Japanese EFL Learners’ Implicit Knowledge and Algorithmic Processing of Dative Alternation: Perspective From Syntactic Priming in Reading Comprehension

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Abstract

The priming method was recently introduced into the field of L2 studies as a new psycholinguistic tool to capture how and to what extent L2 learners possess their implicit knowledge or proceduralize their knowledge of specific grammatical structures. However, this line of studies exclusively explores the productive dimension, but not the receptive dimension, which is said to be better to obtain a deeper insight into the implicit knowledge (Jiang, 2007). In consideration of this, the current study investigated whether L2 learners can utilize syntactically driven algorithmic processing with implicit knowledge through a self-paced reading task with syntactic priming. Twenty highly proficient Japanese learners and 18 native speakers of English engaged in a phrase-by-phrase self-paced reading task after reading prime sentences. The results indicate that: (1) Japanese EFL learners seem to be able to utilize syntactic processing with implicit knowledge in terms of dative alternation; and (2) learners process sentences more “deeply” than natives under certain conditions. The results are discussed in terms of semantic/heuristic processing (good-enough processing) and syntactic/algorithm processing.

1. Introduction

Theories of second language (L2) acquisition have acknowledged, and their empirical studies have confirmed, that L2 learners’ knowledge can be distinguished as explicit and implicit types. These two types of dichotomous knowledge have been called, for instance, “learned and acquired knowledge” (e.g., Krashen, 1982), “declarative and procedural knowledge” (e.g., DeKeyser, 1998), “non-integrated and integrated knowledge” (e.g., Jiang, 2007), and “implicit
and explicit knowledge” (e.g., Ellis, 2004). Explicit knowledge refers to knowledge that is verbally reportable, requires consciousness, and entails control processing. Implicit knowledge, on the other hand, is intuitive knowledge that one uses without being aware of it, and its use involves an automatic process (e.g., Ellis, 2004). Implicit knowledge, in particular, has been considered to play a crucial role in L2 use, and has been actively studied and theorised in various studies (e.g., Bialystok, 1982; Ellis, 2004, 2005; Ellis et al., 2009; Jiang, 2007; Jiang, Novokshanova, Matsuda, & Wang, 2011; Gutierrez, 2013).

Because implicit knowledge has been seen as being almost equivalent to linguistic competence (Ellis, 2005), researchers in the fields of both L2 acquisition and L2 psycholinguistic processing have attempted to exclude the interference of explicit knowledge in order to measure implicit-type knowledge independently. Ellis et al. (2009) operationally defined the two types of knowledge by such criteria as: degree of awareness, time available, focus of attention (form or meaning), systematicity, certainty, metalanguage, and learnability. Previous studies especially manipulated time constraints and developed meaning-focused tasks, and attempted to inhibit participants’ awareness away from the formal aspect of language use.

To achieve this goal, researchers have begun to apply various psycholinguistic methods that are time-sensitive, independent from conscious processing, and thus suitable for measuring L2 implicit knowledge. These methods include, for instance, the timed grammaticality judgment test (e.g., Ellis, 2004; Gutierrez, 2013; Kusanagi & Yamashita, 2013), self-paced reading (Jiang, 2004, 2007; Jiang et al., 2011), eye-tracking (Kusanagi, Leung, Bando, Fukuta, & Sugiura, 2013), and syntactic priming (e.g., Schoonbaert, Hartsuiker, & Pickering, 2007). In particular, Jiang (2004, 2007) strongly emphasized that learners inevitably utilize explicit knowledge in the production-based elicitation task because learners in classrooms are always required to speak or write in L2 accurately, whether explicitly or implicitly.

