Processing Efficiency of L2 Collocations in Sentence Comprehension: From a Self-paced Reading Task for Japanese EFL Learners

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Abstract

The present study attempted to investigate whether or not Japanese learners of English as a foreign language (EFL) process congruent (i.e., being able to translate directly from first language (L1) into second language (L2)) collocations faster than incongruent (i.e., not being able to translate directly from L1 into L2) ones in order to ascertain the learners are capable of utilizing the cognitive advantage of congruent collocations in sentence processing. A self-paced reading task was administered to twenty one Japanese EFL learners to assess reaction times to words and collocations, and the reaction times were analyzed. There were no statistically significant differences of reaction times between congruent collocations and incongruent ones. At the same time, however, a delayed effect was detected in that Japanese EFL learners processed words immediately after congruent collocations significantly faster than those immediately after incongruent ones. The results suggest that Japanese EFL learners are capable of utilizing the cognitive advantage of processing congruent collocations in a sentence.

1. Background

It is generally acknowledged that multiword expressions such as lexical bundles (Biber, Johansson, Leech, Conrad, & Finegan, 1999), formulaic sequences (Wray, 2002), and collocations have a very important role for fluent use of language because they are considered to be processed, retrieved, and stored as single units rather than word by word (Biber et al., 1999; Ellis, 1996; Jiang & Nekrasova, 2007; Tremblay, Derwing, Libben, & Westbury, 2011; Wolter & Gyllstad, 2013; Wray, 2002). These multiword sequences are pervasive in language use (Nattinger & DeCarrico, 1992) and account for a large proportion of spoken and written discourse (Schmitt, 2004). For instance, Erman and Warren (2000) reported that 58.6% of spoken discourse and 52.3% of written discourse were composed of these multiword expressions. It has also been shown in previous studies that EFL and
English as a second language (ESL) learners tend to produce unnatural and unidiomatic expressions owing to a lack and/or misuse of these multiword units (Granger, 1998; Howarth, 1998; Juknevičienė, 2009; O’Donnell, Römer, & Ellis, 2013).

Lexical bundles was defined by Biber et al. (1999) as frequently recurring strings of words that often span traditional syntactic boundaries, and Wray (2002) defined formulaic sequences as being stored and retrieved holistically from the memory in communication, whereas the explicit definition of collocations have been little agreed upon. However, there have been two main traditional approaches for identifying collocations (Barfield & Gyllstad, 2009): the phraseological approach (e.g., Cowie, 1994; Howarth, 1998) and the frequency-based approach (e.g., Sinclair, 1991). In the case of the former approach, collocations are multiword units that involve at least one word which is semantically nontransparent (e.g., blow a trumpet is a free combination rather than collocation, whereas blow a fuse is collocation rather than a free combination). The latter approach is based on corpus frequencies and typically involves relying on statistical measures to determine which recurrent word combinations occur frequently (e.g., t score, mutual information score, and log-likelihood, which all indicate that the collocates occur more frequently together than would be expected by chance). In this study, we use the term collocation to refer to a string of two words occurring in multiple texts that are frequently used together. According to Yamashita and Jiang (2010), collocations, unlike formulaic sequences, are loose combinations of words and each of the component words is able to collocate with many other words to form other collocations. They also argued that collocations often have a counterpart in another language except for culture-specific concepts. However, not all collocations have an equivalent counterpart across languages. Some are able to translate directly into another language, but others are not. For instance, the Japanese collocation tsuyoi kaze can translate directly into strong wind in English (i.e., congruent collocation), whereas tsuyoi ame cannot translate directly into *strong rain (i.e., incongruent collocation).

