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Syntactic, Semantic and Discourse Effects on the Processing of Scrambled Japanese Sentences

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***Abstract*—In Japanese sentences, the default word order is 'subject-object-verb' (SOV). However, Japanese allows scrambling of noun phrases (NPs), for example 'object-subject-verb' (OSV) as opposed to the unscrambled default order. Two self-paced reading experiments in the moving window paradigm were conducted to test the effects of syntax, semantics and discourse in native Japanese and native English speakers' processing of scrambled Japanese sentences. The first experiment examined how the syntactic factor (NP order) and semantic factor (NP animacy) affect processing of Japanese sentences. Results revealed that animacy difference between the subject-NP and object-NP contributes more to native English speakers' processing than default SOV word order, whereas no such difference was found for native Japanese speakers. The second experiment examined the discourse effect in processing of scrambled OSV sentences. The experiment revealed that the processing of Japanese scrambled sentences is facilitated by the preceding context for both native Japanese and English speakers.**

***Index Terms*—word order, animacy, discourse, Japanese, English speakers**

I. Introduction

In the field of second language acquisition (SLA) research, the interface hypothesis maintains that it is generally difficult to acquire a second language (L2) grammar at 'interface', which can be defined as the interaction or mapping between different levels of linguistic representation such as discourse and syntax or between different linguistic modules such as syntax and semantics (Sorace, 2006; White, 2011). This study explored phenomena at the interfaces of syntax, semantics and discourse in Japanese sentences in terms of the native Japanese speakers' and native English speakers' processing of scrambled Japanese sentences. Their processing of scrambled sentences was evaluated as a function of the effects of semantic factors from lexical animacy and syntactic factors from word order, with a grammar-external discourse component.

II. Syntactic Factor: Word Order

In order to process and comprehend sentences, a parser needs to know the grammatical relationships of the noun phrases (NPs) such as the subject or object. Gass (1989) lists four cues for finding the grammatical relationships of arguments, which are lexical items, morphological case markers, word order, and prosody. Also, Bates and MacWhinney (1989) suggest the competition model, which argues that parsers compute the most probabilistic interpretation based on various cues including word order, case marker, semantic information, and so forth. According to the competition model, different languages rely on different cues. Regarding Japanese and English, one big difference in the use of the cues is the case markers and word order. English (which is an SVO language) is a fixed word-order language in terms of the order of the subject, verb and object. On the other hand, Japanese (which is an SOV language) allows scrambling of the order of the subject and object (for example, OSV). Examples are shown below, which indicates that the order of subject and object is fixed in English but free in Japanese.

(1) a. Unscrambled sentences

English:	John ate pasta.		
Japanese:	*John-ga*	*pasta-o*	*tabeta.*
	John-NOM	pasta-ACC	ate
	'John ate pasta.'		

b. Scrambled sentences

English:	*Pasta ate John.[1]		
Japanese:	*Pasuta-o*	*Jon-ga*	*tabeta.*
	pasta-ACC	John-NOM	ate
	'John ate pasta.'		

In Japanese, what makes it possible to scramble the subject and object are the case markers (such as the nominative and accusative markers, *ga* and *o*, in (1) above). Since the case markers indicate NPs' grammatical roles such as the subject or the object, the order of the NPs is relatively free in Japanese. English does not utilize case markers, and the flexible order of the subject and object (OS order) is considered ungrammatical. Thus, English-speaking learners of L2

Japanese may be prone to overlook case markers when reading Japanese sentences and misinterpret scrambled OSV Japanese sentences as the default SOV sentences.

Numerous studies have been conducted on scrambling in Japanese. As for the comprehension of scrambled sentences by adult speakers, in Yamashita's (1997) self-paced reading experiment, adult native Japanese-speaking participants read scrambled OSV sentences as quickly as unscrambled sentences with default SOV word order possibly because the participants utilized information from case markers independently of the word order. On the other hand, another research suggests that scrambled sentences incur increased processing costs for adult native speakers. Mazuka, Itoh and Kondo's (2002) self-paced reading experiment showed that adult Japanese speakers' reading time slowed down when they read a subject-NP that came after an object-NP in scrambled sentences, i.e., the reading speed slowed down at 'Jon-ga' in the sentence, 'Pasuta-o Jon-ga tabeta' ('John ate pasta') as in (1).

Among studies with Japanese children, Hakuta (1982) and Lakshmann and Ozeki (1996) found that Japanese children at the age of 2-6 strongly tend to produce unscrambled/default SOV word-order sentences in their picture description tasks. However, participating children correctly produced scrambled OSV sentences when requested to start the description with the object-NP. It was therefore concluded that Japanese children did indeed have some grammatical knowledge of scrambling. In contrast, many other studies observed that native Japanese children below the age of five often misinterpreted scrambled OSV sentences as if they were SOV sentences, and never misinterpreted SOV as OSV (Hayashibe, 1975; Sano, 1977; Hakuta, 1982). These studies found that L1 Japanese children rely on the default SOV word order of Japanese sentences, paying less attention to the case markers.

