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(Citation)

Language Education & Technology, 54:55-82

(Issue Date)

2017-06

(Resource Type)

journal article

(Version)

Version of Record

(URL)

<https://hdl.handle.net/20.500.14094/90005002>



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

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Abstract

Aligning linguistic representations at each level (e.g., sound, syntactic, semantic, etc.) is important for not only L1 speakers but also L2 learners to achieve smooth communication (Pickering & Garrod, 2004). At the syntactic level, previous studies revealed that learners' repetitive use of the same structure with written primes (*syntactic priming*), the preference of Prepositional-Object (PO) targets compared to Double-Object (DO), and the lowest priming with uncontrolled spoken primes (Morishita, Sato, & Yokokawa, 2010; McDonough, 2006; Morishita, 2011a). However, the effect of modality has not been clarified. Thus, the emergence of syntactic priming by presenting both spoken and written primes needs to be elucidated.

The current study conducted a picture description task with controlled spoken primes to investigate whether the differences of output modality (i.e., spoken or written) and verb (i.e., same or different between primes and targets) affect Japanese EFL learners' syntactic priming. The participants described pictures in either forms after listening to the primes with a PO, DO, or filler. The results show that a priming effect was observed in both modalities, indicating learners successfully understood the primes. Therefore, syntactic structures were activated by the spoken primes, and it enforces syntactic processing when learners encounter the same structures again.

Keywords: syntax, priming, modality, L2 language production, picture description task

1. Introduction

It is essential to acquire productive language skills, such as speaking and writing skills, to express your opinions and get the message across to others efficiently in communication using foreign languages. However, Japanese EFL learners often face

difficulties in producing the language smoothly, and their production processes also lack automaticity. The present study attempted to explore some of the mechanisms of Japanese EFL learners' language production in terms of the learners' input and output, specifically on the occurrence of an interactive alignment by hearing spoken output.

1.1 Spoken Language Processing

One of the psycholinguistic accounts of listening and speaking processes is Levelt's (1989) account shown in Figure 1. In this account, speakers first think about what they want to say in the *conceptualizer*; then, *grammatical encoding* and *phonological encoding* occur in the *formulator*. In the grammatical encoding, information of the lemmas and lexemes stored in a speaker's mental lexicon becomes activated after which the syntactic and phonological representations are constructed. Finally, in the *articulator*, successive chunks of internal speech are retrieved and unfolded for execution.

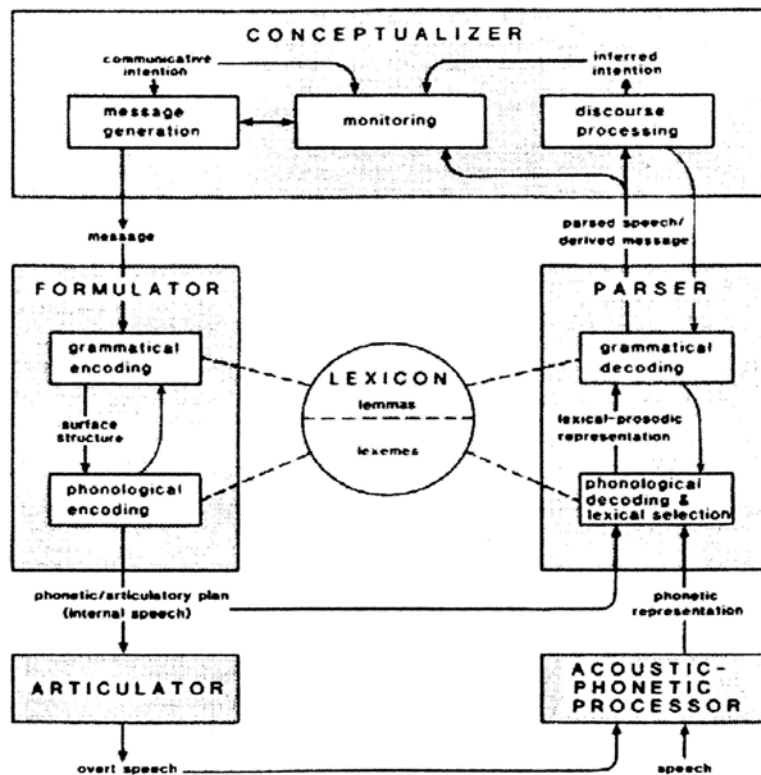


Figure 1. Speaking and listening processes: A blueprint for the speaker (Levelt, 1989, p. 9).

According to Levelt's account, it is significant for speakers to automate the process of grammatical encoding, especially in accessing and building syntax for spoken language comprehension and production to accomplish smooth and efficient communication. In Indefrey, Hellwig, Herzog, Seitz, and Hagoort (2004) neuropsychological research, the Broca's area (the area in the frontal cortex of the brain responsible for speech production) that is sensitive to the complexity of syntactic encoding is strongly activated only with phrase and sentence production, but not with phrase and sentence comprehension. Therefore, syntactic processing seems to be an essential processing within language production. However, non-native speakers, such as Japanese EFL learners, often encounter difficulties with this grammatical encoding, and these difficulties intervene with a smooth output production (Morishita & Yokokawa, 2014). In the present study, we attempted to elucidate on this syntactic processing.

1.2 Interactive Alignment

It is important for interlocutors to align their linguistic representations at each linguistic level within a dialogue and to lead them to mutual understanding to achieve effective communication. Figure 2 illustrates the schematic representation of the stages of comprehension and production processes (Pickering & Garrod, 2004, p. 176). This repetitive use of linguistic elements and structures by interlocutors is said to be caused by the occurrence of the *interactive alignment (co-ordination)*, and repetitions occur at all linguistic levels. Garrod and Anderson (1987) found that participants who played the cooperative maze game tended to repeat their lexical contents each other in order to identify their current places in the maze. Furthermore, Levelt and Kelter (1982) showed that speakers tended to answer to "*What time do you close?*" or "*At what time do you close?*" by using a congruent answer (e.g., "*Five o'clock*" or "*At five o'clock*"). These repetitions may be caused by a lexical or syntactic alignment. In Branigan, Pickering, and Cleland's (2000) study, participants repeated the confederate's syntactic structure in a picture description task. The study states that co-ordination occurs when interlocutors share the same representation at some level. Trofimovich, McDonough, and Foote (2014) explored the occurrence of stress pattern alignment in a dialogue in an L2 classroom. The L2 learners participated in information exchange quizzes. Transcribed texts were analyzed for alignment, which was recognized as higher accuracy rates in contexts where an interlocutor previously produced an accurate target

stress. The results showed that alignment had occurred in terms of pronunciation when participants conducted all the collaborative tasks.