In the field of second language acquisition, the study on L2 collocational processing, particularly on the effects of congruency, has been actively conducted (e.g., Wolter & Gyllstad, 2011, 2013; Wolter & Yamashita, 2014; Yamashita & Jiang, 2010). Yamashita and Jiang used a phrase-acceptability judgment task amongst twenty native speakers (NS) of English, twenty four ESL users, and twenty three EFL learners with congruent collocations and incongruent ones. These collocations used in the study were adjective + noun and verb + (object) noun collocations. They found that Japanese EFL learners showed significant differences in the reaction times and error rates between congruent collocations
and incongruent ones. On the ground that Japanese EFL learners showed significantly more errors on congruent collocations than NS of English, Yamashita and Jiang argued that even though both of the languages have equivalent collocations, transfer from L1 to L2 does not always happen. Furthermore, they concluded that incongruent collocations are much more difficult to acquire than congruent ones, and a large amount of input would be needed to acquire incongruent collocations on the basis of the result that Japanese ESL users showed a significant difference in only error rates. At the same time, however, they also suggested that once accepted in the L2 lexicon, extensive encounters for processing them as efficiently as congruent collocations are unnecessary, because “incongruent collocations are likely to be acquired in contexts without much direct reliance on L1” (Yamashita & Jiang); in other words, the more encounters with incongruent collocations are increased, the more likely direct links to the L2 lexicon are to be established, and thus incongruent collocations come to be processed without depending on the L1 lexicon.

Wolter and Gyllstad (2011) investigated the congruent and incongruent collocational processing through a primed lexical decision task for thirty five NS of English and thirty nonnative speakers (NNS, i.e., L1 Swedish) in which a verb used as the prime and a (object) noun as the target. This study explored whether or not the prime of a verb facilitates faster recognition of a (object) noun target in each condition (i.e., congruent and incongruent). The results showed that NNS demonstrated significantly faster reaction times for congruent collocations over incongruent ones. Based on this result, they concluded that incongruent collocations are more difficult to acquire than congruent collocations. The authors also argued that once incongruent collocations are accepted in the L2 lexicon, “when the first word in the collocation is observed the second word of the collocation is anticipatorily activated” (Wolter & Gyllstad).

Another study that investigated whether or not congruent collocations are processed faster than incongruent ones is Wolter and Gyllstad (2013). In the study, a lexical decision task was administered to twenty five NS of English and NNS (i.e., L1 Swedish) to assess reaction times and error rates. The stimuli were adjective + noun collocations that were extracted from the Corpus of Contemporary American English with a frequency of occurrence of at least 10 times. Their result was also consistent with the previous studies (Yamashita & Jiang, 2010; Wolter & Gyllstad, 2011) and showed that congruent collocations are processed faster than incongruent collocations for NNS. Furthermore, the study concluded that high frequency L2 collocations in both conditions (i.e., congruent or incongruent) were likely to be acquired.

In sum, English learners tend to process incongruent collocations more slowly than
congruent ones. What is more, the results of these studies also suggest that the increased cognitive load while reading incongruent collocations results in the use of increased cognitive resources, because learners reacted significantly more slowly to incongruent items than to congruent ones. Congruent collocations, on the other hand, contribute to fluent use of language in that they require a smaller cognitive load when being processed. Why is reading congruent collocations less demanding in terms of cognitive load? Previous studies have argued that L1 congruency facilitates the acquisition of congruent collocations because they have an equivalent L1 construction and are able to be translated directly into another language (e.g., Wolter & Gyllstad, 2011, 2013; Yamashita & Jiang, 2010); in other words, collocational links directly copied from L1 lexical entries into L2 lexical entries. Interestingly, however, Wolter and Yamashita (2014) is not consistent with previous studies. They investigated the possible influence of L1 collocational pattern on L2 collocational processing through a double lexical decision task in which the prime and target are presented simultaneously. Based on the result that NS of English reacted significantly faster to both J-only collocations (i.e., English translations of collocations that were acceptable only in Japanese) and E-only collocations (i.e., collocations that were acceptable only in English) than to the baseline items (i.e., noncollocational items), they concluded that the L1 lexicon is not activated when processing congruent collocations.

