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Effects of Proficiency on Syntactic Priming in the Language Production of Japanese EFL Learners

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Abstract

The occurrence of *alignment* at each linguistic level (sound, syntactic, semantic, etc.) plays an important role in achieving communication goals, and the same structure tends to be repetitively used between interlocutors in the dialogue (*syntactic priming*). Study on L2 learners has shown syntactic priming with written primes (Morishita, Sato, & Yokokawa, 2010), but the occurrence of syntactic priming in speech communication and how it differs by learners' proficiency levels have not been clarified. This study uses a picture description task with spoken primes to investigate whether proficiency level (upper or lower), and output modality (spoken or written) affect syntactic priming in Japanese EFL learners. The results show that the magnitude of priming for the upper-level learners was significantly higher than that for lower-level learners only with presentation of primes once (as opposed to more than one). This confirms that spoken primes might activate cognitive links between combinatorial nodes and lemmas, promoting production of the relevant structures, more effectively for upper-level learners, but also that presenting primes only once might not be enough to activate the links for lower-level learners with their developing syntactic representations.

Keywords: syntactic priming, proficiency level, L2 language production

Introduction

To express one's opinions and communicate one's message to others efficiently in a foreign language, it is essential to acquire productive language skills, such as speaking and writing skills. Acquisition of speech communication skills in particular is receiving increasing research attention, and it is generally recognized that automatization of lexical and syntactic processing is one of the significant factors promoting fluency in communication. However, non-native speakers of a language, such as Japanese EFL learners often face difficulties in producing the target language smoothly, and their production processes lack automaticity. It has been shown that this lack of automaticity is caused by difficulties with syntactic processing (Morishita & Yokokawa, 2014).

The aims of the study are to examine how Japanese EFL learners' production of syntactic structures automatize by investigating the effects of learners' proficiency among learners on the occurrence of syntactic priming effect, and to investigate the effects of output modality on

the automatization process.

Background

Cognitive Processes in Language Production

One psycholinguistic account of listening and speaking cognitive processes has been proposed by Levelt (1989). In this account, speakers first think about what they want to say in the *conceptualizer*. Then, in the *formulator*, *grammatical encoding* accesses lemma information stored in speaker's mental lexicon and builds syntax, while *phonological encoding* accesses lexeme information to retrieve a phonetic or articulatory plan for each lemma. Finally, in the *articulator*, successive chunks of internal speech are retained and unfolded for execution.

According to Levelt's account, automatization of the process of grammatical encoding, especially accessing and building syntax, is important for spoken language comprehension and production and thereby for smooth and efficient communication. Speaking and writing are considered to share the underlying mechanisms that lead to the construction of grammatical form. Some researchers assume the stages proposed in spoken language production (Levelt, 1989) also hold for written language production. Cleland and Pickering (2006), for example, showed that the processor employs the same mechanism for syntactic encoding in written and spoken production. However, as stated above, non-native speakers of a language, such as Japanese EFL learners, often encounter difficulties with grammatical encoding—difficulties that interfere with smooth output production (Morishita & Yokokawa, 2014). In the present study, we attempted to elucidate on the nature and progression of this syntactic processing.

Lexical and Syntactic Priming as Interactive Alignment

It is important for interlocutors to align their linguistic representations at each linguistic level within a dialogue in order to lead them (selves) to mutual understanding to achieve effective communication. Pickering and Garrod (2004) proposed a schematic representation of the stages of comprehension and production, in which the repetitive use of linguistic elements and structures by interlocutors is said to be caused by the occurrence of *interactive alignment (co-ordination)*, and these repetitions occur at all linguistic levels. Garrod and Anderson (1987) found that participants who played a cooperative maze game tended to repeat their lexical content with each other in order to identify their current places in the maze. They used once established chunks again and adapted them to new locations after their utility was established. Furthermore, Levelt and Kelter (1982) showed that Dutch native speakers tended to answer the questions *What time do you close?* or *At what time do you close?* in Dutch using a congruent answer (e.g., respectively, *Five o'clock* or *At five o'clock*). These repetitions may be caused by lexical (repetition of preposition *at*) or syntactic (repetition of phrasal categories) alignment. In the study, syntactic alignment was enhanced when lexical items are shared.

Interactive alignment is achieved by a *priming* mechanism, which functions at different levels of representation to produce alignment, such as *syntactic priming*. It occurs when the interlocutor repeatedly uses the same syntactic structure because of a recent prior experience with that structure. Recurrent findings have shown that priming at one linguistic level can

enhance priming at other levels (Pickering & Garrod, 2004; Levelt & Kelter, 1982). According to usage-based approaches to language learning, this priming through repetition is caused by recency effects of prior exposure to stimulus, and occurs unconsciously as interlocutors use implicit memory (Ellis, Römer, & O'Donnell, 2016).

The current study focuses on the occurrence of syntactic priming effect in order to clarify the magnitude of automatization of L2 syntactic processing among Japanese EFL learners.

Syntactic Priming Effects and Syntactic Representations in Mental Lexicon

Pickering and Branigan (1998) investigated syntactic priming effects in English native speakers using a written sentence completion task. The participants were told to complete prime sentences such as fragments (1a) to (1d) below by rendering them as either PO (Prepositional-Object) or DO (Double-Object) sentences, after which they were instructed to complete additional target sentences such as the incomplete clause in (2).

- (1) a. The racing driver *showed* the torn overall...
- b. The racing driver *showed* the helpful mechanic...
- c. The racing driver *gave* the torn overall...
- d. The racing driver *gave* the helpful mechanic...
- (2) The patient *showed*...