Hayashibe (1975) explains that native Japanese-speaking children tend to interpret the first NP as the agent and the second NP as patient. This explanation is similar to an SLA account, the First Noun Principle (VanPatten, 1996; VanPatten 2004). The First Noun Principle argues that L2 learners tend to interpret the first NP that they encounter in a sentence as a subject and an agent. Kilborn and Ito (1989), in their experiment on sentence comprehension, found that native English-speaking L2 Japanese learners resorted to SOV word order, paying less attention to the case markers, just as native Japanese children in some earlier studies. Similarly, Iwasaki (2003) tested the L2 Japanese production of native English speakers in a picture-description task. She found that the participating native English speakers always produced the unscrambled/default SOV sentence and did not produce the scrambled OSV sentences. She also found that participants performed significantly more poorly on OSV sentences than on SOV sentences in a fill-in-the-blank-with-case-markers task. Also, Koda (1993) tested learners of L2 Japanese, whose L1s were English, Chinese and Korean. English and Chinese are fixed word-order languages, and Korean is a case-marking language that allows scrambling. The results showed that Chinese and English speakers performed poorly in comprehending scrambled Japanese OSV sentences, but Korean speakers performed equally well in comprehending unscrambled SOV sentences and scrambled OSV sentences. These results implied that, contrary to the First Noun Principle, a learner's L1 could facilitate or interfere with interpretation.

III. Semantic Factor: Anymacy

Clahsen and Felser (2006) maintain the Shallow Structure Hypothesis, which argues that L2 learners process the target language by using semantic information derived from the argument structure of the verb; not by using information from syntactic structure. In other words, learners' syntactic parsing of L2 sentences is shallow, and semantic information is relied on more in their comprehension of L2 sentences. A semantic factor related to the comprehension of the scrambled Japanese sentence is animacy. For example, when native English speakers read a scrambled OSV Japanese sentence such as 'Pasuta-o Jon-ga tabeta' ('John ate pasta') in (1), understanding that John is an animate entity and pasta is an inanimate entity, the parsers would know 'John' is who ate something and 'pasta' is what is eaten, even without paying attention to the case markers or word order. The animacy of the NP could therefore be used as a cue to identify the subject/agent and object/patient. This might be true in L1 sentence processing as well. The "good-enough parsing" account (Ferreira & Stacy, 2000; Ferreira, Bailey & Ferraro, 2002) claims that parsers do just enough processing to come up with a plausible meaning. When a parser is given three pieces of information such as 'John', 'pasta' and 'ate', it is easy for them to construct a plausible meaning, 'John ate pasta', based on semantic information from the NPs and the verb. On the other hand, studies such as Omaki and Schulz (2011) and Hara (2009a, b) argue that L1 and L2 speakers' syntactic analysis of a target sentence goes deeper than the lexical-semantic information.

Note that the Shallow Structure Hypothesis and the good-enough parsing account would not apply when both the subject-NP and object-NP are animate, as in the Japanese sentence, 'Mearii-o Jon-ga hometa' ('John praised Mary'). As Caluianu (2005) states, NP-animacy could cause ambiguity when it does not resolve semantic distinctions. In order to accurately process this type of sentence, parsers would have to pay attention to the case markers.

Overall, both syntactic factors (e.g., word order) and semantic factors (e.g., animacy) could affect parsers' comprehension/processing of sentences. In processing Japanese sentences, scrambled word order might be more difficult to process, and an animacy difference between the subject-NP and object-NP could facilitate their processing. The first experiment of the current study examined how the syntactic and semantic factors interact, to determine which is more or less influential of native Japanese speakers' and learners' processing.

IV. Discourse Factor: Definiteness and Preceding Context

Another factor relevant to the processing of scrambled sentences is the discourse context. Masunaga (1983) argues that scrambled sentences are more acceptable when the fronted object-NP is a definite NP. In other words, (2b) is more acceptable than (2a) in the examples shown below.

(2) a. Pasuta-o Jon-ga tabeta.
pasta-ACC John-NOM ate
'John ate pasta.'
b. Sono pasuta-o Jon-ga tabeta.
that pasta-ACC John-NOM ate
'John ate that pasta.'