L2 psycholinguistic studies have reported L2 learners’ slower and less accurate language use compared with that of native speakers (NSs) in online processing. Studies of morphosyntactic features such as number and gender agreement (e.g., Clahsen & Felter, 2006; Foote, 2010; Jiang, 2004, 2007; Jiang et al., 2011; Kusanagi & Yamashita, 2013; Sato & Felter, 2010) showed insensitivity of L2 learners to grammatical errors, and ambiguity resolution (Dussias, 2001; Felter et al., 2003; Papadopoulou & Clahsen, 2003) showed slower L2 processing than its L1 counterpart, for instance. On the basis of L2 insensitivity and inaccuracy, Clahsen and Felter (2006) proposed the shallow-structure hypothesis, which assumes that L1 and L2 types of grammatical processing are fundamentally different, and L2 learners cannot utilize syntactic representation as is the case with L1 users do.

However, it is still controversial whether or to what extent L2 learners can possess implicit knowledge. Some researchers insist that grammatical processing or representation is not fundamentally different from that of L1. Rather, the difference depends on influence of L1 on L2
grammar acquisition (Sabourin & Store, 2008) or differences of processing route or processing strategies (Lim & Christianson, 2013).

In contrast to the shallow-structure hypothesis, the “good-enough processing” (GE) approach (Lim & Christianson, 2013) does not postulate the presence of a fundamental difference between L1 and L2 representation. Instead, it asserts that there are two different processing routes for sentences computed by humans: a syntactically driven algorithmic route and a semantically based heuristic route. When a reader processes an implausible sentence such as, “The cat was chased by the mouse,” they misinterpret the sentence as “The mouse was chased by the cat” (Ferreira, 2003). This is because semantic processing overrides syntactic processing, and this phenomenon has been observed in both L1 and L2 (Lim & Christianson, 2013). The syntactic algorithm is cognitively demanding and thus considered to be “fragile.” The heuristic parser is fast and frugal, so the algorithm is easily overridden by the heuristics. Such misinterpretation as mentioned above is even seen in L1 processing, but it is known that L2 comprehenders are much more influenced by world knowledge during the stage at which syntactic and semantic processing is integrated (Lim & Christianson, 2013). The syntactic priming effect, as explained later, can be useful to differentiate whether readers process sentences via the algorithmic or heuristic route. As for L2, a problem-solving process with explicit or metalinguistic knowledge is considered to be used during L2 linguistic processing (Kusanagi, 2013), in addition to algorithmic and heuristic processes.

The priming effect itself is found in any of the following categories of stimulus: perceptual, conceptual, lexical, semantic, or syntactic, and the phenomenon is considered to occur when particular representations are activated by preceding stimuli. Syntactic priming originally referred to the phenomenon in which speakers produce a syntactic structure encountered in recent discourse. In other words, certain syntactic structures in discourse increase the likelihood of the use of the congruent structure in a subsequent sentence (e.g., Bock, 1986; Pickering & Branigan, 1998). Later, this priming effect was also adapted to reading comprehension. Researchers have utilized the self-paced reading paradigm, and focused on whether or not priming improves the speed of sentence processing.

The priming method was recently introduced into the field of L2 studies as a new psycholinguistic tool to capture how and to what extent L2 learners proceduralize their knowledge of specific grammatical structures (Fukuta, Goto, Kawaguchi, Murota, & Kurita, 2014; Kusanagi & Fukuta, in press; Morishita, 2011, 2013; Nakagawa, Morishita, & Yokokawa, 2013). However, this line of studies exclusively explores the productive dimension, and very few studies (syntactic priming of PP-attachment ambiguity: Fukuta et al., 2014, and sentence-level semantic priming of prenominal adjective order: Kusanagi & Fukuta, in press) have been conducted in receptive conditions. Confirmation of the priming effect in reading comprehension is important because, as Jiang (2004, 2007) pointed out, interference of explicit knowledge is inevitable when learners engage in a production-based elicitation task. Although L1 syntactic priming effects are said to
occur in the absence of speakers’ awareness or intention (Bock, 1986), they are not well documented in the L2 condition, and also can be considered as a matter of speculation.