There have been, as noted above, many studies on L2 collocational processing, particularly focusing on the aspect of the congruency effect. Nevertheless, these studies have been conducted predominantly using a phrase judgment task or a lexical decision task. It seems that these tasks are not in line with practical use of language. Do learners encounter a collocation alone in any discourse? Do learners figure out if collocations are congruent or incongruent every time they are encountered in everyday life? The answer to these questions is clearly no. Generally, collocations, which learners have read and/or listened to, have been embedded in a sentence in spoken and written discourse with rare exceptions. Accordingly, we would like to assert that when researching L2 collocational processing, experiments should use methods that correspond to practical language use, such as self-paced reading. Previous studies through phrase judgment tasks or lexical decision tasks have shown that congruent collocations tend to be acquired more easily than incongruent ones, and called this effect the cognitive advantage of congruent collocations (i.e., congruency effect). Given actual use of language, this cognitive advantage will probably be detected in sentence processing. Unfortunately, to the best of our knowledge, there have been comparatively little studies investigating L2 collocational processing in sentences through a self-paced reading task focusing on the congruency effect. Furthermore,
there has been little discussion on cognitive load during the processing of congruent and incongruent collocations in previous studies. Therefore, in this article, we adopted a self-paced reading task to approach the processing of congruent and incongruent collocations in a sentence.

2. The Present Study

With this background in mind, the present study set the research question as follows:

(1) Do Japanese EFL learners process congruent collocations faster than incongruent ones in a sentence? It is, as mentioned above, shown in previous studies that Japanese EFL learners tend to process congruent collocations faster than incongruent ones using a phrase judgment task or a lexical decision task. This indicates that processing congruent collocations is less demanding than processing incongruent ones in terms of cognitive load. In this article, our main purpose is to ascertain whether or not Japanese EFL learners take the advantage of congruent collocations in sentence processing.

Twenty one Japanese EFL learners participated in the current study. All participants are NS of Japanese, who were born in Japan and were educated in Japanese schooling system. Their ages and English proficiency are summarized in Table 1. As described in Table 1, judging from participants’ Test of English for International Communication (TOEIC) scores, their English proficiency can be considered to be relatively high.

Table 1

<table>
<thead>
<tr>
<th>Participants’ background</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOEIC Scores</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>$n$</td>
</tr>
<tr>
<td>21</td>
</tr>
</tbody>
</table>

3. Procedure

Collocations used in this study were 10 adjective + noun congruent collocations (e.g., cold tea) and 10 adjective + noun incongruent collocations (e.g., weak tea) that were taken from Yamashita and Jiang (2010). Then, we made short sentences including the congruent collocations (e.g., He drank a cup of cold tea on the table.) and the incongruent ones (e.g., He drank a cup of weak tea on the table.) as stimuli and one collocation (i.e., the congruent collocation or the incongruent collocation) was embedded in each of the sentences. Consequently, we made 20 sentences. As shown in Table 2 and 3, we made an effort to control the sentence lengths for collocations and the number of characters and frequency in
the BNC for region B. To address the research questions, the reaction times of the target region (as described below) were analyzed through a paired t-test. A self-paced reading task has a property that might affect the reaction times of the following word (Jiang, 2007; Pearlmutter, Garnsey, & Bock, 1999). This is why the reaction times of region B and region C were also analyzed using the same statistical method in order to measure the delayed effect.

Example 1 (Congruent conditions): He drank a cup of \(^{\text{A}}\) cold \(^{\text{target}}\) \(^{\text{B}}\) the \(^{\text{C}}\) table.

Example 2 (Incongruent conditions): He drank a cup of \(^{\text{A}}\) weak \(^{\text{target}}\) \(^{\text{B}}\) the \(^{\text{C}}\) table.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Sentence lengths</th>
<th>Number of characters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M)</td>
<td>(SD)</td>
</tr>
<tr>
<td>Congruent conditions</td>
<td>9.7</td>
<td>0.8</td>
</tr>
<tr>
<td>Incongruent conditions</td>
<td>9.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Note. Sentence lengths = mean number of words per sentence. Number of characters = mean number of characters for each collocation per sentence.

Table 3

<table>
<thead>
<tr>
<th></th>
<th>Number of characters</th>
<th>Frequency in the BNC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M)</td>
<td>(SD)</td>
</tr>
<tr>
<td>Congruent conditions</td>
<td>2.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Incongruent conditions</td>
<td>3.1</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Note. Almost all words of the region B were prepositions.