(Pickering & Branigan, 1998, p. 637)

The results showed that participants tended to produce more PO sentences after PO-congruent primes as illustrated in (1a) and (1c) and more DO sentences after the DO primes like those in (1b) and (1d): that is, a syntactic priming effect was observed, in which English native speakers tended to replicate the syntactic structures of the primes.

The previous study discussed above thus shed light on the mechanism of syntactic processing in speakers, and attempted to explain how they formulated their syntactic representations. On this basis, Pickering and Branigan (1998) provided a partial model of the representation of syntactic information associated with verbs in the production lexicon. This model broke syntactic information down into three types: *category* information, which encodes the syntactic category of a word, such as “noun,” “verb,” or “adjective”; *featural* information, which deals with the number, person, tense, aspect, etc., of an instantiation of a verb, and *combinatorial* information, which designates how a word combines with other linguistic units in order to form possible expressions.

According to the model, combinatorial nodes such as *NP* (*noun phrase*), *NP*, or *NP, PP* (*prepositional phrase*) are directly linked to specific lemmas including *give*, *send*, *show* and so on which are unspecified for features such as tense, aspect and number. These combinatorial nodes are thus shared between two different lemmas. When a speaker is exposed to a PO sentence with a lemma such as *give*, a combinatorial node *NP, PP* gets activated, and this activation persists for a time; thus, if a speaker tries to produce a subsequent sentence with a different lemma *send*, the combinatorial node *NP, PP* will be more activated than baseline, with the effect of tending to produce a PO sentence.

Branigan, Pickering, and Cleland (2000) conducted an experiment with English native

speakers using an oral picture description task, in which the participants described pictures freely after they were given prime sentences as stimuli (e.g., *the nun giving the book to the clown ...*). The results showed that the participants produced target sentences using the same syntactic structures as the prime sentences, that is, that a syntactic priming effect occurred. Moreover, the priming rate was higher when the verbs in the prime and target sentences were shared (e.g., *the cowboy giving the banana to the burglar ...*) compared to not shared (e.g., *the cowboy handing the banana to the burglar ...*); they called this the *lexical boost effect*.

McDonough (2006) examined the occurrence of syntactic priming in L2 learners, using an oral picture description task same as Branigan, Pickering, and Cleland (2000) to elicit PO or DO structures when participants began describing pictures orally after exposure to the structures as prime sentences. The results showed that syntactic priming was observed only with PO sentences (and not DO sentences). McDonough found therefore that L2 learners' relative rate of production of PO and DO sentence structures was biased compared to that of English native speakers, who produced both sentence structures equally and showed evidence of syntactic priming with both: that is, L2 learners' degree of retention of syntactic representations in the mental lexicon differs from that of English native speakers.

Cleland and Pickering (2006) reported effects of the difference between input and output modalities (spoken vs. written) on the syntactic priming effect. English native speakers were instructed to complete spoken or written target sentences after hearing or seeing prime sentences; the results showed evidence of syntactic priming with both spoken and written primes, and indicate that English native speakers' syntactic representations are shared between spoken and written comprehension and production. In other words, the difference between input and output modality does not affect the formulation of the speaker's or writer's knowledge of sentence structures.

Morishita (2011a) used the same experimental method as Cleland and Pickering (2006) with Japanese EFL learners, along with a sentence completion task. The Japanese EFL learners' priming rate was found to be stronger with PO prime sentences than with DO prime sentences; it was also found to be lowest with spoken primes and targets. These results suggest that the difference between input and output modality affects the formulation of Japanese EFL learners' knowledge of sentence structures, and that the magnitude of this formulation differs between spoken and written production. However, the study suggested that the lower priming rate could be attributed to the learners' lack of listening ability; this may be because the study did not purely investigate the effects of differences between input and output modalities on syntactic priming, since learners might not be able to hear and understand the spoken primes. Hamada and Yokokawa (2017) conducted a picture description task with spoken primes that were controlled in terms of number of syllables, word familiarity, and speed (speech rate) in order to ensure that the Japanese EFL learners in the study could hear and fully understand them. The results showed a priming effect in both modalities, indicating that learners successfully understood the primes. Therefore, syntactic structures were represented, and links between particular combinatorial nodes and lemmas were activated by the spoken primes; this enforced syntactic processing when learners encountered the same structures again. Moreover, the results demonstrated that different output modalities led to different effects on syntactic priming. This suggests that in

comparison to English native speakers, who are unaffected by modality differences, Japanese EFL learners' way and degree of formulating syntactic representations in English differs between speaking and writing.

The studies discussed above investigated how speakers retain syntactic representations in their mental lexicon, however, studies on EFL learners covering this topic are still scarce.

Effects of Proficiency on Syntactic Priming

Rowland, Chang, Ambridge, Pine, and Lieven (2012) conducted an oral video description task with children (3–4 and 5–6 years old) and adults to illuminate these English native speakers' development of abstract syntax in the cognitive mechanism of language processing. The results showed that the syntactic priming effect was larger in children than in adults, and the lexical boost effect larger in adults than in children's. This implies that children with little knowledge of syntactic structures are more susceptible to the effects of syntactic priming due to less competition from different candidate structures; however, the lexical boost effect increases with development. In addition, the difference was not significant but there was also an evidence that magnitude of the structural priming effect size was greater in the youngest group than in the older children and adults in the different verb condition. It supports that the syntactic priming effect is larger in less skilled speakers and in children. These results support the idea that abstract syntactic knowledge develops separately from verb-specific frames.

