Exploring Lexical Network Systems of Japanese EFL Learners
Through Depth and Breadth of Word Knowledge

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Abstract

Ninety-three Japanese college students were tested productively on three aspects of word knowledge: meaning senses, paradigmatic and syntagmatic (collocational) knowledge for each of 30 target words (10 words each for noun, verb and adjective), together with vocabulary size and proficiency tests. The results show that syntagmatic links are stronger than the paradigmatic ones in their lexical networks for both the upper and lower groups of vocabulary size and proficiency. However, paradigmatic networks as well as syntagmatic ones tend to expand as their vocabulary size grows. The vocabulary size seems to play an important role in network building. It is also suggested that the productive test devised in this study may be a useful measure for exploring lexical networks.

1. Introduction

Assessing the depth (quality) as well as breadth (size) of vocabulary knowledge of L2/EFL learners has been a growing field of interest in recent years, due to frameworks describing how a word is known. Nation’s framework (Nation, 2001), for example, consists of Form, Meaning, and Use at the most general level, including 18 aspects of word knowledge as subcomponents. The majority of research has been carried out on the basis of various aspects or dimensions of word knowledge, such as cross-sectional or longitudinal studies (e.g., Read, 1998; Schmitt and Meara, 1997; Schmitt, 1998; Shimamoto, 2000; Mochizuki, 2002). Componential approaches to lexical knowledge have captured some deeper insights into L2 vocabulary development, yet the complexity of vocabulary acquisition process has not been fully explored.

Aitchison (1994) argues that acquiring word meaning in L1 is a complex process involving three different but connected tasks: labeling, packaging, and network building. Labeling is recognizing that sequences of sound can be used as names for things - naming objects. Packaging
is the classification of several objects under a particular label - concept and referents specification. 

Network building is a process of reorganizing the words in semantic networks. Henriksen (1999) asserts that L2 vocabulary studies tend to focus mainly on the initial stages of labeling and packaging (i.e., mapping meaning onto form, or basically item-learning), and disregard network building, the "semantization process" (p. 307). One of the explanations for this tendency, she claims, is a methodological problem of describing lexical development in terms of network building. Descriptions require longitudinal studies, the use of different test types, and the development of new test formats. She argues that vocabulary acquisition should be described as system changing. Nation (2001) believes Aitchison’s three stages correspond to the three divisions in the Meaning section of his word knowledge: form and meaning, concept, and associations, distinguishing between item knowledge and system knowledge. Clearly, research should be geared toward exploring how L2 learners construct and reorganize their interlanguage semantic networks in order to gain a better understanding of L2 vocabulary development.

2. Background

Word association tests have a long history in psycholinguistic studies into L1 mental lexicons, and most recently in investigating the L2/EFL learners' semantic networks. Standard word association tests involve presenting written or spoken stimulus words, and requiring associative responses for each word. Responses are broadly categorized either as paradigmatic or syntagmatic. Paradigmatic associations are in the same word class as the stimulus, including synonyms, antonyms, subordinates, superordinates, and coordinates (e.g., dog → animal, cat, bulldog), while syntagmatic associations collocate with the stimulus words (e.g., dog → cute, bark). Word association studies suggest that adult native speakers tend to produce more paradigmatic responses, whereas L1 young children tend toward syntagmatic responses. The proportion of paradigmatic responses increases with age and language maturity. This so called syntagmatic-paradigmatic shift is partly confirmed in L2 association research: proportions of paradigmatic to syntagmatic responses tend to be higher for advanced learners than for novice learners (Schmitt, 2000; Wolter, 2001; Orita, 2002).

Traditional types of free word association tests are a good instrument for studying L2 learners' lexical networks, but obviously impractical for a large number of subjects. The Word Association Test (WAT) (Read, 1998) is one of the first attempts to use associations to measure associative and collocational word knowledge in a recognition test. Eight associates and distractors for each target word are divided into two groups of four, each group representing paradigmatic or syntagmatic relationships. Subjects are required to select four associates from both groups, but not told how many from each group.