The present study approached the research questions by conducting a self-paced reading task. This method has an advantage in that participants are required to reading sentences using online processing in the same way as actual language use. The participants of this task could read the words and phrases at their own speed, pressing a key to present the next word or phrase up to the full stop. The sequence of the self-paced reading task is described in Figure 1. All the sentences were randomly presented to participants visually through a program written in Hot Soup Processor version 3.3. The experiment consisted of
the following steps: (1) at the beginning, the positions of each word were presented by underlines where the words of the sentence would be presented; (2) once the participants pressed the right arrow key on the keyboard, the first word appeared on the screen, replacing the first underline; (3) each time the key was pressed, the word / the phrase that was displayed was replaced with an underline and the next word was presented on the screen; (4) the participants repeated step (3) until they reached the end of the sentence; (5) finally, the participants answered a true or false question using a computer mouse to press a “TRUE” or “FALSE” button presented on the screen. They could not start the next trial until they pressed either the “TRUE” or “FALSE” button. The participants could press the key to present the words and collocation at his or her own speed, although they were instructed at the beginning of the experiment to read sentences as quickly as possible. In this experiment, the participants could not backtrack to reread previous words. The time to press the key for each word and collocation was recorded automatically by the program. It should be noted that the collocations, and only the collocations, were presented as two words rather than word by word because we are exploring collocational processing in a sentence rather than word processing in this article.

\[\text{Figure 1. Sequence of the self-paced reading task}\]

\textit{Note.} The numbers at the upper left corner of the rectangles are the sequence number.
4. Result

On the basis of traditional practice in the field, all the reaction times that were two standard deviations away from the mean were eliminated from the analysis as outliers. A quantitative analysis of the remaining data was conducted using a paired t-test. Table 4 summarizes the descriptive statistics for the reaction times of each region. The graphical representation for the flow of each reaction time is presented in Figure 2.

Table 4
The descriptive statistics for the reaction times (ms.) of each region.

<table>
<thead>
<tr>
<th>Region</th>
<th>Condition</th>
<th>M</th>
<th>SD</th>
<th>Maximum</th>
<th>Minimum</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Congruent</td>
<td>410</td>
<td>85</td>
<td>601</td>
<td>222</td>
<td>[371, 448]</td>
</tr>
<tr>
<td></td>
<td>Incongruent</td>
<td>393</td>
<td>77</td>
<td>540</td>
<td>261</td>
<td>[358, 428]</td>
</tr>
<tr>
<td>A</td>
<td>Congruent</td>
<td>848</td>
<td>306</td>
<td>1611</td>
<td>445</td>
<td>[708, 987]</td>
</tr>
<tr>
<td></td>
<td>Incongruent</td>
<td>905</td>
<td>410</td>
<td>1983</td>
<td>405</td>
<td>[718, 1092]</td>
</tr>
<tr>
<td>Target</td>
<td>Congruent</td>
<td>347</td>
<td>103</td>
<td>670</td>
<td>216</td>
<td>[299, 393]</td>
</tr>
<tr>
<td></td>
<td>Incongruent</td>
<td>400</td>
<td>133</td>
<td>888</td>
<td>217</td>
<td>[338, 460]</td>
</tr>
<tr>
<td>B</td>
<td>Congruent</td>
<td>388</td>
<td>116</td>
<td>636</td>
<td>214</td>
<td>[334, 440]</td>
</tr>
<tr>
<td></td>
<td>Incongruent</td>
<td>396</td>
<td>105</td>
<td>601</td>
<td>155</td>
<td>[347, 443]</td>
</tr>
<tr>
<td>C</td>
<td>Congruent</td>
<td>396</td>
<td>105</td>
<td>601</td>
<td>155</td>
<td>[347, 443]</td>
</tr>
</tbody>
</table>

Figure 2. Reaction times to self-paced reading in each region.