Hartsuiker and Bernolet (2017) proposed a lexically-based processing model of L2 syntax acquisition in which learning occurs in a network of representations that achieves a balance between two principles: *representational specificity* and *economy*. L2 language acquisition begins with learning of lexical representations without strong connections to syntactic information. Then, syntactic representations emerge with continued exposure to syntactic structures; at this stage, combinatorial nodes for both frequent and infrequent structures are added to situations in relation to which there has been sufficient exposure to L2 syntactic structures. In the last stage, when learners reach considerable proficiency in their L2, item-specific syntactic representations become more abstract and show both item-specific and abstract priming. Hartsuiker and Bernolet (2017) also proposed that the degree of maintaining and retrieving lexico-syntactic representations in an L2 depends on the learner's proficiency level: lower-level learners tend to rely on lexical items and transfer from their L1 and on imitation when they produce complex structures. After sufficient exposure to L2, intermediate learners gradually acquire language- and item-specific syntactic representations, adding combinatorial nodes. In upper-level learners, syntactic representations become more abstract, and they are less likely to rely on specific lexical items; thus, they tend not to be influenced by a priming effect.

Previous studies investigating L2 learners' syntactic priming shed light on how learners employ syntactic information. Kim and McDonough (2008) conducted an oral picture description task with Korean EFL learners to investigate whether L2 speakers produce more target structures when the same verb is repeated between prime and target, as native speakers do (Branigan et al., 2000; Pickering & Branigan, 1998). The results showed that Korean EFL learners produced more passives when prompted by verbs which occurred in

passives produced by researchers. The study found that lower-level learners are more inclined to rely on the particular lexical items, such as verbs, compared to higher-level learners. Morishita et al. (2010), Morishita (2011b), and Morishita (2013) investigated the effect of language proficiency on the syntactic priming effect through experiments conducted among Japanese EFL learners. In Morishita et al. (2010), Japanese EFL learners were instructed to complete written target sentences after seeing written prime sentences such as PO or DO sentence structures; the results showed that syntactic priming rates in medium- and upper-level learners were higher than in lower-level learners, who tended to produce structures other than target structures including sentences with only one object, those with reversed order of the patient and the beneficiary as well as no response. This suggests in turn that lower-level learners' lexical representations of the structures tend not to be well formulated. However, this study used only written and not spoken primes. In contrast, Morishita (2011b) conducted a sentence completion task in which a sentence being simultaneously spoken and presented on a screen and then the participant being asked to produce an analogous sentence verbally or in writing. Participants were divided into three English proficiency levels according to scores on the Oxford Quick Placement Test (Oxford University Press, 2001). The results showed that the magnitude of the syntactic priming effect increased as learners' proficiency did. Morishita (2013) used the experimental method of Branigan et al. (2000) to conduct an oral picture description task with groups of English native speakers and Japanese EFL learners of three levels of English proficiency based on Versant Speaking Test scores. The results showed that English native speakers' priming rate was higher than that of Japanese EFL learners overall; however, the interaction task used required participants to exchange information and syntactic structures at the same time, which might have made the cognitive load of the task disproportionately heavy for Japanese EFL learners, who lack automaticity in language processing. The results for learners replicated the findings of Morishita (2011b) with one exception: the difference between the priming rates of upper- and medium-level learners was not significant.

Thus, studies investigating effects of proficiency on syntactic priming show contradicting results. Syntactic priming is said to be more effective for children, with little syntactic experience in both L1 and L2 (Rowland et al., 2012); however, priming studies with EFL learners have revealed that priming rates in upper-level learners were higher than in lower-level learners (Morishita et al., 2010; Morishita, 2011b, 2013). Compared to native speakers, learners of course severely lack syntactic and other input; thus, they gradually formulate lexical representations as the amount of input increases, and syntactic priming occurs once they have fully internalized these representations in the mental lexicon.

Previous studies of EFL learners' syntactic priming effect thus demonstrate that learners' proficiency affects the magnitude of priming, which might also differ by developmental stage. However, these studies have not controlled primes for syllables, word familiarity, or speed to ensure that the participants could clearly hear and process the spoken primes. The current study thus investigates the effects of Japanese EFL learners' proficiency on syntactic priming using controlled spoken primes to ensure that participants could hear and fully understand the primes. The study divides participants into two levels of English proficiency (upper or lower) to observe how their syntactic production becomes automatic. The experiment is

designed to enable observation of the effect of proficiency differences on the magnitude of syntactic priming in different prime presentation conditions.

The current study allocated participants randomly to three conditions: (A) presentation of a prime once, (B) presentation of a prime once with a question, and (C) presentation of a prime twice. As it was mentioned before, the study used controlled spoken primes to ensure that participants could hear and fully understand the primes. Condition A was set to investigate whether EFL learners' syntactic priming effect occurs with presentation of a prime once, and Condition C was set to research whether phonological representations get reinforced with presentation of a prime twice. The higher priming rate for Condition C compared to Condition A suggests that EFL learners have difficulties with speech processing. Moreover, Condition B was set to investigate whether diverting the participants' attention from sentential meaning still occur syntactic priming effect with presentation of a prime once with a question. Previous studies with English native speakers show that speakers can process syntactic information correctly and automatically with attention to sentential meaning (Clifton, Traxler, Mohamed, Williams, Morris, & Rayner, 2003), however, L2 learners including Japanese EFL learners rely more on lexical-semantic information. The results with Japanese EFL learners suggest that they process syntactic information when they pay attention to syntactic aspect, but they do not process it when they pay attention to semantical aspect (Narumi, Hashimoto, Nakanishi & Yokokawa, 2016). From the findings with previous studies, the current study investigates whether focusing the participants' attention on sentential meaning would inhibit the activation of syntactic structures or, show robust syntactic priming effect regardless of attention to meanings.