Although economical, WAT has some drawbacks. First, the format is complicated, and target words are difficult for novice learners. Being a test for measuring associative knowledge,
the subject should be familiar with the target words. Second, the target words are all adjectives, meaning they cover only one word class. Previous association research suggests that developmental shifts may occur for different word classes, and even for different individual words (Schmitt, 2000; Wolter, 2001; Orita, 2002). Therefore, a variety of word classes should be included in the test. Third, the test format of WAT tends to invite guess work.

On this basis, Shimamoto (2000) devised a receptive Word Knowledge Test (RWKT): a multiple choice recognition test where each of 50 target words (20 nouns, 15 adjectives, 15 verbs) is presented with one associate and three distractors for both paradigmatic (group A) and syntagmatic (group B) relationships, as shown below.

<table>
<thead>
<tr>
<th>Idea</th>
<th>A: (1) thought</th>
<th>(2) salmon</th>
<th>(3) kingdom</th>
<th>(4) theater</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B: (1) thin</td>
<td>(2) bright</td>
<td>(3) overseas</td>
<td>(4) salty</td>
</tr>
</tbody>
</table>

The RWKT is an improvement - the format is less complicated, with a wider range of target words and distractors. Nonetheless, being a multiple choice test, the problem of guess work has not yet been completely resolved.

Results of Shimamoto (2000) showed that the mean of paradigmatic knowledge test was higher than that of syntagmatic test along the three different vocabulary size groups. Mochizuki (2002) used a similar test and the results also showed higher mean scores of paradigmatic over syntagmatic tests along the different developmental stages. Results from both Shimamoto (2000) and Mochizuki (2002), in comparison with those of previous association studies, indicate that different test formats tend to result in different findings (Laufer, 2004). It is reasonable to assume that receptive and productive tasks elicit different knowledge (Meara, 1990). Henriksen (1999), therefore, recommends employing different test types, while Schmitt (1998) cautions that “the most important role for collocation knowledge is in the production of language” (p. 28). A new type of productive test similar to the conventional association task needs to be devised.

3. Method

3.1 Purpose

This study investigates the development of lexical network systems in Japanese EFL learners by focusing on three aspects of productive word knowledge: meaning senses, paradigmatic and syntagmatic knowledge. The purposes are (1) to investigate interrelationships among the three aspects of word knowledge; (2) to examine how students with varied vocabulary size and English proficiency show different interrelationships among those aspects; (3) to develop a productive test to assess meaning senses, paradigmatic and syntagmatic knowledge.

3.2 Participants

The participants for this study were 93 Japanese university students, mostly juniors and seniors, majoring in foreign languages such as Spanish, German, French or Chinese. They were
non-English majors and taking TOEIC preparation course as part of their elective courses.

3.3 Materials

The following three different test instruments were used to assess both the quality and quantity of vocabulary knowledge, as well as their English proficiency: the Productive Word Knowledge Test (see below), A Vocabulary Levels Test (VLT Test B) (Nation, 2001), and TOEIC (IP). The words from 2,000, 3,000 and 5,000 word levels of VLT were randomly mixed into three different versions in order to counterbalance fatigue.