Masunaga argues that the fronted definite object-NP performs a 'bridging function (p. 456)' between the preceding discourse context and the current sentence, establishing the topic of the current sentence. With the definiteness of the fronted NP, parsers assume that it refers to an entity in the preceding context and continues to be the current topic. Otsu (1994) also noted this effect. In his study with native Japanese children, although they initially misinterpreted scrambled OSV sentences to be unscrambled SOV when the sentence was presented by itself, they comprehended scrambled and unscrambled sentences equally accurately when preceding context with a referent to the fronted object was provided. An example is shown below. Children misinterpreted the sentence in (3a), but accurately understood the sentences in (3b), although the sentence in (3a) and the second sentence in (3b) were both scrambled.

(3) a. Ahiru-o kame-ga oshimashita.
duck-ACC turtle-NOM pushed.
'A turtle pushed a duck.'
b. Kooen-ni ahiru-ga imashita. Sono ahiru-o kame-ga oshimashita
park-at duck-NOM existed that duck-ACC turtle-NOM pushed
'There was a duck at the park. A turtle pushed that duck.'

Otsu's argument implies that context motivates scrambling movements. According to Masunaga again, the object-NP is moved to the front in order to bridge the current sentence and preceding context, and in order to establish the topic of the current sentences. In that case, the fronted object-NP must be a definite NP because it is already mentioned in the previous sentence. This operation of fronting the object-NP is similar to passivization in English, in which the object is moved to the front to become the subject, when it is the topic or theme of the sentence, which Keenan called 'foreground operation' (Keenan, 1985). The second experiment of the current study therefore examined how discourse factor (preceding context and definiteness) interacts with the syntactic factor, i.e., word order.

V. Experiment One

Previous chapters suggested syntactic factor, semantic factor, and discourse factor which may affect processing of Japanese scrambled sentences. Experiment 1 investigated the first two factors, syntactic factor and semantic factor, which are reflected by word order and animacy of NPs, respectively.

A. Participants

Twelve native Japanese speakers and eleven native English speakers from the University of South Carolina participated in Experiment 1. The native English-speaking participants were L2 Japanese learners, enrolled in Japanese language classes at the University.

B. Materials

For Experiment 1, the independent variables were word order and animacy of the subject-NP and the object-NP. These were presented on a computer screen to participants as four experimental Japanese sentences (shown below).

(4) a. Unscrambled SO word order, with Animacy difference (S[+animate] O[–animate])
e.g. Jon-ga pasuta-o tabeta.
John-NOM pasta-ACC ate
'John ate pasta.'
b. Unscrambled SO word order, with No animacy difference (S[+animate] O[+animate])
e.g. Jon-ga Mearii-o hometa.
John-NOM Mary-ACC praised
'John praised Mary.'
c. Scrambled OS word order, with Animacy difference (O[-animate] S[+animate])
e.g. Pasuta-o Jon-ga tabeta.
pasta-ACC John-NOM ate
'John ate pasta.'
d. Scrambled OS word order, with No animacy difference (O[+animate] S[+animate])
e.g. Mearii-o Jon-ga hometa.
Mary-ACC John-NOM praised
'John praised Mary.'

In the items above, (4a) provides both the unscrambled word order and animacy difference as comprehension cues; (4b) provides the unscrambled word order as the cue; (4c) provides animacy difference as the cue; and (4d) provides neither cue. Also, in order to eliminate any potential influence of word or sentence length, all experimental sentences consisted of three words (subject, object and verb), and all words were short enough to allow for participants' concurrent fixation. In addition, the Japanese sentences were shown with an English translation of each content word to eliminate possible error due to word unfamiliarity. An example question as it appeared on the computer screen is shown below.

(5) ジョン(John)が パスタ(pasta)を 食べた(ate)。

There were 60 experimental sentences (15 for each condition of (4a), (4b), (4c) and (4d)) and 80 distractor sentences. All verbs in the experimental sentences were transitive verbs, and the verbs in the distractor items were intransitive verbs or be-verbs. All sentences were in the past tense. The experimental and distractor sentences were given in random order. After participants read each item sentence, a comprehension question was then provided in English on a computer screen, as shown below.

(6) Q: Which is the correct translation of the previous sentence? Press '1' or '2'.
1. John ate pasta.
2. Pasta ate John.

C. Procedure

The sentences were given in the self-paced reading design in the moving-window paradigm using E-prime software, whereby participants read the sentences word by word. The experiment was carried out with each participant viewing the sentences on a computer. During the experiment, the participants first received the welcome message and instructions on the computer screen, and proceeded to a practice block by hitting the space bar. The practice block consisted of four sentences. After they finished the practice block, they received an end-of-practice message and were prompted to begin the actual experiment by hitting the space bar. In both the practice block and actual experiment, each sentence appeared after a fixation mark, '+', was shown for 1500ms on the left side of the screen, where the first letter of the experimental or distractor sentence appeared. After participants read all the words in each sentence, the comprehension questions were shown. Participants answered the question by hitting '1' or '2', and then the fixation mark '+' appeared, which was followed by the first word of the next sentence.