Research Questions

The following research questions were addressed in this study:

- 1: Do differences in learners' proficiency level (i.e., upper or lower proficiency) affect syntactic priming?
- 2: Do differences in learners' proficiency level affect syntactic priming in three prime presentation conditions (Conditions A, B, and C)?

Method

Participants

The participants were 171 native-Japanese-speaking undergraduate learners of English at a university in the Kansai region (divided by production type: spoken production: 85, written production: 86). The participants ranged from 19 to 22 years old, with from 7 to 10 years of previous English study. Each participant attended a one-day experiment. The study was conducted from December 2015 to June 2017 with spoken or written targets (one or the other for each participant). Informed consent was obtained from all the participants. The participants' English proficiency was measured with the Versant Speaking Test (total score: 20–80) for spoken production and the Oxford Quick Placement Test (total score: 60) with written production. Two different measures were used because of the different output modalities. Table 1 shows the participants' English proficiency results, by prime presentation group (A, B, or C, as above).

Table 1

Participants' Mean Scores and SDs on the English Proficiency Tests, Across Conditions

	Spoken Production			Written Production		
	A (<i>n</i> = 28)	B (<i>n</i> = 29)	C (<i>n</i> = 28)	A (<i>n</i> = 28)	B (<i>n</i> = 28)	C (<i>n</i> = 30)
<i>M</i>	37.71	38.03	38.43	39.21	39.75	40.17
<i>SD</i>	6.80	8.10	8.40	4.51	3.40	5.57
C1~	0	0	0	1	0	2
B2	0	1	1	12	14	15
B1	3	3	3	15	14	13
A2	12	12	12	0	0	0
A1	12	12	12	0	0	0

Note. A = presentation of a prime once; B = presentation of a prime once with a question; C = presentation of a prime twice.

Versant scores, for spoken productions, were 37.71, 38.03, and 38.43 for A, B, and C, respectively, placing all groups around A2 (elementary) level of the Common European Framework of Reference for Languages (CEFR). Their mean scores on the Oxford Quick Placement Test, for written productions, were 39.21, 39.75, and 40.17 (A, B, C), respectively, equivalent to B1 to B2 (lower to upper intermediate) level on the CEFR. The data for three participants at C1 level and two participants at A1 level were excluded from the analysis.

Participants were divided into two groups: learners at A2 level in the Versant Speaking Test and learners in B2 level in the Oxford Quick Placement Test were considered upper-level learners, and Versant level A1 and Oxford level B1 learners as lower-level learners, and their respective data compared. These levels should line up sufficiently across tests according to Harada and Morishita (2013).

Upper-level learners numbered 12, 12, 12 (A, B, C) with spoken production and 12, 14, 15 with written production; their mean scores and SDs were respectively 40.33 (2.56), 40.42 (2.43), 39.17 (3.41) with spoken production and 42.67 (1.65), 42.36 (2.19), 42.80 (2.54) with written production, respectively. Lower-level learners numbered 12, 12, 12 (A, B, C) with spoken production and 15, 14, 13 with written production; their mean scores and SDs were 32.75 (1.69), 31.67 (1.93), 32.33 (1.93) with spoken production and 35.80 (2.61), 37.14 (1.96), 35.31 (2.49) with written production, respectively. Significant differences were observed between levels in both spoken and written productions (spoken production: $F(1, 66) = 171.60$, $p < .01$, partial $\eta^2 = .72$, written production: $F(1, 77) = 156.04$, $p < .01$, partial $\eta^2 = .67$).

Materials

Target pictures intended to induce PO and DO sentence structures were prepared, each depicting an action involving an agent and a beneficiary, along with filler pictures. Seven dative verbs (*show*, *give*, *tell*, *send*, *lend*, *sell*, and *buy*) were used for the prime sentences and (corresponding) target pictures (Morishita, 2011b, p. 78). Each verb was presented in a PO or DO prime sentence, using the same or a different verb between prime and target.

The prime sentences containing a subject followed by a verb consisted of a sentence structure with either a PO or DO; in addition, filler sentences unrelated to either target sentence structure and using intransitive verbs were also prepared (e.g., *The store closed*). Sentences (3a) to (3d) are prime sentences, while in (4) the verb is presented in a target picture. The verb remains the same between prime and target in (3a) and (3b), but it is different in (3c) and (3d). All prime sentences were controlled for number of syllables, familiarity, location of agents, and speed. The number of syllables ranged from 7 to 11, and all prime sentences used words from level 5.0 to 7.0 based on the audio and written version of the vocabulary familiarity list (Yokokawa, 2006; 2009). The agents in the target pictures were located on the right side in 10 pictures and on the left in the other 10, in order to avoid participants fostering smooth production by fixating on a specific side of the pictures. The speed of all the spoken primes was also controlled, at 50 wpm.

(3) Prime sentences

- a. The girl *showed* the book to the boy. (*PO sentence structure, same*)
- b. The girl *showed* the boy the book. (*DO sentence structure, same*)
- c. The girl *gave* the book to the boy. (*PO sentence structure, different*)
- d. The girl *gave* the boy the book. (*DO sentence structure, different*).

(4) Target picture and the expected responses



- e. The man showed the letter to the woman (*PO sentence structure*).
- f. The man showed the woman the letter (*DO sentence structure*).