**Productive Word Knowledge Test (PWKT):** a controlled production test devised by the author, measuring three aspects of word knowledge of the target words: meaning senses, paradigmatic and syntagmatic. The 30 target words (10 words each for noun, verb and adjective) were selected from junior and senior high school levels of the Hokkaido University English Vocabulary List (Sonoda, 1996), on the basis of frequency rank and familiarity rating (Yokokawa et al., 2004), with frequency rank under 3,000 in the Kilgarriff Lemmatized list, and familiarity rating average values of three and over. This means that participants are most likely to know at least one meaning sense of each target word. The first question asks the subjects to write in Japanese as many meaning senses as they know of the target word. The second question requires the subject to write as many synonyms, antonyms, super-ordinates or subordinates as they know in English. For the third question, subjects are asked to produce as many English collocates as they can think of. The third one has three variations depending on the word class of a target word. For example, when the target word is a noun, either an adjective or a noun should be supplied as a collocate in the underlined part (e.g., ____ method → easy method / teaching method). In the case of adjectives and verbs, a noun is required (e.g., clean ____ → clean air; accept (a/an/the) ____ → accept money). The reason for restricting word classes for collocates is that these patterns are considered to be the most common and easily retrieved ones. Three different versions of the test, with the target words randomly ordered, were compiled to counterbalance the result.

3.4 Procedure

First, it was decided to assign 50 seconds, timed with a stop watch, for each of the three questions for a target word, following a trial of a shorter version of PWKT. Directions for the test and example exercises were prior to administering the test. Scoring was completed by three native English speakers (two Americans and one Australian). *Collins Cobuild English Collocations CD-ROM, Kenkyusha's New Dictionary of English Collocations, and Shogakukan Corpus Network (www.corpora.jp)* were used as references. Paradigmatic and syntagmatic responses judged correct by the majority of the native informants were scored +1, with spelling mistakes ignored. The total responses produced and correct responses were counted separately. For meaning senses, the score range was set at 0 to 3, with 3 points given if all the responses were correct, 2 points for
the majority being correct, 1 point for the majority being incorrect, and 0 points given for no response. The VLT was given the following week, with levels and total scores calculated. Subjects took TOEIC IP in December, 2003. The subjects were then divided into an upper and lower group, according to VLT and TOEIC deviation scores (Z-score or Hensachi). The upper group had Z-scores of 50 and over, and the lower group had scores below 50.

4. Results

Table 1 shows the summary of the mean scores, the standard deviations of all the tests and the percentage of the correct responses. The syntagmatic mean was higher than that of the paradigmatic knowledge test in both response and correct response numbers. However, the $t$ tests showed a statistically significant difference between paradigmatic and syntagmatic tests only in correct responses, $t(184)=4.17, p<.001$.

<table>
<thead>
<tr>
<th>Table 1. Descriptive statistics for the tests</th>
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<tbody>
<tr>
<td>TOEIC</td>
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<tr>
<td></td>
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<tr>
<td>Mean</td>
</tr>
<tr>
<td>S.D.</td>
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<tr>
<td>% correct</td>
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</table>

Note: N = 93, Res. no = the number of responses

Table 2 reports the intercorrelation of scores, with almost all tests scores at the level of $p < .01$. The correlation between the paradigmatic response numbers and TOEIC scores was positive, but not significant ($r = 0.19$). Also, the syntagmatic response numbers showed significant but very weak correlation with TOEIC ($r = 0.23, p < .05$), suggesting that the number of responses is not related to their general proficiency. On the contrary, the number of correct responses in both paradigmatic and syntagmatic tests relates significantly to both TOEIC and VLT ($p < .01$). In particular, a relatively higher correlation was found between correct paradigmatic responses and VLT ($r = 0.47, p < .01$). Correct paradigmatic responses strongly correlate with the score of meaning sense ($r = 0.55, p < .01$). Clearly, the more meaning senses the learner knows, the more paradigmatic knowledge the learner has. As expected, the VLT score correlates with TOEIC score ($r = 0.58$) and meaning senses ($r = 0.62$) as well. As the number of responses showed no significant difference between paradigmatic and syntagmatic tests, the number of correct responses was further analyzed.
Figure 1 reveals differences in the mean number of correct paradigmatic and syntagmatic responses for each vocabulary size group (upper and lower). Table 3 presents the results of two-way ANOVA: word knowledge type (para vs. syn) × vocabulary size (upper vs. lower). It shows a significant main effect for word knowledge type, $F(1, 183) = 19.21, p < .001$ as well as for vocabulary size, $F(1, 183) = 19.84, p < .001$. Further analysis with $t$ tests revealed that the mean of correct responses was significantly higher in the syntagmatic than in the paradigmatic test for both the upper, $t(94) = 2.68, p < .01$ and the lower groups, $t(88) = 3.54, p < .001$. Moreover, the paradigmatic mean was significantly higher for the upper than for the lower group, $t(91) = 4.20, p < .001$. A significant syntagmatic difference was also found, $t(91) = 2.41, p < .05$. That is, the mean of the upper group is significantly higher than that of the lower group, clearly seen in Figure 1.