D. Data Analyses

The dependent variables were (i) accuracy of processing, which was assessed by the score of the comprehension question and (ii) the reading times per sentence and per word. The paired T-test was used to compare the accuracy and reading times between the unscrambled SO sentences (4a, 4b) vs. the scrambled OS sentences (4c, 4d), and between the sentences with the subject-object animacy difference (4a, 4c) vs. the sentences with no animacy difference (4b, 4d). If the participants' performance for the unscrambled SO sentences (4a, 4b) was significantly better than the scrambled OS sentences (4c, 4d), that would indicate that word order significantly affected the participants' processing. Also, if the participants' performance for the sentences with the subject-object animacy difference (4a, 4c) was significantly better than the sentences without animacy difference (4b, 4d), that would indicate that animacy of NPs significantly affected their processing.

VI. RESULTS: EXPERIMENT ONE

A. Native Japanese Speakers

The mean values and standard deviations of reading times and accuracy rates in the results from the native Japanese speakers are summarized in the table below.

TABLE 1
NATIVE JAPANESE SPEAKERS' ACCURACY SCORE AND READING TIMES IN EXPERIMENT ONE

Conditions and Example sentences	Accuracy (%) [SD]	Reading time (msec) [SD]	
Unscrambled, Animacy difference e.g., (4a) Jon-ga pasuta-o tabeta. 'John ate pasta.'	99.44 [0.87]	Sentence	2346.83 [598.69]
		1st NP (animate Subj)	826.78 [233.11]
		2nd NP (inanimate Obj)	762.88 [191.33]
		Verb	757.17 [253.87]
Unscrambled, No animacy difference e.g., (4b) Jon-ga Mearii-o hometa. 'John praised Mary.'	97.78 [1.48]	Sentence	2622.46 [578.40]
		1st NP (animate Subj)	797.35 [189.24]
		2nd NP (animate Obj)	835.14 [261.11]
		Verb	989.97 [264.42]
Scrambled, Animacy difference e.g., (4c) Pasuta-o Jon-ga tabeta. 'John ate pasta.'	96.11 [2.07]	Sentence	2569.76 [717.58]
		1st NP (inanimate Obj)	764.57 [204.87]
		2nd NP (animate Subj)	877.40 [296.94]
		Verb	927.82 [284.86]
Scrambled, No animacy difference e.g., (4d) Mearii-o Jon-ga hometa. 'John praised Mary.'	64.44 [12.88]	Sentence	2895.29 [697.85]
		1st NP (animate Obj)	819.19 [261.62]
		2nd NP (animate Subj)	922.72 [271.06]
		Verb	1153.38 [315.95]

For accuracy, sentential reading times and reading times per word, the outcome from the T-test analyses is shown in the below table. Although no significant difference was found in reading times for the first NP, all other comparisons showed significant differences: unscrambled sentences (4a, 4b) were more accurately comprehended and required less time to read than scrambled sentences (4c, 4d); and sentences with the animacy difference (4a, 4c) were more accurately comprehended and required less time to read than sentences without animacy difference (4b, 4d)).

TABLE 2
T-TEST ANALYSES FOR NATIVE JAPANESE SPEAKERS' ACCURACY SCORE AND READING TIMES IN EXPERIMENT ONE

	Unscrambled SOV (4a) S[+animate] O[-animate] (4b) S[+animate] O[+animate] vs. Scrambled OSV (4c) O[-animate] S[+animate] (4d) O[+animate] S[+animate]	Animacy difference (4a) S[+animate] O[-animate] (4c) O[-animate] S[+animate] vs. No Animacy difference (4b) S[+animate] O[+animate] (4d) O[+animate] S[+animate]
Accuracy	$p < .001$*	$p = .002$*
Sentential Reading time	$p < .001$*	$p < .001$*
1st NP Reading time	$p = .229$	$p = .327$
2nd NP Reading time	$p = .004$*	$p = .045$*
Verb Reading time	$p < .001$*	$p < .001$*

Note. An asterisk indicates significant differences ($p < .05$).

These results show that both word order and NP-animacy significantly affect the task-performance of native Japanese-speaking participants.

B. Native English Speakers

The mean values and standard deviations of reading times and comprehension accuracy for native English speakers are summarized in the table below.