As mentioned previously, a self-paced reading task is considered to be one of the sophisticated measurements to examine L2 implicit processing or knowledge. However, this reading paradigm always has the potential risk of heuristic processing being mixed into language use because comprehenders often ignore structural features when they can understand message content without syntactic parsing, unlike in the case for speakers (Bock, 1995). In contrast, syntactic priming can differentiate the algorithmic route from the heuristic route during language processing. That is, when a reader comprehends a text using heuristic processing, effects of syntactic priming disappear (Ferreira, 2003). By the use of a self-paced reading and priming paradigm, the present study attempts to assess whether learners can utilize implicit knowledge through syntactically driven algorithmic processing by eliminating the interference of both explicit knowledge and heuristic processing.

The syntactic priming paradigm has the potential to shed new light on the fundamental aspects of L2 implicit knowledge. Self-paced reading studies that attempted to measure L2 implicit knowledge have been a part of anomaly detection paradigm. From this perspective, we can assess whether L2 learners are sensitive or not to grammatical errors and speculate on the extent to which they have implicit knowledge through the obtained results. The present study explores the same aspect without using anomaly detection because the insensitivity to grammatical errors might not necessarily mean that learners do not utilize syntactic processing with implicit knowledge.

The target structure of this study is dative alternation. The acquisition process of dative alternation is theoretically well documented, particularly perspectives from usage-based accounts (e.g., Casenhiser & Grodberg, 2005; Goldberg & Casenhiser, 2008; McDonough, 2006; McDonough & Nekrasova-Becker, 2014; Year & Gordon, 2009). A usage-based approach explains that the nature of learning a linguistic structure is initially item-based, and emphasizes the importance of input. A learner acquires a variety of constructions (e.g., give me the first present, give me the scissors, hand me the tape, pass me the ribbon, give me the blue paper, hand me a tag; McDonough & Nekrasova-Becker, 2014) and gradually generalizes the rule for them (e.g., verb + me + a / the N) through statistical information from a huge amount of input, and forms abstract schemata. However, Japanese EFL learners in general, even highly proficient ones, do not have many opportunities to receive such input compared with learners who trained in ESL contexts or in countries where English is used as the official language. It is also worth examining whether the amount of input in Japanese EFL circumstances is sufficient (Tode, 2012), in particular, for the acquisition of implicit knowledge in dative alternation1.
2. The Present Study

2.1 Research Questions

The research questions of the present study are as follows:

RQ1. Do Japanese EFL learners utilize algorithmic processing with implicit knowledge?
RQ2. Are there any differences of processing between Japanese EFL learners and English
native speakers?

We investigate the syntactic priming effect during meaning-focused self-paced reading to
explore the answer to RQ1. The syntactic priming effect was operationally defined as decreasing
the reading time in priming conditions, in which the prime sentence structure is congruent with the
target structure, compared with an alternate condition in which the prime structure is incongruent
with the target structure. Comparing the effects on the Japanese EFL learners and the native
speakers of English, we examined the differences of processing between them to answer RQ2.

2.2 Participants

Twenty highly proficient Japanese learners of English (NNSs) and 18 native speakers of
English (NSs) participated in the present study. All of the NNS participants were educated in the
Japanese schooling system. They speak Japanese as their first language. Their proficiency levels
of English were estimated using the reported Test of English for International Communication
(TOEIC, developed by Educational Testing Service) score, \( M = 898.42, SD = 61.58 \). As for the
NSs, they were educated in their home country (Australia, India, and US) and came to Japan as
exchange students. The dominant language of all of them was English. Both NSs and NNSs were
majoring in various fields, such as international relations, sociology, and psychology. Table 1
shows the demographic information of the participants².