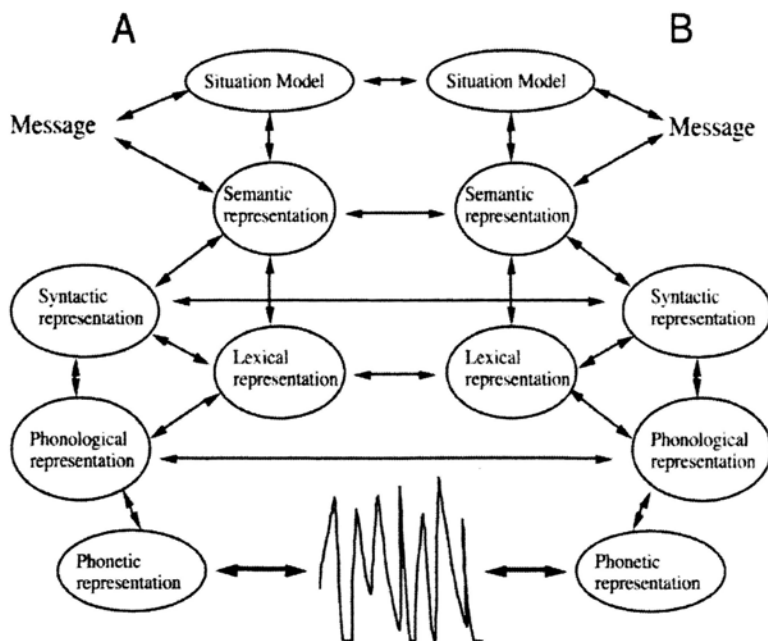


Figure 2. Schematic representation of the stages of comprehension and production processes according to the interactive alignment model (Pickering & Garrod, 2004, p. 176).

Interactive alignment is achieved by a *priming* mechanism, and this mechanism produces alignment at other levels of representation, such as *syntactic priming*. It occurs when the interlocutor repeatedly use the same particular syntactic structure because of a recent prior experience with the structure. Recurrent findings have shown that priming at one level can lead to more enhanced priming at other levels (Pickering & Garrod, 2004). Branigan, Pickering, and Cleland (2000) conducted an experiment with English native speakers by using an oral picture description task, in which the participants described the pictures freely after they were given stimulus sentences (prime sentences, e.g., *the nun giving the book to the clown*). As a result, 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 when the verbs were not shared (e.g., *the cowboy handing the banana to the burglar*). The participants produced target sentences by using the same syntactic structures as the prime sentences. Therefore, the

study revealed that syntactic priming is enhanced when more lexical items are shared between interlocutors. This enhancement is not limited to different linguistic levels independently, and interlocutors align their representations at each linguistic level mutually.

1.3 Effects of Verb Differences on Syntactic Priming

Bock and Loebell (1990) investigated the syntactic priming effects of English native speakers. The participants in the study were given prime sentences with a Prepositional-Object (PO) or Double-Object (DO), and they read the prime sentences aloud after which they were instructed to complete the target fragments with each fragment containing a subject followed by a dative-alternating verb. The primes were after the subject and verb, namely, the PO and DO in the sentences. As a result, participants tended to produce more PO sentences after the PO primes and more DO sentences after the DO primes; therefore, a syntactic priming effect was observed. The result showed that English native speakers tend to replicate the syntactic structures of the primes within sentence targets. McDonough (2006) also examined the occurrence of syntactic priming and L2 English speakers. The study used confederate scripting to elicit PO or DO structures when participants began describing the pictures orally after they were exposed to the structures as prime sentences. Results showed that syntactic priming was observed with only PO sentences, and not DO sentences. Therefore, the current study found that the production percentage of L2 English speakers' PO and DO sentence structures is biased compared to English native speakers who produced both sentence structures equally with evidence of syntactic priming with both structures.

Pickering and Branigan (1998) investigated syntactic priming using a written completion task. English native speakers were told to complete the prime sentences such as fragments (1a) to (1d) with either PO or DO sentences, and after that, they were instructed to complete the target sentences, such as the incomplete clause in (2). As a result, syntactic priming occurred with both PO and DO sentence structures. The experiments also showed that syntactic priming was observed when the verbs remained the same and when the verbs varied between the prime and target sentences. However, syntactic priming was stronger if the verbs remained the same as illustrated in (1a), (1b), and (2) compared to when the verbs varied in (1c), (1d), and (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)

Morishita, Sato, and Yokokawa (2010) applied the experimental method of Pickering and Branigan (1998) to Japanese EFL learners and conducted a written completion task. The study found similar results to the results of the study using English native speakers obtained by Pickering and Branigan (1998) but with stronger syntactic priming when the verbs remained the same between prime and target sentences.

The previous studies discussed above have shed light on the mechanism of syntactic processing of English native speakers, English L2 speakers, and EFL learners, and attempted to explain how these different speakers retain their syntactic representations. Syntactic structure is said to be consisted of a combination of lexical representations, and the node between a word and syntax is activated when the same word is repeated (*lexical boost effect*). In Hartsuiker et al.'s (2008) study, syntactic priming effect and lexical boost effect were observed in experiments using a picture description task to Dutch native speakers. By controlling the number of fillers between the prime and the target, this study found that a lexical boost effect is sustained in a speaker's short-term memory; on the other hand, a syntactic priming effect is sustained in the long-term memory. Thus, the study implied that the syntactic priming is the one of the forms of implicit learning. Therefore, if syntactic priming is observed when the verbs remain the same, it is likely that only a short-term lexical boost effect occurred. On the other hand, if syntactic priming is observed when the verbs vary, it is likely that a long-term generalization of syntactic information by learners occurred.

1.4 Effects of Modality on Syntactic Priming

Cleland and Pickering (2006) reported the effects of the differences of output modality (i.e., spoken or written) on syntactic priming effect. English native speakers were instructed to complete spoken or written target sentences after hearing or seeing the prime sentences. The result shows the evidence of syntactic priming with both spoken and written primes. Therefore, the result indicates that English native speakers' syntactic representations are shared between speaking and writing, and the differences

of output modality do not affect the operation of a speaker's or writer's knowledge of sentence structures. Morishita (2011a) used the experimental method of Cleland and Pickering (2006) to Japanese EFL learners, and conducted sentence completion task. As a result, the Japanese EFL learners' priming rate was stronger with PO prime sentences compared to the priming rate with DO prime sentences; however, it was the lowest with spoken primes and targets. The results suggest that the differences of output modality affect the operation of Japanese EFL learners' knowledge of sentence structures, and the magnitude of the operation differs with speaking and writing. Although, the study highlighted the learners' lack of listening ability, and the results cannot be concluded since learners might not be able to hear and understand the spoken primes. Thus, in the current experiments, we controlled the primes in terms of their syllable, familiarity and speed to ensure that the participants of the study could hear the spoken primes. Moreover, there is a possibility that presentation of primes once was not enough to cause syntactic priming with spoken primes and targets. Therefore, the present study researched whether the differences of primes' presentation conditions affect participants' syntactic priming rate. Thus, in current experiments, we set conditions which focus participants' attention more to meanings or forms, and participants were randomly allocated to three conditions: (a) presentation of primes once, (b) presentation of primes once with a question, and (c) presentation of primes twice.