In the experiments, 20 sets of experimental items were prepared by using four conditions (PO, DO, same verb, and different verb). The experimental items were then placed into four lists (A, B, C, and D), and each list comprised five experimental sentences from each condition, and ten filler sentences. Each of the four lists contained 30 sentences, including experimental and filler sentences.

Procedure

The experimental files were presented on a computer screen; participants were seated in front of the computer in a quiet booth, and were given instructions by the researcher. First, the experimental procedure was described, and then, to obscure the actual purpose of the experiment, participants were told that the researcher was interested in what kinds of sentences Japanese EFL learners could produce. The total time needed for the experiment was around 90 minutes. The procedure is described in detail below.

The experiment had three phases. First, Phase 1 (Baseline) of the experiment was conducted, to investigate the participants' original proportional tendency toward PO, DO, and other sentence structures. Participants were randomly presented with 30 target pictures to either speak or write about using the given verbs. The procedure of Phase 2 is shown in Figure 1.

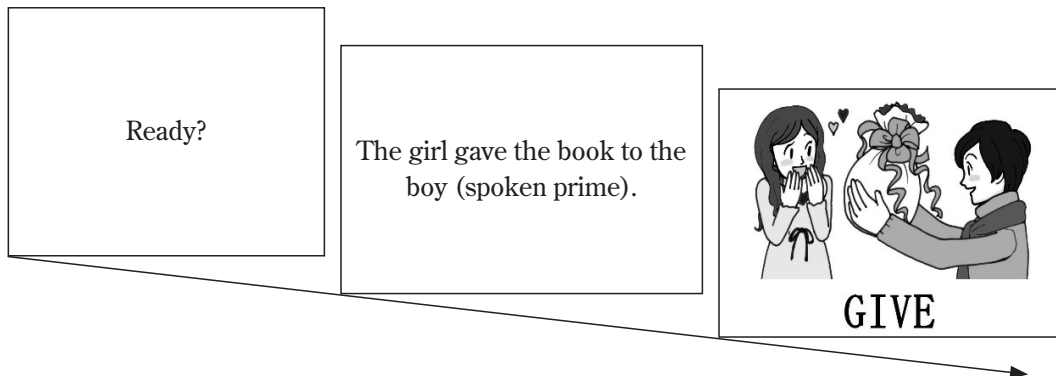


Figure 1. Procedure of Phase 2 (Priming Experiment).

In Phase 2 (Priming Experiment), the participants listened to the spoken primes. As described above, Phase 2 was divided into three prime presentation conditions. In Condition A, the spoken primes were presented only once to the participants, whereas in Condition B, after hearing the spoken primes once, the participants were instructed to answer a question about the spoken primes. Condition B was set to investigate whether focusing the participants' attention on sentential meaning would promote an additional syntactic priming effect or, conversely, inhibit the activation of syntactic structures. In Condition C, the same spoken primes were presented twice, to investigate whether hearing the same spoken prime twice would ease participants into "catching" the spoken prime in terms of semantic meaning and syntax, which they might not have heard or understood the first time, and/or whether repetition would enforce the syntactic structures as a result of hearing the spoken prime twice. Participants were randomly presented with 30 sentences, including 10 PO sentence structures, 10 DO sentence structures, and 10 fillers, and after they had heard the spoken primes, in either form PO or DO, in either Condition A, B, or C, then they were told to either speak or write about the target picture using the given verb. At the beginning of each trial, the participants would see the message "Ready?" on the computer screen, and would press the "Enter" key to start. Then, participants would listen to the primes, and repeat the focal prime as soon as they heard it. Participants would listen to the primes in one condition among the three (Conditions A, B, and C). A target picture would appear on the computer screen, and the participants would use the verb presented with the target picture to describe the picture in one sentence, either by speaking or by writing it down as quickly as they could. Four lists (120 trials) were randomly presented to each participant; the responses were recorded with an IC recorder and transcribed.

In Phase 3, participants answered a questionnaire on their impression of the task after

completing the experiment, to confirm whether they could listen to and understand the primes. The questionnaire also confirmed that they did not know (had not become aware of) the (real) purpose of the current study (to investigate whether differences in output modality and verb usage between prime and target sentences affect Japanese EFL learners' syntactic priming).

Results

Questionnaire results confirmed that the participants heard and understood the primes without difficulty and that none of them noticed the importance of the target structures.

Output Modalities and Learners' Proficiency Among Conditions

As noted, the participants listened to the spoken primes and then produced the targets either in spoken or written form. Transcribed target responses were divided into "Priming," "Alternate," and "Other" groups; these sentence structures and the verb differences between primes and targets (i.e., same or different) were analyzed as within-participant factors using two-way ANOVA, in order to investigate occurrence of the syntactic priming effect. Throughout the analyses, p -values less than .05 were considered statistically significant; partial eta-squared (η^2) values are reported as effect sizes.

Table 2 provides the results for the overall mean numbers of responses, relative proportions (%), and SDs, based on learners' proficiency in spoken production; Table 3 shows the result for written production. According to the results for the PO primes, the simple main effect of sentence structure was significant in Condition A regardless of learners' proficiency levels with spoken and written production (spoken production upper: $F(2, 22) = 12.71, p < .01$, partial $\eta^2 = .54$; lower: $F(2, 22) = 4.28, p < .05$, partial $\eta^2 = .28$; written production upper: $F(2, 22) = 17.64, p < .01$, partial $\eta^2 = .62$; lower: $F(2, 28) = 13.35, p < .01$, partial $\eta^2 = .49$). The proportion of Priming structures was significantly larger than those of Alternate and Other structures except in the case of Other structures in the spoken productions of lower-level learners (spoken production upper: adjusted $ps = .00, .01$; lower: adjusted $ps = .00, .01$; written production upper: adjusted $ps = .00, .89$; lower: adjusted $ps = .00, .79$). Therefore, a syntactic priming effect was observed with PO primes; this finding confirms that Japanese EFL learners' syntactic representations are shared between comprehension and production (Branigan et al., 2000).