2.3 Materials and Method

Forty-eight target sentences including double object (DO) sentences and prepositional
object (PO) sentences were constructed (half DO primes, half PO primes). Four conditions
of sentence pairs were established (DO-DO and PO-PO for priming conditions, and DO-PO and
PO-DO for alternate conditions); thus, 22 pairs of sentences were made for each form. All of the
pairs, priming sentences and target sentences, of verbs lexically overlapped. There were four sets
of different forms, and every form contained different combinations of pairs. Each form was
constructed by 24 pairs of targets and 16 pairs of fillers. The numbers of characters and words as
well as the frequency in sentences were controlled, and none of the differences among the
compared conditions was statistically significant (\( \alpha = .05 \)). The words in the stimuli were regarded
as high-frequency words (under the 3000 level in JACET 8000³).
Table 1  
Demographic Information of Japanese EFL Learners (NNSs) and English Native Speakers (NSs)  

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>22.44</td>
<td>2.35</td>
<td>19.00</td>
<td>26.00</td>
</tr>
<tr>
<td>Period of residence in Japan (months)</td>
<td>7.80</td>
<td>5.37</td>
<td>1.00</td>
<td>18.00</td>
</tr>
<tr>
<td>NNS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>24.95</td>
<td>7.37</td>
<td>20.00</td>
<td>48.00</td>
</tr>
<tr>
<td>TOEIC</td>
<td>898.42</td>
<td>61.58</td>
<td>775.00</td>
<td>990.00</td>
</tr>
<tr>
<td>Experience abroad (months)</td>
<td>8.37</td>
<td>8.19</td>
<td>0.00</td>
<td>36.00</td>
</tr>
<tr>
<td>Self-ratios on the skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td>3.68</td>
<td>0.75</td>
<td>3.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Writing</td>
<td>3.37</td>
<td>0.83</td>
<td>2.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Listening</td>
<td>3.21</td>
<td>1.08</td>
<td>1.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Speaking</td>
<td>3.16</td>
<td>0.90</td>
<td>2.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Grammar</td>
<td>3.37</td>
<td>1.01</td>
<td>2.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>3.00</td>
<td>0.67</td>
<td>2.00</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Note. The self-ratios on the skills were rated on a 1-5 rating scale, with 5 indicating “very confident”, and 1 indicating “not confident at all”.

The presentation of test materials and the recording of reaction times were accomplished using Hot Soup Processor (HSP) version 3.3. Participants engaged in a phrase-by-phrase self-paced reading task after reading prime sentences that were either DO or PO sentences (e.g., *The teacher told the students the news last week* for a DO sentence, *The teacher told the news to the students last week* for a PO sentence). We also constructed 16 pairs of filler sentences. Fillers were followed by a two-choice question constructed to facilitate meaning-focused reading.

In the experiment, the participants were examined individually in a quiet room. They were asked to sign a written consent form if they agreed to participate in this experiment. A questionnaire was also given to the participants before the experiment in order to gather information about their demographic characteristics. Subsequently, they were asked to engage in the self-paced reading task with priming. The participants were asked to read a prime sentence, followed by a self-paced reading section to read target sentences. They were instructed to read each sentence as quickly as possible, but also to understand its meaning as accurately as possible. In the self-paced reading part, sets of four regions (described below) were displayed individually. The pairs of stimuli were presented one at a time on a display in a random order.

2.4 Analysis

For the comparisons of reading times, the study set four regions (e.g., DO sentence: The teacher | told the students | the news | last week; PO sentence: The teacher | told the news | to the students | last week). Region one is the first NP (Det+N; e.g., *The teacher*). Region two is a verb
phrase (V+Det+N; e.g., told the students for DO, and told the news for PO). Region three is a noun phrase for an indirect object, in terms of DO (Det+N; e.g., the news), and a preposition phrase for a PO sentence (P+Det+N; e.g., to the students). Region four is allocated to an adverbial phrase (e.g., in the afternoon); it aims to prevent the wrap-up effect in the self-paced reading task.

The present study mainly focuses on the second region, which is the first stage at which the participants can perceive whether the sentence is DO or PO, and the third region, at which participants encounter the NP for DO sentences or PP for PO sentences. The reading times in each region were calculated to the nearest millisecond.