Morishita (2011b) conducted the experiments using a sentence completion task, which produced spoken or written targets with spoken and written primes in a simultaneous presentation to English native speakers and Japanese EFL learners. As a result, the syntactic priming effect was observed with both English native speakers and Japanese EFL learners. The English native speakers' priming rate was stronger with spoken targets, but the differences of output modality were not observed with the Japanese EFL learners' priming rate. However, Morishita's (2011b) participants received spoken and written primes simultaneously, so the study did not intend to investigate how Japanese EFL learners are operating their syntactic representations during speaking and writing. These studies have not explored the effect of modality. Thus, the current study needs to clarify the evidence of syntactic priming by presenting only spoken primes.

Therefore, the current study put the focus on observing Japanese EFL learners' syntactic priming after hearing the spoken primes, and effects of verb and primes' presentation conditions differences on the syntactic priming. Moreover, since the

previous studies have not demonstrated the effect of output modality on Japanese EFL learners' syntactic priming, we conducted two experiments in order to investigate whether the differences of output modality affect Japanese EFL learners' syntactic priming in language production. Therefore, Experiment 1 was conducted with spoken targets, and Experiment 2 was conducted with written targets.

2. Purpose of the Study

In this study, a picture description task with spoken primes was conducted to investigate whether the differences of output modality (i.e., spoken or written) and verb (i.e., same or different between primes and targets) affect Japanese EFL learners' syntactic priming.

The following research questions were addressed in this study:

Research Question 1: Does syntactic priming effect occur with the presentations of spoken primes?

Research Question 2: Do the differences in the primes' syntactic structure affect syntactic priming? Do verb differences (i.e., same or different between primes and targets) affect syntactic priming?

Research Question 3: Do the presentation conditions of the primes' differences affect syntactic priming?

Research Question 4: Do syntactic priming rates differ by comparing the results of spoken production (Experiment 1) and written production (Experiment 2)?

3. Method

3.1 Participants

The participants consisted of 70 Japanese undergraduate learners at a university located in Kansai area (Experiment 1: 35, Experiment 2: 35). Participants were all native speakers of Japanese, and their age ranged from 19 to 22 years old. The length of their previous English study ranged from 7 to 10 years. The participants attended one day experiment. The study was conducted from December 2015 to January 2016 with spoken targets, and May to June 2016 with written targets. Informed consent was obtained from all the participants. The participants' English proficiency was measured with the Versant Speaking Test (total score: 20~80) in Experiment 1 and Oxford Quick Placement Test (Oxford University Press, 2001: total score: 60) in Experiment 2. Two

different measurements were used because of the different output modality: Versant Speaking Test is conducted in spoken modality, whereas the Oxford Quick Placement Test is conducted in written modality.

Table 1 shows the results of the English proficiency tests of the participants in Experiment 1 and 2. Participants were randomly allocated to three conditions: (a) presentation of primes once (Condition A), (b) presentation of primes once with a question (Condition B), and (c) presentation of primes twice (Condition C). The participants' mean scores in the Versant Speaking Test in Experiment 1 (A, B, C) were 42.08, 42.00, and 37.45, respectively: The scores are equivalent to A2 (elementary) level of the Common European Framework of Reference for Languages (CEFR) (Council of Europe, 2001). Their mean scores in the Oxford Quick Placement Test in Experiment 2 (A, B, C) were 41.00, 41.25, and 40.73, respectively: The scores are equivalent to B2 (upper intermediate) level of the CEFR. Their results were compared based on three conditions, namely, A, B, and C, and the differences between the conditions were non-significant in both Experiment 1 and 2.

Table 1

Scores of the English Proficiency Tests across Conditions in Experiment 1 and 2

	Experiment 1			Experiment 2		
	A	B	C	A	B	C
	(n = 12)	(n = 12)	(n = 11)	(n = 12)	(n = 12)	(n = 11)
Mean	42.08	42.00	37.45	41.00	41.25	40.73
SD	6.76	6.37	8.23	2.95	3.08	4.84

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

3.2 Materials

The target pictures that are intended to induce PO and DO sentence structures (see Appendix A) and filler pictures were prepared. Each target picture depicts actions involving an agent and a beneficiary. Seven dative verbs (*show*, *give*, *tell*, *send*, *lend*, *sell*, and *buy*) were used for the prime sentences and target pictures (Morishita, 2011b, p. 78). Each verb was presented by using PO or DO prime sentences, and using a same or different verb between the primes and targets.

- (3) 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) SHOW

The prime sentences containing a subject followed by a verb were consisted of sentence structure with either a PO or DO (see Appendix B); in addition, filler sentences that were unrelated to both target sentence structures were also prepared (e.g., *The woman found the cat.*). Sentences (3a) to (3d) are prime sentences, and the verb (4) is presented in a target picture. The verb remains the same between the primes and targets in (3a) and (3b), but it is different in (3c) and (3d). All prime sentences were controlled in terms of their syllable, familiarity, location of agents, and speed. The number of syllables in the prime sentences that were prepared ranged from 7 to 11, and all the prime sentences were constructed by using words that are 5.0 or above, but within 7.0 levels, of its audio familiarity rates based on the audio and word version of the vocabulary familiarity list (Yokokawa, 2006; Yokokawa, 2009). The agents in the target pictures were located on the right side in 10 pictures and on the left side in the other 10 pictures in order to avoid participants being fixated on a specific side of the pictures for smooth production. The speed of the all the spoken primes was also controlled at 50 wpm.

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 which each condition only appearing in each list once, and ten filler sentences. Therefore, each of the four lists contained 30 sentences, including experimental and filler sentences.

3.3 Procedure

The experiments comprised three phases. As described above, Phase 2 was divided into three conditions. In Condition A, the spoken primes were presented only once to the participants, and 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 to the sentential

meaning would promote an additional syntactic priming effect, or it would inhibit the activation of syntactic structures. In Condition C, the same spoken primes were presented twice. This condition was set to investigate whether hearing the same spoken prime twice would ease participants into “catching” the spoken prime, which they might not have heard for the first time, or repetition would enforce the syntactic structures by hearing the spoken prime twice.