The learners' proficiency levels (i.e., upper or lower) and output modality (i.e., spoken or written) were analyzed as between-participant factors in a two-way ANOVA to investigate the effects of learner proficiency on the syntactic priming effect in each condition.

According to the results for PO Priming in Condition A, the simple main effect of learners' proficiency was significant (A: $F(1, 47) = 6.91, p < .05$, partial $\eta^2 = .13$). Thus, the proportion of PO Priming was significantly larger in upper- than in lower-level learners, with spoken and written productions. This demonstrates that learners' proficiency affects the magnitude of syntactic priming. However, these differences were not significant for PO priming in Conditions B and C (B: $F(1, 48) = 0.99, n.s.$, partial $\eta^2 = .02$, C: $F(1, 48) = 1.05, n.s.$, partial $\eta^2 = .02$). It is likely that focusing attention on semantic processing inhibits the activation of syntactic structures in Condition B, and that presentation of primes twice was not enough to

show the difference in Condition C.

Moreover, according to the results for DO Priming, the simple main effect of output modality was significant in all conditions (A: $F(1, 47) = 8.53, p < .01$, partial $\eta^2 = .15$; B: $F(1, 48) = 9.55, p < .01$, partial $\eta^2 = .17$, C: $F(1, 48) = 5.22, p < .05$, partial $\eta^2 = .10$), indicating that the proportion of DO Priming in written productions was significantly larger than in spoken productions.

Table 2

Spoken Production: Overall Mean Numbers of Responses, Relative Proportions (%), and SDs Based on Learners' Proficiency

		Priming			Alternate			Other			
Prime	Levels	<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>	
A	PO	Upper	27.42	34.27	12.37	2.67	3.33	6.46	9.92	12.40	10.54
		Lower	18.00	22.50	8.06	6.92	8.65	6.71	15.08	18.85	8.66
	DO	Upper	4.00	5.00	8.41	25.67	32.08	12.54	10.33	12.92	9.22
		Lower	7.33	9.17	6.07	18.42	23.02	7.54	14.25	17.81	7.61
B	PO	Upper	21.25	26.56	8.35	5.67	7.08	6.83	13.08	16.35	9.15
		Lower	18.00	22.50	7.93	6.33	7.92	5.76	15.67	19.58	7.27
	DO	Upper	6.75	8.44	8.25	21.33	26.67	10.30	11.92	14.90	10.66
		Lower	8.75	10.94	8.21	14.67	18.33	8.40	16.58	20.73	7.87
C	PO	Upper	23.00	28.75	9.18	7.58	9.48	7.61	9.42	11.77	4.89
		Lower	23.25	29.06	11.72	7.83	9.79	10.72	8.92	11.15	8.39
	DO	Upper	8.58	10.73	8.08	26.00	65.00	7.38	10.17	12.71	5.95
		Lower	9.25	11.56	11.93	21.25	26.56	8.09	9.50	11.88	8.35

Note. A = presentation of a prime once; B = presentation of a prime once with a question; C = presentation of a prime twice.

Table 3

Written Production: Overall Mean Numbers of Responses, Relative Proportions (%), and SDs Based on Learners' Proficiency

		Priming			Alternate			Other			
Prime	Levels	<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>	
A	PO	Upper	26.00	32.50	8.29	6.83	8.54	8.67	7.17	8.96	4.45
		Lower	22.20	27.75	6.55	9.20	11.50	6.70	8.60	10.75	6.71
	DO	Upper	12.08	15.10	11.45	21.83	27.29	9.69	6.08	7.60	4.62
		Lower	12.93	16.17	6.72	18.07	22.58	5.81	9.00	11.25	6.86
B	PO	Upper	21.64	27.05	10.09	13.79	17.23	11.43	4.57	5.71	2.68
		Lower	19.79	24.73	9.97	14.07	17.59	11.65	6.14	7.68	5.10
	DO	Upper	17.64	22.05	12.25	17.57	21.96	10.58	4.79	5.98	3.21
		Lower	16.36	20.45	12.75	16.93	21.16	10.43	6.79	8.48	5.86
C	PO	Upper	23.47	29.33	8.09	8.73	10.92	6.61	7.80	9.75	7.97
		Lower	17.62	22.02	10.26	10.08	12.60	7.82	12.31	15.38	9.06
	DO	Upper	13.87	17.33	8.00	18.40	23.00	7.44	7.73	9.67	8.13
		Lower	15.77	19.71	8.90	10.85	13.56	7.08	13.38	16.73	9.75

Note. A = presentation of a prime once; B = presentation of a prime once with a question; C = presentation of a prime twice.

Prime Presentation Condition and Learner Proficiency

The learners’ proficiency level (upper or lower) and prime presentation conditions (A, B, or C) were analyzed as between-participant factors in a two-way ANOVA, to investigate the syntactic priming effect in each condition. Figures 2, 3, and 4 show the overall proportions (%) of participants’ responses by output modality and learner proficiency in Conditions A, B and C.