Table 4 shows the results of two-way ANOVA for word knowledge type by proficiency level. A significant main effect was found for both word knowledge type and proficiency. Further $t$ tests indicated that the syntagmatic mean was significantly higher than the paradigmatic for upper, $t(86) = 2.75, p < .01$ and lower groups, $t(96) = 3.27, p < .01$. The upper group showed a significantly higher paradigmatic mean than the lower group, $t(91) = 2.10, p < .05$. As for the syntagmatic mean, however, the difference was not significant between them. Figure 2 illustrates the mean difference between paradigmatic and syntagmatic correct responses for both groups.
Table 3. Results of two-way ANOVA for Word Knowledge Type by Vocabulary Size

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Knowledge Type (Para vs. Syn)</td>
<td>11.325</td>
<td>1</td>
<td>11.325</td>
<td>19.214***</td>
</tr>
<tr>
<td>Vocabulary Size (Upper vs. Lower)</td>
<td>11.691</td>
<td>1</td>
<td>11.191</td>
<td>19.835***</td>
</tr>
<tr>
<td>Error</td>
<td>107.863</td>
<td>183</td>
<td>0.589</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>130.879</td>
<td>185</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

***p < .001

Table 4. Results of two-way ANOVA for Word Knowledge Type by Proficiency Level

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Knowledge Type (Para vs. Syn)</td>
<td>11.325</td>
<td>1</td>
<td>11.325</td>
<td>18.006***</td>
</tr>
<tr>
<td>Proficiency Level (Upper vs. Lower)</td>
<td>4.452</td>
<td>1</td>
<td>4.452</td>
<td>7.078**</td>
</tr>
<tr>
<td>Error</td>
<td>115.101</td>
<td>183</td>
<td>0.629</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>130.879</td>
<td>185</td>
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**p < .01, ***p < .001

On the basis of the results given above, the major findings can be summarized as follows:

(1) Overall, participants produced more correct syntagmatic responses than paradigmatic ones. This tendency is consistent regardless of their vocabulary size and proficiency.

(2) The upper vocabulary size and proficiency groups produced significantly more correct
paradigmatic responses than the lower groups – in particular, paradigmatic knowledge correlates with vocabulary size.

(3) The upper vocabulary size group produced significantly more correct syntagmatic responses than the lower group.

The finding (1) suggests that syntagmatic connections are stronger than paradigmatic ones in their lexical network systems, irrespective of vocabulary size and proficiency. The syntagmatically dominated structure has often been reported in both L1 younger children and L2 learners in the previous association studies. However, it should be noted that in this study more advanced learners with the average TOEIC score of 590 showed syntagmatic dominance, suggesting that this dominance tends to persist throughout language development. Orita (2002) reports that only the most advanced group exhibited a “syntagmatic-paradigmatic shift” whereas the three lower levels did not, suggesting that the shift does not always take place at all the stages of learning. Wolter (2001) argues that although the L1 and L2 mental lexicon share many similarities, they are fundamentally different for words that are well known, and that syntagmatic connections play a more important role in organizing words in L2 mental lexicon.

