocabulary Size Measure than on the other two instruments, and the Revised Word Associates Collocation Test had a higher percentage than the Revised Word Associates Polysemy Test. *Modest* was answered correctly most frequently on the Revised Word Associates Collocation Test, and the Vocabulary Size Measure had a higher percentage than the Revised Word Associates Polysemy Test. Figure 4 graphically displays the percent correct for the three anchored words in the fourth 1,000 word frequency level on the three lexical instruments.



Note: *VSM = Vocabulary Size Measure; POL = The Revised Word Associates Polysemy Test; COL = The Revised Word Associates Collocation Test; the unit of the score is percent correct.*

Figure 4: The percentile of the three anchor words in the fourth 1,000 word frequency level on the three aspects of lexical knowledge.

In sum, even though the anchor words in the first 1,000 word frequency level showed a hierarchical pattern for the three aspects of lexical knowledge, the anchor words for the rest of the frequency levels did not show an order of difficulty. The results indicated that there was considerable item dependency and great individual variation for each anchor word on the three aspects of lexical knowledge.

Discussion

The macro-analysis of the relationship among the three aspects of lexical knowledge as shown in Table 2 showed strong correlations among the three measures. This finding supports previous research (Akbarian, 2010; Nurweni & Read, 1999, Qian, 1998, 2002) indicating that two dimensions of lexical knowledge, vocabulary size and depth of vocabulary knowledge, are closely related. The more learners expand their written receptive vocabulary—even when their knowledge of a word is partial—the more likely they are to learn about various aspects of those words, such as their common collocations. This study is the first to produce this finding for relatively low proficiency EFL learners.

It is possible to outline the process of lexical acquisition using usage-based models of second language acquisition theory. In usage-based models of language acquisition, language

acquisition is fundamentally regarded as sequence learning, starting from sub-lexical phonological strings to lexical items and then to probabilistic sequences of strings that form collocations or multi-word units (Ellis, 1996). Hence, it is plausible that learners acquire the core meaning of single words initially and then acquire secondary meanings or collocates later. The micro-analyses of the 12 anchored words in terms of vocabulary size, polysemy, and collocational knowledge indicated strong item dependency and wide individual item variation. Hence, the results do not imply a clear hierarchical pattern for acquiring these aspects of lexical knowledge for EFL learners at this proficiency level. Four factors led to these inconclusive results: (a) the nature of the input or word meanings taught in school; (b) the influence of the L1 lexicon or schemata, particularly on collocational knowledge; (c) loanword status, and (d) different sensitivity of the three instruments used in this study. I next consider these four factors in turn.

First, the nature of the input or word meanings taught in school might have influenced some of the results. For example, in Figure 3 the percentage of correct responses for *remote* on the Vocabulary Size Measure was much higher than for other words in the third 1,000 word frequency level. Figure 4 also showed that the percentage of correct responses for *ripe* on the Vocabulary Size Measure was much higher than for other words in the fourth 1,000 word frequency level. The unexpectedly high number of correct responses might have occurred because the participants had learned the primary meanings of *remote* and *ripe* in a TOEIC preparation class two weeks before the Vocabulary Size Measure was administered. The participants were instructed to check the appropriate meaning of these words in sentences on a transcription of the TOEIC listening section using an electronic English-Japanese dictionary. Moreover, the students took a quiz in which they were required to translate the meaning of these words in Japanese. Because these words were taught explicitly, it was possible that they remembered their meanings.

Figure 2 indicates that the percentage correct for *calm* on the Revised Word Associates Polysemy Test was much lower than for the other two items for all three aspects of lexical knowledge. The item appeared as follows on the Revised Word Associates Polysemy Test.

calm

a. large

b. still

c. open

d. usual

The target word *calm* was meant to indicate *without much wave or wind*. Therefore, the correct answer is *b*, *still*, which means *without moving*. However, it was expected that the Japanese participants knew *still* as adverb (e.g., *I am **still** young.*), rather than this adjectival meaning of the word.

The learners' L1 also influenced their knowledge of collocations. Yamashita and Jiang (2010) argued that collocations are often cross-linguistic, that is, a collocation in one language frequently has a counterpart in another language unless culture-specific concepts are involved. For example, both English and Japanese have the identical collocation of *hot tea* (暑いお茶, *atsui ocha*). However, there are also many examples in Japanese and English in which the collocations differ. For instance, the phrase *strong tea* is expressed as *thick tea* (濃いお茶, *koii ocha*) in Japanese. Thus, specific lexical items used to express the same idea can vary between languages. Collocations can be classified as congruent collocations and incongruent collocations. The former share identical lexical elements in the L1 and target language and the latter contain different lexical elements. Thus, the learners' L1 plays an important role in the learning of collocations. Wolter (2006) suggested that the role of L1 in learning collocations can be both facilitative and inhibiting. When L2 learners encounter a new collocation that is L1 congruent, they should find it easy to comprehend it provided that they know the meaning of the words that make up the collocation. In contrast, even when L2 learners know the meanings of the individual words, they might find it difficult to comprehend or they might misunderstand the meaning of L1 incongruent collocations because they cannot rely on L1 collocational knowledge. Hence, L1 incongruent collocations should be more difficult to learn than L1 congruent collocations.