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 from the researcher. They were told that the researcher is interested in what kinds of sentences Japanese EFL learners could produce to divert participants’ attention from the actual purpose of the current study after an experimental procedure was given to them. The total time of the experiment was around 90 minutes. The detailed procedure of the experiment is described below.

The Phase 1 (Baseline) of the experiment intended to investigate the participants’ original proportional tendency for PO, DO, and other sentence structures; therefore, they 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 forms, they were told to either speak (Experiment 1) or write (Experiment 2) about the target pictures using the given verbs. In Phase 2 (Priming Experiment), the participants listened to the spoken primes in either Conditions, A, B or C, and then they were told to either speak (Experiment 1) or write (Experiment 2) about the target pictures using the given verbs. At the beginning of each trial, the participants would see the message “Ready?” on the computer screen, and by pressing the “Enter” key, they would indicate that they were ready to start. Then, participants would listen to the primes in one condition from the three Conditions A, B, and C, and as soon as they heard the primes, they would press the “Enter” key. After that, a target picture would appear on the computer screen, and the participants would use the verb presented on a target picture to describe about the picture in one sentence, either by speaking or writing it down as quickly as they could. Four lists (120 trials) were randomly presented to each participant, and the responses were recorded using the Sony IC Recorder and transcribed. In Phase 3, participants answered a questionnaire their impression of the task after completing the experiment to confirm whether they could listen and understand the primes. The questionnaire also confirmed that they did not know the purpose of the current study, which was to investigate whether the

differences of output modality and verb usage in prime and target sentences affect Japanese EFL learners' syntactic priming.

4. Results and Discussion

According to the result of questionnaire, it confirmed that the participants listened and understood the primes without difficulties, and none of them noticed the target structures. In Condition A, the spoken primes were presented only once to the participants, and in Condition B, after hearing the spoken primes once, the participants were instructed to answer a question about the spoken primes. In Condition C, the same spoken primes were presented twice.

4.1 Experiment 1

In Experiment 1, the participants listened to the spoken primes, and produced the targets in spoken forms.

4.1.1 Production of targets' syntactic structures in conditions

Figure 3 shows the overall proportions of participants' responses based on primes' presentation conditions and verb differences in spoken production.

After examining the raw data of the participants' responses, they produced more PO targets than DO targets after they were presented with the PO primes (PO: 81.25, 75.00%, DO: 8.33, 11.25%); however, they produced more PO targets than DO targets even after they were presented with the DO primes (PO: 72.08, 76.25%, DO: 10.42, 10.83%) in Condition A. The proportion of the PO target productions after a PO prime presentation with the same verb between the primes and targets was the largest (81.25%) in all target productions. In Condition B, the participants produced more PO targets than DO targets after they were presented with the PO primes (PO: 59.17, 55.42%, DO: 14.17, 15.00%). Nevertheless, they produced more PO targets than DO targets even after they were presented with the DO primes (PO: 53.33, 55.42%, DO: 17.92, 17.50%). The proportion of the PO target productions after a PO prime presentation with the same verb between the primes and targets was the largest (59.17%) in all target productions. In Condition C, participants produced more PO targets than DO targets after they were presented with the PO primes (PO: 74.55, 63.64%, DO: 7.73, 13.18%); however, they produced more PO targets than DO targets even after they were presented with DO primes (PO: 62.73, 67.27%, DO: 14.55, 9.55%). The proportion of the PO target productions after a PO prime presentation

with the same verb between the primes and targets was the largest (74.55%) in all target productions.

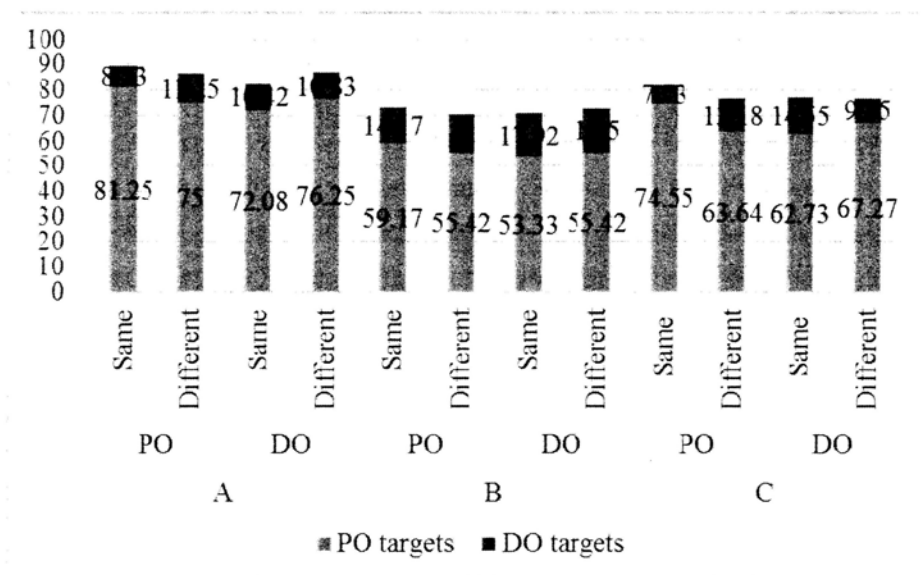


Figure 3. Overall Proportions (%) of Responses Based on Primes' Presentation Conditions and Verb Differences in Spoken Production.

4.1.2 Primes' presentation conditions and targets' syntactic structures

Transcribed target responses were divided into “Priming” (i.e., Using the same sentence structure between primes and targets), “Alternate” (i.e., DO target production for PO prime sentences or PO target production for DO prime sentences), and “Other” (i.e., Other which is unrelated to Priming and Alternate groups) groups. The primes' presentation conditions (i.e., A, B, or C) as a between-participant factor and sentence structures (i.e., Priming, Alternate, or Other) as a within-participant factor were analyzed in a two-way analysis of variance (ANOVA). Throughout the analyses, *p*-values less than .05 were considered to be statistically significant, and partial eta-squared (η^2) values are reported as effect sizes. Table 2 provides the result of the overall mean numbers of responses, relative proportions (%), and SDs for Experiment 1.