TABLE 3
NATIVE ENGLISH SPEAKERS' ACCURACY SCORE AND READING TIMES IN EXPERIMENT ONE

Conditions and Example sentences	Accuracy (%) [SD]	Reading time (msec) [SD]	
Unscrambled, Animacy difference e.g., (4a) Jon-ga pasuta-o tabeta. 'John ate pasta.'	95.75 [2.02]	Sentence	4395.35 [1564.87]
		1st NP (animate Subj)	1882.74 [827.89]
		2nd NP (inanimate Obj)	1452.67 [570.01]
		Verb	1059.93 [410.54]
Unscrambled, No animacy difference e.g., (4b) Jon-ga Mearii-o hometa. 'John praised Mary.'	93.33 [4.02]	Sentence	5500.34 [2020.74]
		1st NP (animate Subj)	2079.23 [964.48]
		2nd NP (animate Obj)	1873.31 [816.87]
		Verb	1547.79 [684.68]
Scrambled, Animacy difference e.g., (4c) Pasuta-o Jon-ga tabeta. 'John ate pasta.'	92.11 [8.88]	Sentence	5046.42 [2112.48]
		1st NP (inanimate Obj)	2304.52 [1194.91]
		2nd NP (animate Subj)	1622.04 [707.95]
		Verb	1119.86 [547.32]
Scrambled, No animacy difference e.g., (4d) Mearii-o Jon-ga hometa. 'John praised Mary.'	58.18 [18.25]	Sentence	5502.36 [2290.97]
		1st NP (animate Obj)	2018.13 [1041.02]
		2nd NP (animateSubj)	1925.48 [1030.94]
		Verb	1558.75 [863.39]

The outcome from the T-test analyses is summarized in the table below. Accuracy rate was found to be significantly different for both comparative tasks, just as with native Japanese speakers. However, native English speakers differed from native Japanese speakers with respect to reading times. For native English speakers, word order (i.e., scrambled (4a, b) sentences vs. unscrambled (4c, d) sentences) resulted in no significant difference while animacy did.

TABLE 4
T-TEST ANALYSES FOR NATIVE ENGLISH SPEAKERS' ACCURACY SCORE AND READING TIMES IN EXPERIMENT ONE

	Unscrambled SOV (4a) S[+animate] O[-animate] (4b) S[+animate] O[+animate] vs. Scrambled OSV (4c) O[-animate] S[+animate] (4d) O[+animate] S[+animate]	Animacy-difference (4a) S[+animate] O[-animate] (4c) O[-animate] S[+animate] vs. No Animacy-difference (4b) S[+animate] O[+animate] (4d) O[+animate] S[+animate]
Accuracy	$p = .011$*	$p = .002$*
Sentential Reading time	$p = .159$	$p = .006$*
1st NP Reading time	$p = .229$	$p = .353$
2nd NP Reading time	$p = .251$	$p = .012$*
Verb Reading time	$p = .396$	$p = .006$*

Note. An asterisk indicates significant differences ($p < .05$).

The results above demonstrate that, in reading Japanese sentences, native English speakers rely on the semantic information from the animacy of NPs more than the syntactic information from the word order.

VII. DISCUSSION: EXPERIMENT ONE

As shown in Tables 1 and 3, the results indicate that, for both native Japanese and English-speaking participants, the accuracy scores for (4a) with both syntactic and semantic cues, (4b) with the syntactic cue (unscrambled SO word order), and (4c) with the semantic cue (subject-object animacy difference) were considerably higher than (4d) with neither cue. Also, as shown in Tables 2 and 4, comprehension accuracy of the unscrambled sentences (4a, 4b) was significantly higher than for the scrambled sentences (4c, 4d), and comprehension accuracy of the sentences with subject-object animacy difference (4a, 4c) was significantly higher than comprehension for the sentences with no animacy difference (4b, 4d). These results indicate that both cues from unscrambled SOV word order and from the subject-object animacy difference significantly improved accurate comprehension of Japanese sentences.

The native Japanese speakers' reading times for the unscrambled sentences (4a, 4b) were shorter than for the scrambled sentences (4c, 4d). Also, reading speed was significantly faster for the sentences with subject-object animacy difference (4a, 4c) compared to the sentences with no animacy difference (4b, 4d). This outcome suggests that the native Japanese speakers' processing speeds were affected by both word order and animacy difference.

The native English speakers' reading times for the sentences with subject-object animacy difference (4a, 4c) was significantly shorter than for sentences with no animacy difference (4b, 4d), while the reading times for the unscrambled sentences (4a, 4b) were not significantly different from those of the scrambled sentences (4c, 4d). This suggests that the animacy of NPs (a semantic factor) is reliable for English speakers when attempting to quickly comprehend Japanese sentences, but the word order (a syntactic factor) is not.

The observation of the reading times per word reveals the effect of NP-animacy in more detail. Regarding the syntactic factor (word order), native Japanese speakers read the second NP and verb in unscrambled sentences (4a, 4b) significantly faster than those in scrambled sentences (4c, 4d). In other words, the delay of the participants' sentence processing occurred on the second NP and the verb. This suggests that native Japanese speakers retrieved the first NP (object) to put it after the second NP (subject) in order to process them in the default SO order, when encountering scrambled sentences, as illustrated below.