The finding (2) indicates that the number of correct paradigmatic responses grew as the subjects’ vocabulary size and their proficiency increased, implying that learners with larger vocabulary size and/or higher proficiency tend to have developed more intensive paradigmatic networks than those with smaller vocabulary and/or lower proficiency. It is conceivable that the learner’s vocabulary size plays an important role in the semantic organization since the learner with larger vocabulary size has a wider selection of possible words for paradigmatic responses when the stimulus word activates other related words in his/her mental lexicon (Wolter, 2001).

The finding (3) provides another insight into the L2 lexical development. It is likely to suggest that not only paradigmatic but also syntagmatic knowledge increases as the learner’s vocabulary size grows. In other words, both types of lexical knowledge would develop to form a greater level of organization in L2 mental lexicon. Figure 1 clearly shows this incremental nature of vocabulary development as often cited by researchers (e.g., Schmitt and Meara, 1997). Thus, as Walter (2001) pointed out, syntagmatic-paradigmatic shift does not necessary mean that the increase in paradigmatic responses presupposes the decrease in the syntagmatic responses. Schmitt (2000) differentiates syntagmatic knowledge from paradigmatic knowledge: the former as being contiguity and the latter as being more meaning based, more semantic in nature. He holds that although not every word passes the same route, the progression from syntagmatic to paradigmatic indicates the general evolution of lexical organization patterns. Yokokawa et al. (2002) and Kadota (2003) hypothesize two types of conceptualization in L2 mental lexicon: one is categorical relations representing hierarchical conceptual structures and the other is syntagmatic relations, reflecting collocations or chunks. They argue that “the network in our mental lexicon usually work or function in both directions, and in other words, the intensities of paradigmatic or vertical network and of syntagmatic or horizontal network are usually balanced” (Yokokawa et al.,
2002, p. 37). This can account for the developmental stages of network organization. All three findings of the present study together seem to clearly illustrate a development of L2 learners’ lexical network structures. Although syntagmatic network building seems to precede paradigmatic development, there is a progression in both syntagmatic and paradigmatic lexical organization as the vocabulary size grows.

Finally, comparisons of receptive and productive association tests showed different results. In Shimamoto (2000) using Receptive Word Knowledge Test (RWKT), subjects with three different vocabulary levels all showed higher mean for the paradigmatic test than for the syntagmatic test, differing drastically to the results of the productive test here. Schmitt and Meara (1997) argue that the productive association correlations with vocabulary size and proficiency are stronger because a word must be known relatively well in order to give productive associations. The discrepancy in the results could well be due to an intrinsic difference in the lexical processing of production and recognition (Aitchison, 1994). However, simpler reasons may account for this. When the subject with small vocabulary size is presented with a stimulus word for a production test, only a limited number of words are activated in his or her mental lexicon for paradigmatic associations. In a recognition test, on the other hand, the stimulus word activates a large number of syntagmatic associations, making it hard to choose correctly (hinted at by Shimada, 2004). Bearing this in mind, a productive test as devised in this study might be better suited for exploring lexical networks.

6. Conclusion

This research confirms that although syntagmatic lexical organization precedes paradigmatic one, paradigmatic networks, together with syntagmatic networks, develop as the learner’s vocabulary grows. The productive association test format as used in this study may serve as an effective measure for assessing word knowledge; there are, however, some limitations. First, it is difficult to set a scoring standard for different responses. Second, some target words might tend to activate more paradigmatic or syntagmatic responses than others. The future studies should also incorporate an analysis of individual stimulus words since the previous studies suggest that individual words seem to undergo different lexical organization change.

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References


横川博一、谷村緑、斎内智 (2004) 「日本人英語学習者の英単語親密度をめぐって」 LET 関西2004春期シンポジウム発表要旨

門田修平（編）（2003）『英語のメンタルレキシコン』松栄社

島田勝正 （2004）第8回 「EAP 語彙の広さと深さの関係」JLTA 全国大会発表要旨

園田勝英（編）（1996）大学生用英語語彙表のための基礎的研究『言語文化研究報告書叢書 7』 北海道大学