Table 2

Experiment 1: Overall Mean Numbers of Responses, Relative Proportions (%), and SDs

Prime	Priming			Alternate			Other		
	<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>
A PO	31.25	78.13	8.16	3.92	9.79	7.13	4.83	12.08	4.43
DO	4.25	10.63	6.68	29.67	74.17	10.86	6.08	15.21	3.75
B PO	22.92	57.29	5.98	5.83	14.58	6.36	11.25	28.13	6.99
DO	7.08	17.71	8.21	21.75	54.38	8.14	11.17	27.92	8.35
C PO	27.64	69.09	6.65	4.18	10.45	5.00	8.18	20.45	5.27
DO	4.82	12.05	6.60	26.00	65.00	7.38	9.18	22.95	5.46

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

According to the results of the PO primes, the interaction between the primes' presentation conditions and sentence structures was significant ($F(4, 64) = 2.50, p < .05, \text{partial } \eta^2 = .14$). The simple main effect of sentence structures was significant with all conditions (A: $F(2, 64) = 46.64, p < .01, \text{partial } \eta^2 = .59$; B: $F(2, 64) = 16.38, p < .01, \text{partial } \eta^2 = .34$; C: $F(2, 64) = 30.47, p < .01, \text{partial } \eta^2 = .49$). Thus, the proportion of the Priming was significantly larger than the proportions of the Alternate and Other structures in all conditions (A: *adjusted p s* = .00, .00, B: *adjusted p s* = .00, .00, C: *adjusted p s* = .00, .00). In addition, the simple main effect of the primes' presentation conditions was significant with Priming and Other structures (Priming: $F(2, 32) = 3.68, p < .05, \text{partial } \eta^2 = .19$; Other: $F(2, 32) = 3.46, p < .05, \text{partial } \eta^2 = .18$). The proportion of the Priming structures in Condition A was significantly larger than that in Condition B (*adjusted p* = .03); on the other hand, the proportion of the Other structures in Condition A was smaller than that in Condition B (*adjusted p* = .04). According to the results of the DO primes, the interaction between the primes' presentation conditions and sentence structures was not significant. However, the main effect of sentence structures was significant ($F(2, 64) = 45.98, p < .01, \text{partial } \eta^2$

= .59). The proportion of the Alternate structures was significantly larger than proportion of the Priming and Other structures in all conditions (Priming: *adjusted p* = .00, Other: *adjusted p* = .00). Therefore, the results showed that participants had a tendency to produce PO sentence structures even after they were presented with DO primes.

The results demonstrated the evidence of a syntactic priming effect after the presentation of PO primes in all conditions. By comparing Conditions A and B, the proportion of the Priming structures in Condition A was significantly larger. Thus, it is conceivable that focusing participants' attention to semantic processing could have inhibited the activation of target syntactic structures. There was no significant difference between Conditions A and B. The result suggests that participants could catch the spoken prime only once, or hearing the same spoken prime twice was not enough to enforce the target syntactic structures. There was also no significant difference between Conditions B and C, and this suggests that directing participants' attention to semantic processing inhibited the activation of target syntactic structures, or hearing the same spoken prime twice was not enough to enforce the target syntactic structures.

4.1.3 Primes' sentence structures and verb differences

The types of sentence structures of the primes (i.e., PO or DO) and the verb differences between the primes and targets (i.e., same or different) as within-participant factors were analyzed using a two-way ANOVA. Table 3 shows the result of the overall mean numbers of responses and relative proportions (%), and SDs based on verb differences for Experiment 1.

In the case of PO targets in Conditions A and C, the interaction between the sentence structures of the primes and the verb differences was significant (A: $F(1, 11) = 7.45, p < .05, \text{partial } \eta^2 = .40$; C: $F(1, 10) = 7.46, p < .05, \text{partial } \eta^2 = .43$). The simple main effect of sentence structures of the primes was significant, and the syntactic priming rate was significantly higher when the verbs remained the same between the primes and targets (A: $F(1, 11) = 7.97, p < .05, \text{partial } \eta^2 = .42$; C: $F(1, 10) = 6.79, p < .05, \text{partial } \eta^2 = .40$). Therefore, the result shows that using the verb of a prime as a retrieval cue eases the process of retrieving the information from participants' memory, and this enhancement promotes the reutilization of the same syntactic structure for the next output. As mentioned previously, a syntactic priming effect was observed when the verbs remained the same and when the verbs varied

between the written primes and targets in previous studies using English native speakers and Japanese EFL learners as participants. However, the syntactic priming rate was significantly higher when the verbs remained the same, and the present study followed the same tendency with these previous findings (Morishita, Sato, & Yokokawa, 2010; Pickering & Branigan, 1998).

Table 3

Experiment 1: Overall Mean Numbers of Responses and Relative Proportions (%), and SDs Based on Verb Differences

			PO targets			DO targets		
Prime			<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>
A	PO	Same	16.25	81.25	3.79	1.67	8.33	3.52
		Different	15.00	75.00	4.61	2.25	11.25	3.67
	DO	Same	14.42	72.08	3.29	2.08	10.42	3.03
		Different	15.25	76.25	4.07	2.17	10.83	3.74
B	PO	Same	11.83	59.17	3.16	2.83	14.17	3.34
		Different	11.08	55.42	4.01	3.00	15.00	3.46
	DO	Same	10.67	53.33	4.27	3.58	17.92	4.14
		Different	11.08	55.42	4.10	3.50	17.50	4.23
C	PO	Same	14.91	74.55	2.55	1.55	7.73	2.16
		Different	12.73	63.64	4.29	2.64	13.18	3.04
	DO	Same	12.55	62.73	4.16	2.91	14.55	3.81
		Different	13.45	67.27	3.67	1.91	9.55	2.88

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

In the case of PO targets in Condition B, the interaction between the primes' sentence structures and verb differences was not observed, and this result shows that a question after a prime enforced participants to understand the meaning of primes and focused their attention to semantic processing. It inhibited a strong priming effect that was expected to occur because of the lexical boost effect when the verb remained the same. In the case of DO targets in Condition C, the interaction between the sentence structures of the primes and the verb differences was significant ($F(1, 10) = 10.71, p < .01, \text{partial } \eta^2 = .52$). The simple main effect of sentence structures of the primes was significant, and the syntactic priming rate was significantly higher when the verbs remained the same between the primes and targets ($F(1, 10) = 5.04, p < .05, \text{partial } \eta^2 = .34$). This tendency was not observed in the previous study (McDonough, 2006), which had only demonstrated EFL learners' syntactic priming effect with PO sentence structures but not DO sentence structures with spoken primes and targets. Thus, hearing the same prime twice had a possibility of enhancing the activation of syntactic representations of the DO sentence structure with lower preference.

4.2 Experiment 2

In Experiment 2, the participants listened to the spoken primes, similar to Experiment 1, and produced the targets in written forms.

4.2.1 Production of targets' syntactic structures in conditions

Figure 4 shows the overall proportions of participants' responses based on primes' presentation conditions and verb differences in written production.