Table 4 shows the 12 anchor adjectives with noun collocates and the equivalent collocation in Japanese. Except for *even number*, all of the collocations are L1 congruent. This is one possible reason why the percentage correct for *even* on the Revised Word Associates Collocation Test was lower than for the other words in the first 1,000 word frequency level (see Figure 1). If learners know the meaning of the individual words, it is possible for them to comprehend the congruent collocations using knowledge of their L1.

Table 4: 12 Anchor Words with Collocated Words and Japanese Counterparts

English collocation	Japanese	Direct translation
direct flight	直行便	non-stop flight
even number	偶数	even number
brief note	短いメモ	short memo
fresh water	真水	unsalinated water
calm person	穏やかな人	relaxed person
bright future	明るい未来	bright future
bare feet	裸足	naked feet
vague answer	曖昧な答え	unclear answer
remote island	離島	far from main land
ample evidence	十分な証拠	enough evidence
ripe cheese	成熟したチーズ	mature cheese
modest improvement	あまり大きくない進歩	not big improvement

Second, the loanword status of the anchor words might have influenced the results. Figure 1 shows that the percentage of correct responses for *direct* on the Vocabulary Size Measure and the Revised Word Polysemy Test was higher than for the other words in the first 1,000 word frequency level. Figure 2 indicates that the percentage of correct responses for *fresh* on the Vocabulary Size Measure and the Revised Word Associates Collocation Test was much higher than for the other words in the second 1,000 word frequency level. These results might have occurred because the anchor words, *direct* and *fresh*, are loanwords, that is, Japanese words borrowed from the English language. Modern Japanese contains many such words. For example, Daulton (1998) estimated that up to 38% of the 2,000 most frequent words of English and 26% of the words in the University Word List (Xue & Nation, 1984) are English loanwords used in Japanese language. Nation (2001, 2013a) stated that loanwords should generally be easy to acquire because the cognitive effort involved in making the form-meaning connection is relatively light. In addition, several researchers (e.g., Brown & Williams, 1985; Daulton, 1998, 2008; Millar, 2006) have suggested that loanwords help Japanese learners studying

English to recognize, infer, and produce English words. Hence, it can be hypothesized that most of the participants know the loanwords used in this study and were therefore able to select the correct option on the tests.

Third, the different item sensitivity on three instruments of lexical knowledge could have influenced the results. Figure 4 indicates that the percentage correct for both *ample* and *modest* on the Vocabulary Size Measure was lower than that on the Revised Word Associates Collocation Test. This result was unexpected because the Revised Word Associates Collocation Test requires test-takers to know the meaning of both words in order to choose the correct collocate. The result implies that L2 learners can be aided by contextual information, as their knowledge of one word can be triggered by knowledge of the other. In extreme cases, some test-takers might have been able to choose the correct answer on the Revised Word Associate Collocation Test without knowing the core meaning of either *ample* or *modest*.

Another factor that might have influenced the results was the different degree of item sensitivity between the two tests. Even though all three lexical knowledge tests, the Vocabulary Size Measure, the Revised Word Associates Polysemy Test, and the Revised Word Associates Collocation Test are four-option, multiple-choice items, it is plausible that the degree of item sensitivity on each test differs. Below is the item for *modest* on the Vocabulary Size Measure.

modest: She is modest

a. relaxed and friendly

b. honest and cares about other people

c. not talking about things she can do well

d. not showing strong emotion

In this case, the Vocabulary Size Measure requires test-takers to read relatively long phrases and have "a moderately developed idea of the meaning of the word" (Nation & Beglar, 2007, p. 11) because the correct definition often shares elements of meaning with the distractors. For instance, the distractor *d—not showing strong emotion*—was selected by 19% of the test-takers. If people express strong emotion, such as excitement or happiness when they succeed at something, it can be considered boasting in Japanese society; hence, even though distractor *d* is not the correct answer, it shares elements of meaning with *modest*. Moreover, the grammatical forms of the above options include a relative clause (i.e., *not talking about things she can do well*) and an adjective followed by preposition (i.e., *honest and cares about other people*); hence, the Vocabulary Size Measure also requires test-takers to have some knowledge of complex syntax and reasonable reading skills (Nguyen & Nation, 2011). On the contrary,

the Revised Word Associates Collocation Test provides options that consist of a single word. Below is the item that tested the same anchor word, *modest*.