(7) ~~Object NP~~$_t$ → Subject NP → Object NP$_t$

(Retrieve)

Also, the reading slow-down appearing on the verb could be considered a spill-over effect. Even when the Japanese speakers processed the verb, they were possibly still trying to construct the default (unscrambled) SOV sentences.

Regarding the semantic factor (animacy), the time required for native Japanese speakers to read the second NP and verb was significantly longer in sentences with no subject-object animacy difference (4b, 4d) compared to the sentences with animacy difference (4a, 4c). The delay of the participants' reading appeared on the second NP because, when they encountered the second NP (when both NPs were animate), they were likely to be confused as to which NP was the subject or object. This slow-down also appeared upon processing the verb, which may be another example of a spill-over effect; their confusion may have continued onto the end of the sentences.

On the other hand, similar to native Japanese speakers, the time required for English speakers to read the second NP and verbs was significantly longer in sentences with no subject-object animacy difference (4b, 4d) compared to those with animacy difference (4a, 4c). However, no significant differences were found between the times required for unscrambled sentences (4a, 4b) and scrambled sentences (4c, 4d). This clearly suggests that processing speeds were significantly affected only by NP-animacy, but not word order.

Overall, the results indicate that native Japanese speakers rely on both the syntactic cue from the word order and the semantic cue from the NP-animacy, but native English-speaking learners of L2 Japanese primarily rely on semantic cues from the NP- animacy.

VIII. Experiment Two

As mentioned, in Japanese, the unscrambled SOV order is default, and the scrambled OSV order is non-default. The first experiment above revealed that native Japanese speakers read the sentences in the scrambled word order significantly slower with less accuracy, compared to the unscrambled sentences. A fundamental question arising here is, when and why do Japanese speakers scramble the subject and object? One possible answer regarding production/utterance is the different accessibility-levels of each word. In a real-time conversation, speakers may tend to produce a word, which they first accessed in their mind, and incrementally complete a sentence following the word. This is not only true to Japanese scrambling. In English also, native English speakers occasionally say the object first as, ‘That, I don’t know’, for example.

In addition, another explanation pertaining to discourse-level effect was suggested by the Otsu (1994) and Masunaga’s (1983) studies mentioned earlier. According to them, the presence of the referent in preceding context and definiteness of a fronted object motivate scrambling; scrambling occurs in order to topicalize an NP that overlaps with an NP from the preceding context. Thus, Masunaga argues, if the fronted object-NP is a definite NP that refers to an entity, the scrambled sentences sound more acceptable. Also, in Otsu’s study, providing the preceding context with a referent of the fronted object-NP facilitated native Japanese children’s comprehension of scrambled sentences. Along with this line, the second experiment of the current study tested the effects of definiteness and preceding contexts with native Japanese speakers and native English-speaking L2 Japanese learners. In other words, this second experiment examined the discourse-level effect of the definiteness of the fronted object-NP and the preceding context on the processing of scrambled sentences.

A. Participants

Twelve native Japanese speakers and eleven native English speakers from the University of South Carolina participated in Experiment 2. Like Experiment 1, the native English speakers were L2 Japanese learners, enrolled in Japanese language classes at the University.

B. Materials

In this experiment, the independent variables were the definiteness of the fronted object-NP (definite or indefinite) and whether the fronted object-NP was preceded by a referent, which serves as a contextual cue. Since Japanese does not have indefinite or definite articles (i.e., ‘a/an’ or ‘the’), the definiteness of the NP was established using *sono* (‘that’) in this experiment, consistent with Masunaga’s (1983) study. The experimental sentences were given to the participants in three conditions shown below.

(8) a. Indefinite fronted Object

e.g.	Ahiru-o	kame-ga	oshita.		
	duck-ACC	turtle-NOM	pushed		
	‘A turtle pushed a duck.’				

b. Definite fronted Object

e.g.	Sono-ahiru-o	kame-ga	oshita.		
	that-duck-ACC	turtle-NOM	pushed		
	‘A turtle pushed the duck.’				

c. Preceding context + Definite fronted Object

e.g.	Ahiru-ga	ita.	Sono-ahiru-o	kame-ga	oshita.
	duck-NOM	existed	that-duck-ACC	turtle-NOM	pushed.
	‘There was a duck. A turtle pushed the duck.’				

Just as in the first experiment, the sentences were presented in Japanese texts with English translations for the content words, as shown below.

(9) そのアヒル(that duck)を かめ(turtle)が おした(pushed)。

In order to exclude the semantic influence, all the NPs were animate. Also, the preceding context as in (8c) did not provide a pragmatic clue for finding which NP in the following scrambled sentences was the subject or object. All sentences were in the past tense, provided with comprehension questions as shown below.