![Figure 1. Procedures of self-paced reading task with syntactic priming](image)

3. Results

As data screening for reaction times, responses that were +/- 2.0 standard deviations away from each participant's mean were discarded as outliers. The descriptive statistics for the data in each condition are shown in Table 2. First, the difference of priming condition and alternate condition in regions 2 and 3 was examined. For region 2, in both groups, the sentence was read faster in a priming condition than in an alternate condition (NS: 696 vs. 714; NNS: 986 vs. 1065). However, the result of paired t-test showed that only the difference in NNSs was statistically significant, NS: t (17) = 0.48, p = .64, r = .12; NNS: t (19) = 2.18, p = .04, r = .45.

Next, in terms of the descriptive statistics of region 3, both the groups again showed that sentences in a priming condition were read faster than in an alternate condition (NS: 568 vs. 572; NNS 822 vs. 859). However, the result of t-test showed that the differences in both NSs and NNSs were not statistically significant, NS: t (19) = 0.25, p = .08, r = .06; NNS: t (17) = 0.93, p = .40, r = .22.
Table 2
Descriptive Statistics of NSs and NNSs in Each Condition. The Value Shows the Reaction Times (ms) on Average. \( M = \text{mean}, SD = \text{standard deviation}, CI = \text{confidence interval.} \)

<table>
<thead>
<tr>
<th></th>
<th>Region 2</th>
<th>Region 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( M (SD) )</td>
<td>( M (SD) )</td>
</tr>
<tr>
<td></td>
<td>95% CI</td>
<td>95% CI</td>
</tr>
<tr>
<td>NS (n = 18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>696 (228)</td>
<td>568 (141)</td>
</tr>
<tr>
<td></td>
<td>[583, 809]</td>
<td>[498, 638]</td>
</tr>
<tr>
<td>DO</td>
<td>676 (205)</td>
<td>556 (136)</td>
</tr>
<tr>
<td></td>
<td>[574, 778]</td>
<td>[488, 624]</td>
</tr>
<tr>
<td>PO</td>
<td>717 (262)</td>
<td>579 (154)</td>
</tr>
<tr>
<td></td>
<td>[587, 847]</td>
<td>[502, 655]</td>
</tr>
<tr>
<td>Alternate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>714 (317)</td>
<td>572 (136)</td>
</tr>
<tr>
<td></td>
<td>[556, 872]</td>
<td>[504, 640]</td>
</tr>
<tr>
<td>DO</td>
<td>739 (333)</td>
<td>550 (115)</td>
</tr>
<tr>
<td></td>
<td>[573, 905]</td>
<td>[493, 607]</td>
</tr>
<tr>
<td>PO</td>
<td>689 (306)</td>
<td>594 (166)</td>
</tr>
<tr>
<td></td>
<td>[537, 841]</td>
<td>[511, 677]</td>
</tr>
<tr>
<td>NNS (n = 20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>986 (287)</td>
<td>822 (193)</td>
</tr>
<tr>
<td></td>
<td>[843, 1129]</td>
<td>[726, 918]</td>
</tr>
<tr>
<td>DO</td>
<td>970 (283)</td>
<td>804 (211)</td>
</tr>
<tr>
<td></td>
<td>[829, 1111]</td>
<td>[699, 909]</td>
</tr>
<tr>
<td>PO</td>
<td>1000 (313)</td>
<td>838 (207)</td>
</tr>
<tr>
<td></td>
<td>[844, 1156]</td>
<td>[735, 941]</td>
</tr>
<tr>
<td>Alternate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>1065 (344)</td>
<td>859 (238)</td>
</tr>
<tr>
<td></td>
<td>[894, 1236]</td>
<td>[741, 977]</td>
</tr>
<tr>
<td>DO</td>
<td>1140 (486)</td>
<td>828 (297)</td>
</tr>
<tr>
<td></td>
<td>[898, 1382]</td>
<td>[680, 976]</td>
</tr>
<tr>
<td>PO</td>
<td>1000 (271)</td>
<td>884 (192)</td>
</tr>
<tr>
<td></td>
<td>[895, 1135]</td>
<td>[789, 979]</td>
</tr>
</tbody>
</table>