After examining the raw data of participants' responses, they produced more PO targets than DO targets after they were presented with the PO primes (PO: 62.08, 53.75%, DO: 16.25, 22.50%); however, they produced more PO targets than DO targets even after they were presented with the DO primes (PO: 44.58, 45.83%, DO: 35.42, 35.00%) in Condition A. The proportion of the PO target productions after a PO prime presentation with the same verb between the primes and targets was the largest (62.08%) in all target productions. In Condition B, participants produced more PO targets than DO targets after they were presented with the PO primes (PO: 57.50, 49.17%, DO: 33.33, 38.33%). Then again, they produced more PO targets than DO targets even after they were presented with the DO primes (PO: 45.83, 50.00%, DO: 41.25, 39.58%). The proportion of the PO target productions after a PO prime presentation with the same verb between the primes and targets was the largest

(57.50%) in all target productions. In Condition C, participants produced more PO targets than DO targets after they were presented with the PO primes (PO: 65.45, 53.18%, DO: 18.18, 28.18%); however, they produced more PO targets than DO targets even after they were presented with the DO primes (PO: 45.45, 47.73%, DO: 35.91, 32.27%). The proportion of the PO target productions after a PO prime presentation with the same verb between the primes and targets was the largest (65.45%) in all target productions.

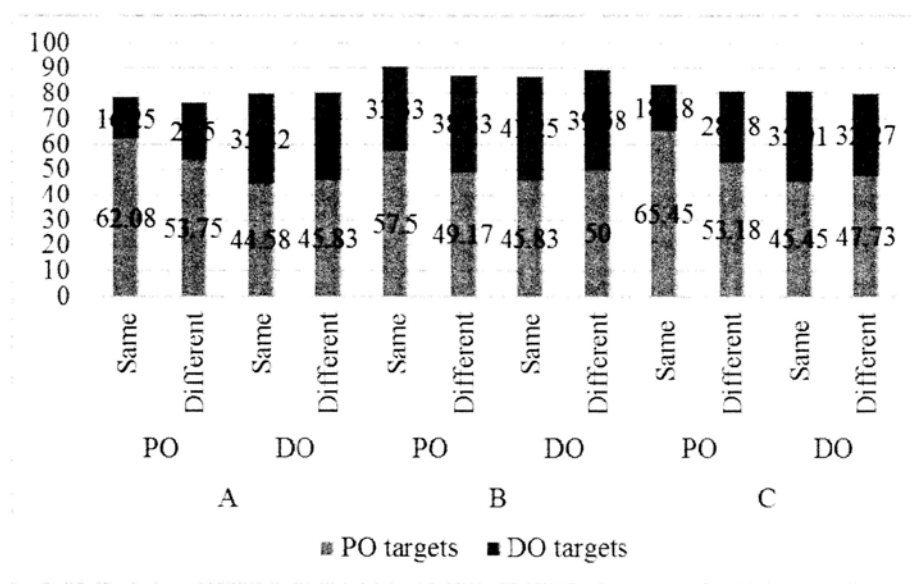


Figure 4. Overall Proportions (%) of Responses Based on Primes' Presentation Conditions and Verb Differences in Written Production.

4.2.2 Primes' presentation conditions and targets' syntactic structures

The data from Experiment 2 were analyzed as in Experiment 1. Table 4 provides the result of the overall mean numbers of responses and relative proportions (%), and SDs for Experiment 2.

According to the results of the PO primes, the main effect of sentence structures was significant ($F(2, 64) = 21.38, p < .01, \text{partial } \eta^2 = .40$). In all three conditions, the proportion of the Priming structures was significantly larger than the proportions of the Alternate and Other structures (Alternate: *adjusted p* = .00, Other: *adjusted p* = .00). According to the results of the DO primes, the main effect of sentence structures was

significant ($F(2, 64) = 11.34, p < .01, \text{partial } \eta^2 = .26$). There was no significant difference between the proportions of Priming and Alternate structures; however, the proportion of the Other structures was significantly larger than the proportions of the Priming and Alternate structures (Priming: *adjusted p* = .00, Alternate: *adjusted p* = .00).

Table 4

Experiment 2: Overall Mean Numbers of Responses and Relative Proportions (%), and SDs

Prime	Priming			Alternate			Other		
	<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>
A PO	23.17	57.92	8.74	7.75	19.38	8.71	9.08	22.71	6.89
DO	14.08	35.21	10.67	18.08	45.21	7.77	7.83	19.58	6.32
B PO	21.33	53.33	10.87	14.33	35.83	11.98	4.33	10.83	2.53
DO	16.17	40.42	11.82	19.17	47.92	10.21	4.67	11.67	3.28
C PO	23.73	59.32	9.81	9.27	23.18	5.08	7.00	17.50	9.62
DO	13.64	34.09	6.50	18.64	46.59	7.71	7.73	19.32	10.17

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

The results showed evidence of a syntactic priming effect after the presentation of the PO primes in all conditions, although, the differences across all conditions were not observed. Therefore, the result suggests three possibilities: (a) participants could “catch” the spoken prime even only once, (b) guiding their attention to semantic processing inhibited the activation of target syntactic structures, or (c) hearing the same spoken prime twice was not enough to enforce the target syntactic structures.

4.2.3 Primes' sentence structures and verb differences

The data from Experiment 2 were analyzed as in Experiment 1. Table 5 shows the result of the overall mean numbers of responses and relative proportions (%), and SDs based on verb differences for Experiment 2.

Table 5

Experiment 2: Overall Mean Numbers of Responses and Relative Proportions (%), and SDs Based on Verb Differences

			PO targets			DO targets		
Prime			<i>n</i>	%	<i>SD</i>	<i>n</i>	%	<i>SD</i>
A	PO	Same	12.42	62.08	4.44	3.25	16.25	4.41
		Different	10.75	53.75	4.77	4.50	22.52	4.85
	DO	Same	8.92	44.58	4.40	7.08	35.42	5.58
		Different	9.17	45.83	3.64	7.00	35.00	5.36
B	PO	Same	11.50	57.50	5.89	6.67	33.33	6.61
		Different	9.83	49.17	5.15	7.67	38.33	5.43
	DO	Same	9.17	45.83	5.02	8.25	41.25	6.30
		Different	10.00	50.00	5.38	7.92	39.58	5.65
C	PO	Same	13.09	65.45	5.17	3.64	18.18	2.54
		Different	10.64	53.18	4.92	5.64	28.18	2.87
	DO	Same	9.09	45.45	3.86	7.18	35.91	3.43
		Different	9.55	47.73	4.27	6.45	32.27	3.80

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

Unlike in the case of spoken production in Experiment 1, the interaction between the primes' sentence structures and verb differences was not observed when the verbs

remained the same between the primes and targets as in the case of the PO targets in Condition A, thus suggesting that the process of writing down was more time consuming than speaking, and the activation of a syntactic structure would have decayed because of the lowered magnitude of the lexical boost effect in written production.