According to the results, no simple main effect of prime presentation condition was observed (PO spoken: $F(2, 66) = 0.92$, n.s., partial $\eta^2 = .03$; PO written: $F(2, 77) = 1.20$, n.s., partial $\eta^2 = .03$, DO spoken: $F(2, 66) = 0.27$, n.s., partial $\eta^2 = .01$, DO written: $F(2, 77) = 0.79$, n.s., partial $\eta^2 = .02$).

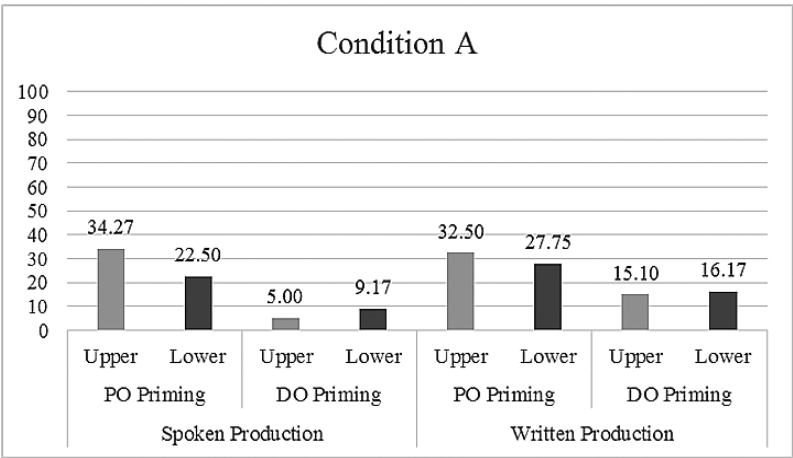


Figure 2. Overall proportions (%) of responses based on output modality and learner proficiency in Condition A.

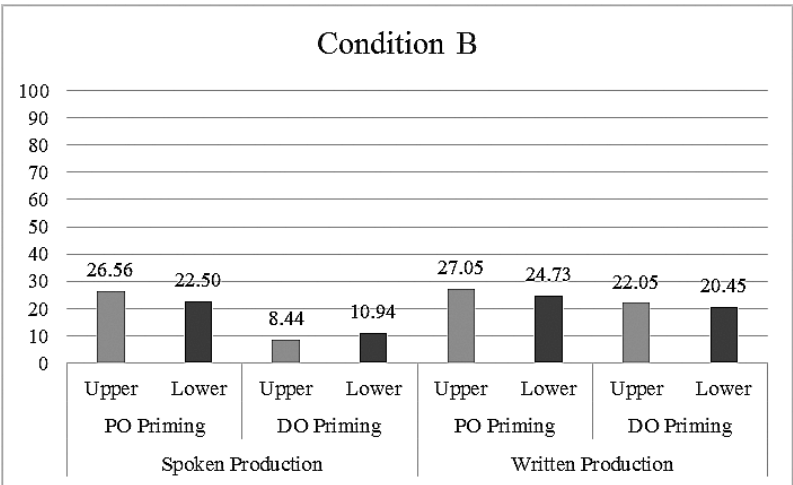


Figure 3. Overall proportions (%) of responses based on output modality and learner proficiency in Condition B.

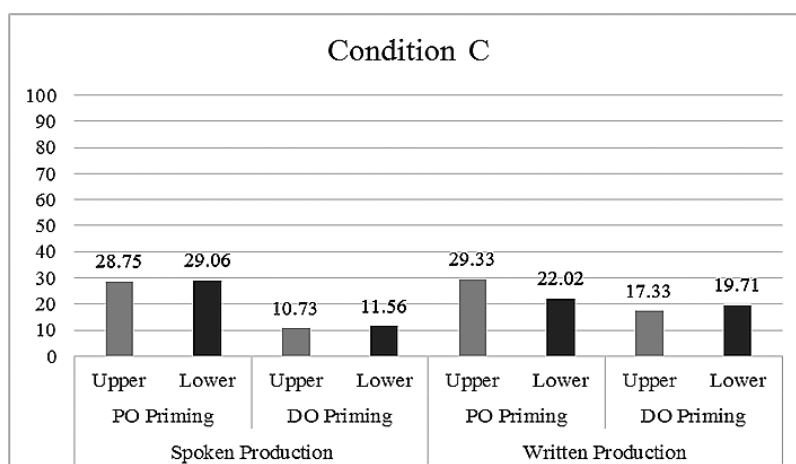


Figure 4. Overall proportions (%) of responses based on output modality and learner proficiency in Condition C.

Discussion

The aim of the current study was to examine how Japanese EFL learners' production of syntactic structures is automatized by investigating the effects of learners' proficiency on the occurrence of syntactic priming effect. A picture description task with spoken primes was conducted to investigate whether differences in learners' proficiency level and output modality affect their syntactic priming, in three different conditions.

Research question 1 asked whether differences in proficiency level affect syntactic priming with spoken primes; it was found that they do.

First, the results showed a priming effect with PO primes in both modalities regardless of proficiency level, indicating that learners' syntactic representations are shared between comprehension and production (Branigan et al., 2000).

The results for PO Priming in Condition A showed that it was significantly more frequent in upper- than in lower-level learners, in both spoken and written productions. In general, upper-level learners tended to produce PO sentence structures after primes but not DO after DO primes, while lower-level learners tended to produce neither other structures. This indicates that upper-level learners' links between combinatorial nodes and lemmas were more activated by PO primes than those of lower-level learners, and this residual activation promoted learners to produce the same sentence structures. However, with presentation of DO primes, links between combinatorial nodes *NP*, *NP* and lemmas had not been fully formulated, which might prohibit the production of the sentence structures. This difference between the results of PO and DO primes might be due to difference in cognitive complexity (Hulstijn & de Graaff, 1994). The DO sentence structure is recognized as complex because it involves multiple thematic arguments, while lower-level learners' syntactic representations might still be developing and might not have been fully formulated for both combinatorial nodes, leaving them unable to utilize the prime to produce the same sentence structure.