Note. The target region was presented as two words.
The participants unexpectedly showed no significant differences and a small sized effect in the reaction times between congruent collocations and incongruent ones; \( t(20) = 1.28, p = .21, r = .28. \) However, Japanese EFL learners demonstrated significantly faster reaction times for the words immediately after the congruent collocations and showed a medium effect size; thus the delayed effect was detected; \( t(20) = 2.55, p = .02, r = .50. \)

5. Discussion

This study investigated how the collocational efficiency (i.e., the size of cognitive load in processing both types of collocations) affected the processing of the collocations in a sentence. To address this, we set the research question of whether or not Japanese EFL learners process congruent collocations faster than incongruent ones in a sentence. The participants showed no significant differences in the reaction times between the two conditions. Furthermore, the effect size was small. This result was unexpected because English learners demonstrated significantly faster reaction times for congruent collocations over incongruent ones in the previous studies (e.g., Wolter & Gyllstad, 2011, 2013; Yamashita & Jiang, 2010). The result that Japanese EFL learners did not react significantly faster to congruent collocations in a sentence leads us to conclude that congruent collocations are not less demanding in terms of cognitive load. However, there were significant differences in the reaction times between region B (i.e., the words immediately after collocations), that is to say, the delayed effect was detected \( (p = .02, r = .50). \) The reason why Japanese EFL learners did not react significantly faster to congruent collocations but demonstrated significantly faster reaction times for the words immediately after congruent collocations over those after incongruent ones may be the way in which the collocations were presented. In other words, the task effect may provide a plausible explanation for this result. The task design presenting collocations two words at a time may have affected the reaction time to the words immediately after the collocations. Hence, the delayed effect was detected; Japanese EFL learners did react significantly faster to congruent conditions. The faster reaction times to congruent ones over incongruent ones was due to the congruency effect. Thus, the processing of congruent collocations is less demanding in terms of cognitive resources. In the case of the collocations presented word by word, the delayed effect might nevertheless be detected. It is necessary to focus on this respect in future studies.

The result of the present study suggests that congruency may have an impact on processing collocations, because congruent collocations have equivalent constructions across languages; in other words, L1 congruency facilitates the acquisition of L2 congruent
collocations. Unlike incongruent collocations, collocational links copied directly from the L1 lexicon to the L2 lexicon. Therefore, the processing of congruent collocations is less demanding in terms of cognitive load, and congruency facilitates their recognition. In terms of reaction times, one advantage for processing fixed expressions such as multiword units is that it leads to more rapid recognition than other expressions. From the result of this study, it can be said that the same is true for the processing of congruent collocations, and it can be also said that cognitive load is less demanding so that learners can use more cognitive resources for higher level language processing. However, this possibility should be investigated in future studies, because this article only investigated the processing of collocations in a sentence. Furthermore, the result of the present study cannot deny or confirm the suggestion of Wolter & Yamashita (2014) that L1 lexicon is not activated when processing congruent collocations, because NS did not participate in this study.

There are several limitations in the present study. We should make references to the stimuli, the participants, and the task. First, the present study used 20 sentences as test items. Although almost all of the stimuli were composed of ten words, the semantic relations and length of the sentences were not satisfactorily controlled. These conditions should be controlled in future studies. Second, only twenty one Japanese EFL learners who are relatively highly proficient participated in this study. In cases where a sample size is small, individual differences and outliers may affect the reaction times. Therefore, one should be careful in generalizing the results of the present study. Finally, there is a limitation of a self-paced reading task in which the participant can press a key to read words or phrases at their own speed. The participant can press the key regardless of whether or not they read the word or phrase. Given this perspective, a self-paced reading task might not be enough to investigate natural processing. Therefore, method such as eye-tracking which provides an online record of more natural processing evidence may be necessary in future studies.

6. Conclusion

The result of the present study showed that when processing congruent collocations in a sentence, Japanese EFL learners had been less cognitive load. This indicates that Japanese English learners are capable of utilizing the cognitive advantage for the processing of congruent ones in a sentence. It at least can be said that this study is important in this respect.

References
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