In the case of the PO targets in Condition B, the interaction between the sentence structures of the primes and the verb differences was significant ($F(1, 11) = 6.60, p < .05, \text{partial } \eta^2 = .38$). The simple main effect of sentence structures of the primes was significant, and the syntactic priming rate was significantly higher when the verbs remained the same unlike in Experiment 1 where no interaction was observed ($F(1, 11) = 5.76, p < .05, \text{partial } \eta^2 = .34$). The result shows that focusing participants' attention to semantic processing did not decay the lexical boost effect, and it enhanced syntactic priming.

In the case of the PO and DO targets in Condition C, the interaction between the sentence structures of the primes and the verb differences was significant, which is similar to the case of spoken production (PO targets: $F(1, 10) = 6.80, p < .05, \text{partial } \eta^2 = .40$; DO targets: $F(1, 10) = 6.59, p < .05, \text{partial } \eta^2 = .40$). The simple main effect of sentence structures of the primes was significant, and the syntactic priming rate was significantly higher when the verbs remained the same (PO targets: $F(1, 10) = 9.17, p < .05, \text{partial } \eta^2 = .48$; DO targets: $F(1, 10) = 6.69, p < .05, \text{partial } \eta^2 = .40$). Thus, it seems that hearing the same prime twice enhanced the activation of a syntactic structure with lower preference.

4.3 Comparison between Experiment 1 and 2

To address the research questions 1 and 2, which asked whether syntactic priming effect occurs with the presentations of spoken primes, and whether the differences in primes' syntactic structure and verb differences affect syntactic priming, a syntactic priming effect was observed with the PO primes and with repetition of verbs between the primes and targets in both spoken and written production. These results demonstrated that the participants of the present study had the same tendency as the previous study with higher priming rates for the PO sentence structure (Morishita, 2011a), indicating that the acquisition of PO knowledge and the sharing of a lexical item between a prime and a target promote more syntactic priming effect. Research question 3 asked whether the presentation of conditions of the primes' differences affect syntactic priming. In spoken production, a significant difference was observed

between Conditions A and B; however, the presentation conditions of the primes' differences did not affect syntactic priming in written production. This difference was observed because the cognitive load of Condition B, which needs semantic processing, seemed heavier in spoken production with a shorter duration for production compared with that of written production. Therefore, the activation of the target structure was inhibited, and it lowered the syntactic priming rate. Research question 4 enquired whether syntactic priming rates differ by comparing the results of spoken production (Experiment 1) and written production (Experiment 2). The result shows that the priming rate with the PO primes in Conditions A and C in spoken production was higher than that in written production (A: 78.1, 57.9, C: 69.1, 59.3). There are two possible reasons why the difference was observed. One reason is that the lexical boost effect, which was observed when the verbs remained the same between primes and targets, had decayed in written production, because a written output requires more time than a spoken production. Another possible reason is that the input modality using spoken primes affected the syntactic priming rate. Thus, the results of the current study differed with the results of English native speakers in that the differences of the output modality did not affect the operation of the speaker's or writer's knowledge of sentence structures (Cleland & Pickering, 2006). On the other hand, the DO production was increased in written production (A: 10.6, 35.2, B: 17.7, 40.4, C: 12.0, 34.1), and the result indicates the tendency of increased production of the structure with lower preference. This tendency is similar with Hartsuiker et al.'s (2008) result with increased production of the DO sentence structure in written production compared with the result of spoken production. Therefore, the result suggests that participants implicitly learned and began using more DO sentence structures.

5. Conclusion

The present study investigated whether the syntactic priming effect is observed by presenting spoken primes when Japanese EFL learners speak or write down target sentences. Moreover, it researched whether the way and the magnitude of operating syntactic representations differ between two modalities (i.e., speaking or writing). The results show that a syntactic priming effect was observed in both modalities, indicating that learners successfully heard and understood the controlled primes. This result demonstrates that participants' syntactic structures were activated by the presentation of spoken primes, and a prior exposure of the structures enforces syntactic processing when they encounter the same structures again. Therefore, enforcement of the syntactic

processing led to promoting the production of the same structures. In addition, the verb differences affect the syntactic priming rate in both modalities, whereas the presentation of prime sentences conditions did not affect the syntactic priming rate, and the DO production was increased in written production. Thus, the results demonstrated that differences in the output modality had different effects on syntactic priming. This finding suggests that in comparison to English native speakers who are unaffected by the modality differences, Japanese EFL learners' way and magnitude of operating syntactic representations differ between speaking and writing.

By presenting spoken primes, learners' syntactic structures were activated and syntactic processing was also promoted. Therefore, the result confirmed that Japanese EFL learners' syntactic representations were shared between comprehension and production. Thus, it suggests that syntactic priming facilitates L2 development, and if Japanese EFL learners can hear and understand the given input properly, spoken input might promote their grammatical encoding which intervene with a smooth output production.

The current study investigated whether the differences of output modality affect Japanese EFL learners' syntactic priming. However, the experiments were conducted within a relatively short period of time. As such, the observed syntactic priming effect could have been caused by the occurrence of the temporary lexical boost effect, and, in actuality, the participants might not have acquired the target syntactic structures. Therefore, an investigation on whether the syntactic priming effect, which was observed in this study, would continue for a longer period remains an avenue for further research.

Acknowledgments

This study was supported by JSPS Grant-in-Aid for Scientific Research (A) "An investigation of the automatization process in second language processing with respect to noticing, attention and interactive alignment" (PI: Hirokazu Yokokawa, No. 26244031).