The effects of learners' proficiency on the magnitude of the syntactic priming effect were observed with PO primes. It can be assumed that the degree of formulation of syntactic

representations will change with increased syntactic experience in the long term; if (both upper- and lower-level) learners in the current study are exposed to more input, the syntactic representations for both sentence structures might become fully formulated. However, the results of the current study are limited to learners at particular CEFR levels; therefore, further studies are needed to investigate the effects of learners' proficiency on the syntactic priming effect with learners at other proficiency levels such as medium-level learners who might be more susceptible to syntactic priming effect compared to lower-level learners.

Moreover, while no interaction between learners' proficiency and output modality was observed, the simple main effect of output modality was significant in all conditions with DO Priming, indicating that the proportion of DO Priming in written productions was significantly larger than in spoken productions. DO productions increased at a slower pace in written than in spoken production, indicating increased production of the latter structure and a decline in the discrepancy in preference. Therefore, the results suggest that difference in output modality affects proportions of PO and DO productions but not the degree of formulating syntactic structures between upper- and lower-level learners.

Research question 2 asked whether the differences in learners' proficiency level affect syntactic priming, across three prime presentation conditions. The results showed that PO Priming in upper-level learners (PO spoken: 34.27, PO written: 32.50) was significantly higher than in lower-level learners (PO spoken: 22.50, PO written: 27.75) with presentation of a prime once (Condition A), while in Condition B PO Priming (PO spoken: 26.56, PO written: 27.05) was slightly smaller than PO and DO Priming in Condition A, and PO and DO Priming in lower-level learners in Condition C (PO spoken: 29.06, PO written: 22.02, DO spoken: 11.56, DO written: 19.71) were slightly greater than PO and DO Priming in Condition A, except for PO Priming in written modality. However, no simple main effect of prime presentation condition was observed (PO spoken: $F(2, 66) = 0.92$, n.s., partial $\eta^2 = .03$; PO written: $F(2, 77) = 1.20$, n.s., partial $\eta^2 = .03$, DO spoken: $F(2, 66) = 0.27$, n.s., partial $\eta^2 = .01$, DO written: $F(2, 77) = 0.79$, n.s., partial $\eta^2 = .02$). This suggests that prime presentation condition did not affect upper- or lower-level learners' syntactic priming in the current study. In addition, in Condition B, it is likely that focusing attention on semantic processing inhibited the activation of syntactic structures by using large amount of linguistic processing resources and prohibiting learners to allocate it to syntactic processing for upper-level learners. On the other hand, in Condition C, it is possible that presentation of primes prime more than twice might promote internalization of syntactic representations and show a significant difference between Conditions A and C in lower-level learners—a topic for future study.

However, no significant difference was observed between conditions; thus, the results show that Japanese EFL learners in the study did not have difficulties with speech processing when they can hear and understand the primes, and showed robust syntactic priming effect regardless of attention to meanings.

Conclusion

The current study investigated how Japanese EFL learners' production of syntactic structures become automatized by examining the effects of learner proficiency on the occurrence of a syntactic priming effect. From the results, it appears that learners' syntactic

representations were shared between comprehension and production in both modalities, regardless of proficiency level. Upper-level learners' syntactic representations were fully activated with exposure to the same structure, while in lower-level learners, it appears possible that increasing the number of a prime would promote automatization of syntactic processing. Moreover, since prime presentation condition did not affect upper- or lower-level learners' syntactic priming and robust syntactic priming effect was observed, the result suggests that Japanese EFL learners can conduct speech processing without difficulties.

In the globalized world, promoting fluency in productive language skills such as speaking and writing is indispensable not only in L1 but also in a foreign language. The result of the current study shows the robust syntactic priming effect with spoken input of native-Japanese-speaking undergraduate learners of English at a university level regardless of their proficiency levels. Therefore, conducting oral interactions repeatedly in the classroom would facilitate L2 learners to access to and retrieve their syntactic information in the production lexicon, and lead to the reinforcement of the syntactic representations.

Moreover, the priming effect with PO primes was observed, but the priming effect with DO priming was not observed in the study. The result contradicts with Chang, Dell, and Bock (2006) with English native speakers, asserting that less frequent and unexpected structures yield greater error than more frequent structures. However, this result is similar to the results of McDonough (2006)'s study with L2 learners. It is said that the production percentage of L2 learners' PO and DO sentence structures is biased compared to English native speakers because Japanese EFL learners have a difficulty processing and acquiring DO primes with multiple thematic arguments (Hulstijn & Graaff, 1994). Together with giving explicit instruction of sentence structures, exposing to a large amount of input is required for Japanese EFL learners with deficit input of English. Bock and Griffin (2000) mentioned that speakers implicitly learn somehow better how to express the message with the given structure when they repeat and process a given syntax structure. Besides, Yonamine and Yokokawa (2013)'s study with Japanese EFL learners showed that the priming rate with spoken input was significantly higher than that with written input, and cumulative priming effect was observed with increase of number of exposure to the target structures. Thus, it is suggested that conducting speech-based interactions is an effective way to embed syntactic structures and strengthen its operations.

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