(10) Q: Which is the correct translation of the previous sentence? Press ‘1’ or ‘2’.

1. A turtle pushed that duck.
2. That duck pushed a turtle.

There were 45 experimental sentences (15 for each of (8a), (8b) and (8c)), and they were mixed among 70 distractor sentences. The experimental and distractor sentences were given in random order. The procedure of this experiment was the same as the first experiment: self-paced, word-by-word reading in the moving window paradigm.

C. *Data Analyses*

The measured dependent variables were (i) the accuracy of the comprehension, which was assessed by the score of the comprehension question, and (ii) the reading time of all the scrambled OSV sentences, excluding the preceding context. The T-test was used to compare the three conditions with respect to these variables.

According to Masunaga (1983), participants were expected to perform better in comprehension accuracy and reading times for sentences (8b, 8c) with definite object-NPs than for those (8a) with indefinite object-NPs. Also, according to Otsu (1994), the participants were expected to perform better for sentences (8c) with preceding context than sentences (8a, 8b) with no preceding context.

IX. RESULTS: EXPERIMENT TWO

A. *Native Japanese Speakers*

The mean values and standard deviations of reading times and accuracy rates in the results from the native Japanese speakers are summarized in the table below.

TABLE 5
NATIVE JAPANESE SPEAKERS' ACCURACY SCORE AND READING TIMES IN EXPERIMENT TWO

Conditions and Example sentences	Accuracy (%) [SD]	Reading time (msec) [SD]	
Indefinite fronted Object e.g., (8a) Ahiru-o kame-ga oshita. 'A turtle pushed a duck.'	87.23 [14.22]	Sentence 1st NP (animate Subj) 2nd NP (inanimate Obj) Verb	2376.79 [997.95] 668.42 [254.90] 695.77 [208.49] 1012.60 [599.44]
Definite fronted Object e.g., (8b) Sono-ahiru-o kame-ga oshita. 'That turtle pushed the duck.'	90.00 [9.56]	Sentence 1st NP (animate Subj) 2nd NP (animate Obj) Verb	2624.75 [911.88] 937.13 [394.73] 765.63 [241.09] 921.98 [389.49]
Preceding context + Definite fronted Object e.g., Ahiru-ga ita. Sono-ahiru-o kame-ga oshita. 'There was a duck. A turtle pushed the duck.'	93.89 [5.42]	Sentence 1st NP (inanimate Obj) 2nd NP (animate Subj) Verb	2391.23 [572.67] 782.56 [181.43] 807.07 [228.06] 801.60 [279.70]

The accuracy rates and reading times for the three conditions were compared via T-test, whose outcome is shown below.

TABLE 6
T-TEST ANALYSES FOR NATIVE JAPANESE SPEAKERS' ACCURACY SCORE AND READING TIMES IN EXPERIMENT TWO

	(8a) Indefinite fronted Object vs. (8b) Definite fronted Object	(8a) Indefinite fronted Object vs. (8c) Preceding context + Definite fronted Object	(8b) Definite fronted Object vs. (8c) Preceding context + Definite fronted Object
Accuracy	p = .254	p = .067	p = .066
Sentential Reading time	p = .081	p = .465	p = .088
1st NP Reading time	p = .003*	p = .025*	p = .081
2nd NP Reading time	p = .007*	p = .038*	p = .249
Verb Reading time	p = .219	p = .038*	p = .015*

Note. An asterisk indicates significant differences (p < .05).

Regarding the accuracy rates and sentential reading times, the analyses showed no significant difference between the three conditions. However, there were significant differences in reading times per word. First, for the first NP (scrambled/fronted object) and the second NP (subject), the reading times for the (8a) indefinite-OSV sentences were significantly shorter than for the other two conditions. In contrast, the reading time for the verb in the (8c) definite-OSV with preceding context was significantly shorter than the other two conditions. In other words, the native Japanese speakers' reading was initially faster for (8a) sentences with indefinite fronted objects than for the others, but the reading became faster for (8c) sentences with preceding contexts at the end, compared with the other sentences.

B. *Native English Speakers*

The mean values and standard deviations of reading times and accuracy of native English-speaking participants are summarized in the table below.