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Appendix A

Example of a target picture and the expected responses



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

Appendix B

The prime sentences used in Experiments 1 and 2

No	Prime Sentence	Category
1	a The girl showed the book to the boy.	(<i>PO sentence structure, same</i>)
	b The girl showed the boy the book.	(<i>DO sentence structure, same</i>)

- | | | | |
|----|---|--|---|
| | c | The girl gave the book to the boy. | <i>(PO sentence structure, different)</i> |
| | d | The girl gave the boy the book. | <i>(DO sentence structure, different)</i> |
| 2 | a | The lawyer told the news to the woman. | <i>(PO sentence structure, same)</i> |
| | b | The lawyer told the woman the news. | <i>(DO sentence structure, same)</i> |
| | c | The lawyer sent the news to the woman. | <i>(PO sentence structure, different)</i> |
| | d | The lawyer sent the woman the news. | <i>(DO sentence structure, different)</i> |
| 3 | a | The mother gave the money to the child. | <i>(PO sentence structure, same)</i> |
| | b | The mother gave the child the money. | <i>(DO sentence structure, same)</i> |
| | c | The mother lent the money to the child. | <i>(PO sentence structure, different)</i> |
| | d | The mother lent the child the money. | <i>(DO sentence structure, different)</i> |
| 4 | a | The worker sold the food to the girl. | <i>(PO sentence structure, same)</i> |
| | b | The worker sold the girl the food. | <i>(DO sentence structure, same)</i> |
| | c | The worker gave the food to the girl. | <i>(PO sentence structure, different)</i> |
| | d | The worker gave the girl the food. | <i>(DO sentence structure, different)</i> |
| 5 | a | The chief sent the report to the client. | <i>(PO sentence structure, same)</i> |
| | b | The chief sent the client the report. | <i>(DO sentence structure, same)</i> |
| | c | The chief showed the report to the client. | <i>(PO sentence structure, different)</i> |
| | d | The chief showed the client the report. | <i>(DO sentence structure, different)</i> |
| 6 | a | The man gave the flower to the woman. | <i>(PO sentence structure, same)</i> |
| | b | The man gave the woman the flower. | <i>(DO sentence structure, same)</i> |
| | c | The man bought the flower for the woman. | <i>(PO sentence structure, different)</i> |
| | d | The man bought the woman the flower. | <i>(DO sentence structure, different)</i> |
| 7 | a | The woman bought the jacket for the man. | <i>(PO sentence structure, same)</i> |
| | b | The woman bought the man the jacket. | <i>(DO sentence structure, same)</i> |
| | c | The woman sold the jacket to the man. | <i>(PO sentence structure, different)</i> |
| | d | The woman sold the man the jacket. | <i>(DO sentence structure, different)</i> |
| 8 | a | The worker sold the fish to the mother. | <i>(PO sentence structure, same)</i> |
| | b | The worker sold the mother the fish. | <i>(DO sentence structure, same)</i> |
| | c | The worker showed the fish to the mother. | <i>(PO sentence structure, different)</i> |
| | d | The worker showed the mother the fish. | <i>(DO sentence structure, different)</i> |
| 9 | a | The chief showed the letter to the woman. | <i>(PO sentence structure, same)</i> |
| | b | The chief showed the woman the letter. | <i>(DO sentence structure, same)</i> |
| | c | The chief gave the letter to the woman. | <i>(PO sentence structure, different)</i> |
| | d | The chief gave the woman the letter. | <i>(DO sentence structure, different)</i> |
| 10 | a | The boy bought the ring for the girl. | <i>(PO sentence structure, same)</i> |

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- | | | | |
|----|---|--|---|
| | b | The boy bought the girl the ring. | <i>(DO sentence structure, same)</i> |
| | c | The boy sent the ring to the girl. | <i>(PO sentence structure, different)</i> |
| | d | The boy sent the girl the ring. | <i>(DO sentence structure, different)</i> |
| 11 | a | The teacher lent the book to the boy. | <i>(PO sentence structure, same)</i> |
| | b | The teacher lent the boy the book. | <i>(DO sentence structure, same)</i> |
| | c | The teacher sold the book to the boy. | <i>(PO sentence structure, different)</i> |
| | d | The teacher sold the boy the book. | <i>(DO sentence structure, different)</i> |
| 12 | a | The man lent the bike to the woman. | <i>(PO sentence structure, same)</i> |
| | b | The man lent the woman the bike. | <i>(DO sentence structure, same)</i> |
| | c | The man bought the bike for the woman. | <i>(PO sentence structure, different)</i> |
| | d | The man bought the woman the bike. | <i>(DO sentence structure, different)</i> |
| 13 | a | The worker sold the dress to the woman. | <i>(PO sentence structure, same)</i> |
| | b | The worker sold the woman the dress. | <i>(DO sentence structure, same)</i> |
| | c | The worker lent the dress to the woman. | <i>(PO sentence structure, different)</i> |
| | d | The worker lent the woman the dress. | <i>(DO sentence structure, different)</i> |
| 14 | a | The mother sent the box to the child. | <i>(PO sentence structure, same)</i> |
| | b | The mother sent the child the box. | <i>(DO sentence structure, same)</i> |
| | c | The mother gave the box to the child. | <i>(PO sentence structure, different)</i> |
| | d | The mother gave the child the box. | <i>(DO sentence structure, different)</i> |
| 15 | a | The teacher told the story to the class. | <i>(PO sentence structure, same)</i> |
| | b | The teacher told the class the story. | <i>(DO sentence structure, same)</i> |
| | c | The teacher sent the story to the class. | <i>(PO sentence structure, different)</i> |
| | d | The teacher sent the class the story. | <i>(DO sentence structure, different)</i> |
| 16 | a | The driver showed the dog to the child. | <i>(PO sentence structure, same)</i> |
| | b | The driver showed the child the dog. | <i>(DO sentence structure, same)</i> |
| | c | The driver bought the dog for the child. | <i>(PO sentence structure, different)</i> |
| | d | The driver bought the child the dog. | <i>(DO sentence structure, different)</i> |
| 17 | a | The boss gave the book to the man. | <i>(PO sentence structure, same)</i> |
| | b | The boss gave the man the book. | <i>(DO sentence structure, same)</i> |
| | c | The boss sold the book to the man. | <i>(PO sentence structure, different)</i> |
| | d | The boss sold the man the book. | <i>(DO sentence structure, different)</i> |
| 18 | a | The mother lent the money to the boy. | <i>(PO sentence structure, same)</i> |
| | b | The mother lent the boy the money. | <i>(DO sentence structure, same)</i> |
| | c | The mother showed the money to the boy. | <i>(PO sentence structure, different)</i> |
| | d | The mother showed the boy the money. | <i>(DO sentence structure, different)</i> |
| 19 | a | The man bought the pencil for the woman. | <i>(PO sentence structure, same)</i> |
| | b | The man bought the woman the pencil. | <i>(DO sentence structure, same)</i> |
| | c | The man lent the pencil to the woman. | <i>(PO sentence structure, different)</i> |
| | d | The man lent the woman the pencil. | <i>(DO sentence structure, different)</i> |

- 20 a The patient sent the present to the doctor. (*PO sentence structure, same*)
 b The patient sent the doctor the present. (*DO sentence structure, same*)
 c The patient showed the present to the (*PO sentence structure, different*)
 doctor.
 d The patient showed the doctor the (*DO sentence structure, different*)
 present.