Table 3
Differences in Each Comparison and the Results of Statistical Tests

<table>
<thead>
<tr>
<th></th>
<th>Difference (SD)</th>
<th>95% CI</th>
<th>( t )</th>
<th>( p )</th>
<th>( r )</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS (n = 18)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DO-DO and PO-DO</td>
<td>-63 (188)</td>
<td>[-156, 30]</td>
<td>1.34</td>
<td>.20</td>
<td>.31</td>
</tr>
<tr>
<td>PO-PO and DO-PO</td>
<td>28 (149)</td>
<td>[-46, 102]</td>
<td>0.76</td>
<td>.46</td>
<td>.18</td>
</tr>
<tr>
<td>Region 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DO-DO and PO-DO</td>
<td>6 (72)</td>
<td>[-29, 42]</td>
<td>0.32</td>
<td>.76</td>
<td>.08</td>
</tr>
<tr>
<td>PO-PO and DO-PO</td>
<td>-15 (81)</td>
<td>[-55, 25]</td>
<td>0.72</td>
<td>.49</td>
<td>.17</td>
</tr>
<tr>
<td>NNS (n = 20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DO-DO and PO-DO</td>
<td>-170 (292)</td>
<td>[-315, -25]</td>
<td>2.55</td>
<td>.02</td>
<td>.51</td>
</tr>
<tr>
<td>PO-PO and DO-PO</td>
<td>0 (42)</td>
<td>[-21, 21]</td>
<td>0.00</td>
<td>.99</td>
<td>.00</td>
</tr>
<tr>
<td>Region 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DO-DO and PO-DO</td>
<td>-33 (193)</td>
<td>[-129, 63]</td>
<td>0.54</td>
<td>.60</td>
<td>.12</td>
</tr>
<tr>
<td>PO-PO and DO-PO</td>
<td>56 (223)</td>
<td>[-55, 167]</td>
<td>0.90</td>
<td>.38</td>
<td>.20</td>
</tr>
</tbody>
</table>
In order to investigate further the reason for such results, we conducted post hoc analysis involving a comparison of each pair of conditions, namely, DO-DO, PO-PO, DO-PO, and PO-DO conditions. Note that comparison between DO-DO and PO-DO conditions shows the priming effect on DO targets, and the difference between PO-PO and DO-PO reflects the priming effect on PO targets.
Figures 2 and 3 show the results of NSs: Figure 2 for region 2 and Figure 3 for region 3. In contrast, Figures 4 and 5 show the results of NNSs: Figure 4 for region 2 and Figure 5 for region 3. The figures indicate that the priming effect emerged only in the results of NNSs, and the effect on DO was found only in region 2, while the effect on PO did not strongly emerge. The differences of reaction times in each comparison and the result of t-tests are summarized in Table 3.

In the results for NNSs, the difference of DO in region 2 was statistically significant, but that of NSs was not, although it had a medium-sized effect, NS: \( t (17) = 1.34, p = .20, r = .31 \); NNS: \( t (19) = 2.55, p = .02, r = .51 \). However, those of region 3 in both groups were not statistically significant, NS: \( t (17) = 0.32, p = 0.76, r = 0.08 \); NNS: \( t (19) = 0.54, p = .60, r = .12 \). In terms of the differences of primed PO and alternate PO conditions, for both NSs and NNSs, and for both region 2 and region 3, they were not statistically significant: region 2 NS: \( t (17) = 0.76, p = .46, r = .18 \); region 2 NNS: \( t (19) = 0.00, p = .99, r = .00 \); region 3 NS: \( t (17) = 0.72, p = .49, r = .17 \); region 3 NNS: \( t (17) = 0.90, p = .38, r = .20 \). That is, the priming effect was found only in NNSs’ DO structures.

4. Discussion

To answer RQ1, *Do Japanese EFL learners utilize algorithmic processing with implicit knowledge?*, we examined the syntactic priming effect by comparing NNSs’ reaction times for primed and alternate conditions. The priming effect was found in region 2, and post hoc analysis showed that this was because of the effect of priming on DO structure, but not on PO structure. The results suggest that, for dative alternation, NNSs utilize algorithmic processing with implicit knowledge, at least when processing DO structures.