modest

a. dust

b. improvement

c. hole

d. steel

The cognitive processes involved in taking the Revised Word Associates Collocation Test might be less complex than that for taking the Vocabulary Size Measure, as the Revised Word Associates Collocation Test does not require the test-takers to read a phrase or clause to understand the definition of the target word. In addition, these options might unintentionally provide the participants with hints if the participants utilize a test-taking strategy such as categorization. For instance, the distractors *dust*, *hole*, and *steel* are objects that do not have any positive or negative meaning, while the correct answer, *improvement*, involves change and has a positive meaning. Thus, some participants might understand that *improvement* differs from the other three options, and this understanding might serve as clue to the correct answer. Therefore, even though test-takers do not know the exact meaning of *modest*, they might be able to choose *improve* as a correct answer.

Even though each of the above four factors was discussed independently, it is possible that some of them interactively influenced the results. For example, in the Revised Word Associates Collocation Test, the target word *fresh* collocates with *water*. Moreover, as discussed previously, the collocation, *fresh water* is a loanword that is also an L1 incongruent collocation. Even though the Vocabulary Size Measure was piloted with students with similar English proficiency as the participants in this study, a micro-analysis of these anchored words was not conducted; therefore, these four factors were not taken into account when the tests were made. The participants who missed each of the 12 anchor items on the Vocabulary Size Measure were excluded from further analysis because the form-meaning link should be established prior to the development of polysemy and collocational knowledge. Table 5 shows the percentage correct of the 12 anchor words on the Revised Word Associates Polysemy and the Revised Word Associates Collocation Test after eliminating the participants who missed each of the 12 anchor words on the Vocabulary Size Measure.

As the participants were expected to know the core meaning of the 12 anchor words, the question concerned which of the two aspects of depth of vocabulary knowledge, polysemy or collocational knowledge, developed next. However, Table 5 shows that the higher percentage

correct for polysemy and collocational knowledge varied depending on the respective word; hence, the results do not indicate any hierarchical acquisitional pattern. One explanation is that the lack of the pattern is a valid result. That is, as each learner whose proficiency are rough the same, learns the core meaning of different words from a common course book (Saragi, Nation, & Meister, 1978), they next develop knowledge of polysemy or collocational knowledge in a somewhat idiosyncratic way depending on the way an individual word appears in context, the word's loanword status, or whether the collocates are L1 congruent or incongruent.

Table 5: Number of Participants Who Correctly Answered The 12 Anchor Word on The Vocabulary Size Measure and Their Percentage Correct of 12 Anchor Words on Polysemy and Collocational Knowledge

Target word	Word frequency	VSM (N)	Polysemy	Collocation
even	1K	101	58.42	59.41
brief	1K	111	72.97	56.76
direct	1K	158	88.00	41.77
calm	2K	101	23.76	68.32
fresh	2K	132	81.06	92.42
bright	2K	96	72.92	83.33
bare	3K	66	71.21	36.36
vague	3K	76	72.37	71.05
remote	3K	133	61.65	40.60
ripe	4K	82	13.43	48.78
ample	4K	28	35.71	57.14
modest	4K	47	23.40	46.80

Note: VSM = Vocabulary Size Measure; Polysemy = the Revised Word Associates Polysemy Test; Collocation = the Revised Word Associates Collocation Test; 1K = the first 1,000 word frequency level; 2K = the second 1,000 word frequency level; 3K = the third 1,000 word frequency level; 4K = the fourth 1,000 word frequency level; N = the number of the participants who correctly answer each of the 12 anchor words on the Vocabulary Size Measure; the unit of the score is percent correct.

CONCLUSIONS

This study was an investigation of the two levels of relationship of three aspects of lexical knowledge—vocabulary size, polysemous knowledge, and collocational knowledge. The macro-analysis showed strong correlations among the Vocabulary Size Measure, the Revised Word Associates Polysemy Test, and the Revised Word Associates Collocation Test. The micro-analysis of 12 anchor words was conducted to examine whether there is an order of acquisition for vocabulary size, knowledge of polysemy, and collocational knowledge. The results indicated strong item dependency and wide individual variation; thus, no clear hierarchical acquisition pattern was identified for these aspects of lexical knowledge for the EFL learners in this study.

Future research should further explore hierarchical acquisitional pattern among the three aspects of lexical knowledge, which will provide significant insights on a theory of acquisitional order of lexical knowledge. This is crucial as Meara (1983) noted the absence of an overall theory of vocabulary acquisition, and currently there is still the case.

In order to further investigate the acquisitional pattern, influential factors such as loan word status and the congruency/incongruency status of the collocations should be controlled in the instruments. As discussed above, these factors might have contributed to the inconclusive results for the micro-analysis of the 12 anchor words.

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