The existence of an effect on DO structure but little effect on PO structure can possibly be explained by the differences of input frequency. That is, an infrequently encountered structure tends to show stronger priming effects than a frequently encountered one (Ferreira, 2003), and a PO sentence tends to be produced more often in actual language use than a DO sentence (Gries, 2005). Thus, the result of the present study is compatible with the assumptions derived from the previous studies.

As for RQ2, *Are there any differences of processing between Japanese EFL learners and English native speakers?*, the reaction times of the target structure performed by NSs and NNSs were compared. Surprisingly, the results consistently showed that the differences between primed and alternate conditions in NSs, as well as post hoc respective analyses of DO and PO structures, were all statistically insignificant. That is, NNSs showed the priming effect in region 2, whereas NSs did not show any priming effects in the present study.

Conventionally, no effects on NSs have meant the failure of an experiment; NSs have usually been considered to possess “perfect” implicit knowledge and always process stimuli with “complete” syntactic parsing. Therefore, researchers have examined L2 representation and
processing after confirming certain effects that result in the L1 representation or processing. On
the basis of a perspective derived from the GE approach, we argue, rather, that this asymmetric
effect between the two groups shows the nature of the differences between NSs’ and NNSs’
processing. As mentioned in the background section, the heuristic parser is fast and frugal, and the
syntactic algorithm is cognitively demanding and thus considered to be fragile. Because the
syntactically driven algorithm is more demanding than semantically driven heuristics,
comprehenders would prefer to use semantic heuristics to increase processing efficiency
(Kusanagi, 2013). In other words, if no problem exists and readers can understand the sentences
presented, they process the sentences via the heuristic processing route.

This study used only quite high-frequency words and very common target structures in
daily language use. The words and structures in the present stimuli were obviously easy for L1
speakers of English, which is considered to lead to heuristic processing because the syntactically
driven algorithm is easily overridden by semantically driven heuristics via intervenes of lexical
information (Lim & Christianson, 2013). From this standpoint, it can be hypothesized that the
easier the words used in a stimulus are, so that learners do not experience difficulty understanding
them, the more NSs use semantically driven heuristic processing. As evidence supporting this, it
has been reported that NSs showed a weaker priming effect than NNSs when processing
PP-attachment ambiguity (Fukuta et al., 2014), and also that NSs showed stronger priming effects
than NNSs in terms of sentence-level “semantic” priming (Kusanagi & Fukuta, in press). Both
studies used only high-frequency words in their stimuli (at the same frequency as in the present
study), and the results supported the notion that NSs relied heavily on semantic processing when
processing stimuli consisting of high-frequency (and thus easy) words. This is an important point
that should be considered when we compare L1 and L2 processing in terms of the syntactic
priming paradigm. The results of the present study indicate that, in NNSs, dative structures are
processed more “deeply” under certain conditions, contrary to the “shallow”-structure hypothesis.
It is thus anticipated that future studies will explore what these “certain conditions” consist of.
Previous studies, as mentioned above, reported that native speakers show sensitivity to
ungrammatical sentences, unlike learners, in the anomaly detection paradigm. However, in the
syntactic priming paradigm applied in the present study, ungrammatical sentences were not used.
The different results between anomaly detection and the priming paradigm suggest that learners
are insensitive to grammatical errors, but this does not necessarily mean that they do not utilize
syntactic processing with implicit knowledge.

The results also have some other significant implications. First, the effects of priming on
dative alternation are not monolithic. That is, there is interplay between the structure types (i.e.,
DO and PO structures) and target regions. In order to obtain deeper insight into the effect of
priming on the structure, this interplay should be taken into account. Moreover, strong frequency
effects of syntactic priming were found in NNSs’ reaction times. This indicates that the priming
effect may support the existence of a representation of implicit knowledge with algorithmic
processing. This frequency is also an important variable to be taken into account in future studies that explore the effects of syntactic priming.

Most importantly, even though Japanese EFL learners are often said to have less opportunity to receive sufficient input than ESL learners or learners in countries where English is used as the official language, the results show that they can acquire implicit knowledge of dative alternation. This result is the complete opposite of findings in previous studies on L2 morphosyntactic representation that maintained that the morphosyntactic feature cannot be acquired as implicit knowledge by L2 learners (e.g., Clahsen & Felser, 2006); thus, learners can only utilize “shallow” processing. Why, then, can the dative structure be acquired as implicit knowledge? One possible explanation is that syntactic structures such as dative alternation are related to word order, argument structure, and semantic role (agent, patient, etc.), unlike morphosyntactic features, and are thus considered to be more salient. Salient linguistic structures are said to be learned faster than less salient ones (Bardovi-Harlig, 1987) and can be acquired by less input (O’Grady, 2008; O’Grady, Kwak, Lee, & Lee, 2010). For the acquisition of syntactic structure, in contrast, more complex rules such as the narrow-range rule in dative alternation are difficult for Japanese learners of English to acquire (Inagaki, 1997) because of interaction among salience, rule complexity, and input frequency (O’Grady, 2008, O’Grady et al., 2010). Therefore, the features that determine (un)acquirable structures as implicit knowledge for EFL learners should be examined further.

Here is a pedagogical implication the study can present: namely, structure by treatment interaction (DeKeyser, 2012; Tamura & Kusanagi, this volume). This notion suggests that different structures have a differential need for instruction (DeKeyser, 2012). For instance, if certain target structure is difficult to acquire as implicit knowledge, learners have to compensate the syntactic parsing system by explicit knowledge. Also, it is well known that accessing to explicit knowledge can become faster by ample practice (DeKeyser, 1998). Thus, to describe the learning difficulty as implicit and explicit knowledge is valuable for English language instruction.

5. Concluding Remarks and Future Research

This study introduced the distinction of semantically driven heuristic processing and syntactically driven algorithmic processing to the study of L2 implicit/explicit knowledge representation, and examined whether Japanese EFL learners can utilize syntactically driven algorithmic processing with implicit knowledge. To achieve this goal, the study adopted a priming paradigm for a self-paced reading task. The results indicated that Japanese EFL learners can implicitly and syntactically process dative alternation, but it was also suggested that the processing routes utilized by NSs and NNSs differ.

It is hoped that this study can act as an initial building block on which to base further studies in this field. The present experiment focused on just one syntactic structure, simple dative
 alternation. The results thus cannot be generalized to the acquisition of other structures. Future studies will shed light on the other structures in terms of the perspective presented by this study, and will identify the features that determine learning difficulty. Other possible topics of study, as previously mentioned, include rule complexity, salience, and input frequency. In addition, other traditional factors, such as L1 influence and aptitude, should be further considered. As such, there are many issues to be taken into account before any conclusions about the nature of L2 knowledge representation and processing can be drawn. However, we hope that this work will encourage further study to investigate this issue, which is one of the central concerns in research on acquisition of a second language.

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Notes

1 An anonymous reviewer pointed out that including the participants who experienced study abroad is not reasonable in testing whether or not the amount of input which Japanese EFL learners exposed is enough. While this is true, in reality, the majority of highly-proficient Japanese learners of English experience study abroad. Moreover, in terms of the amount of input, the learners who participated in the current study do not come close to from learners who trained in an ESL context or in countries where English is used as the official language. However, future studies are encouraged to evaluate the effects of experience abroad as a possible variable influencing the results.

2 The present study showed the self-rating scores to present detailed demographic information of the samples for future replications although the study did not analyze them.

3 The stimuli are available in the IRIS digital repository (www.iris-database.org).

4 This $r$ represents the effect size. The $r$ is conventionally interpreted as: small: $r = .10$; medium, $r = .30$; and large: $r = .50$ (Cohen, 1988).

References


Morishita, M. (2013). The effects of interaction on syntactic priming: A psycholinguistic study
using scripted interaction tasks. ARELE, 24, 141–156.