TABLE 7
NATIVE ENGLISH SPEAKERS' ACCURACY SCORE AND READING TIMES IN EXPERIMENT TWO

Conditions and Example sentences	Accuracy (%) [SD]	Reading time (msec) [SD]
Indefinite fronted Object e.g., (8a) Ahiru-o kame-ga oshita. 'A turtle pushed a duck.'	55.76 [29.26]	Sentence 4135.37 [2137.26] 1st NP (animate Subj) 1458.82 [862.47] 2nd NP (inanimate Obj) 1265.43 [792.91] Verb 1411.12 [630.03]
Definite fronted Object e.g., (8b) Sono-ahiru-o kame-ga oshita. 'That turtle pushed the duck.'	57.31 [28.32]	Sentence 4608.32 [2301.99] 1st NP (animate Subj) 1862.08 [928.79] 2nd NP (animate Obj) 1258.84 [618.50 Verb 1487.41 [946.77]
Preceding context + Definite fronted Object e.g., Ahiru-ga ita. Sono-ahiru-o kame-ga oshita. 'There was a duck. A turtle pushed the duck.'	70.91 [22.83]	Sentence 3755.45 [1671.16] 1st NP (inanimate Obj) 1458.95 [741.59] 2nd NP (animate Subj) 1173.10 [607.19] Verb 1123.40 [369.81]

Accuracy, sentential reading times and reading times per word were compared for the three conditions. The outcome from T-test analyses is shown below.

TABLE 8
T-TEST ANALYSES FOR NATIVE ENGLISH SPEAKERS' ACCURACY SCORE AND READING TIMES IN EXPERIMENT TWO

	(8a) Indefinite fronted Object vs. (8b) Definite fronted Object	(8a) Indefinite fronted Object vs. (8c) Preceding context + Definite fronted Object	(8b) Definite fronted Object vs. (8c) Preceding context + Definite fronted Object
Accuracy	p = .419	p = .014*	p = .013*
Sentential Reading time	p = .005*	p = .048*	p = .004*
1st NP Reading time	p = .001*	p = .500	p = .011*
2nd NP Reading time	p = .214	p = .322	p = .190
Verb Reading time	p = .326	p = .007*	p = .044*

Note. An asterisk indicates significant differences ($p < .05$).

The analyses showed that the accuracy scores for (8c) definite-OSV preceded by context were significantly higher than the two conditions with no preceding context (8a, 8b). No significant differences were otherwise observed between them.

As for the sentential reading times, significant differences were found between all conditions; reading for (8c) definite-OSV preceded by context were significantly faster than the other conditions; and reading for the (8a) indefinite object-NP condition was found to be faster than (8b) definite object-NP with no preceding context.

Regarding the reading time per word, as for the first NP (i.e., fronted object-NP), the reading time was found to be longer for (8b) definite object-NP with no preceding context compared to the other two conditions (8a, 8c). No significant differences were found between these two conditions. Also, no significant differences were found in the reading times for the second NP (i.e., subject-NP). As for the reading time per verb, reading times for (8c) definite-OSV preceded by context was significantly shorter than for the other two conditions (8a, 8b).

X. DISCUSSION: EXPERIMENT TWO

Regarding native Japanese speakers, no significant differences were found between the three conditions of (8a), (8b) and (8c) with respect to the accuracy scores and sentential reading times. Closer inspection of per-word reading times reveals that when processing the first NP and the second NP, reading speeds were faster for the (8a) sentences with indefinite object-NP compared to the other conditions with definite object-NP (8b, 8c). This indicates two possible explanations: first, simply because the indefinite object-NP in (8a) (i.e., *ahiru-o* or 'duck-ACC') were shorter than the definite object-NPs in (8b, 8c) (i.e., *sono-ahiru-o* or 'that duck-ACC'), the indefinite NP allowed participants to read them faster than definite NPs, although all words were short enough to fit in readers' perceptual span. Second, another possible explanation is that the definiteness of the object-NP in (8b, c) led participants try to search for and retrieve its referent, which required extra time, thereby increasing reading times.

However, native Japanese speakers' reading time per verb was fastest for (8c) definite-OSV preceded by context compared to the other two conditions (8a, 8b). This may reflect the facilitatory effect from the preceding context, as argued in Otsu's (1994) study. In other words, participants seem to have less confusion in processing scrambled sentences, when the referent of the fronted object-NP appeared earlier in the preceding context. Furthermore, the presence of the preceding context may be motivation for scrambling, and the markedness of the scrambled word order could be neutralized, thereby allowing participants to process the scrambled OSV sentences relatively quickly.

On the other hand, (8b) sentences with definite object-NP but with no preceding context were not found to be read any faster than (8a) those with indefinite object-NP. This may indicate that only definiteness alone does not help native Japanese speakers' processing of the scrambled sentences: a clear referent for the fronted object-NP was needed to be quickly processed. This explanation could be still compatible with Masunaga's (1983) argument that Japanese scrambling is an option for topicalization of an NP (i.e., whereby a fronted object-NP is made to be the topic of the sentence). Essentially, the topic-NP in Japanese carries the information that the participants of the communication share and already know (Kuno, 1972). Thus, in order to topicalize an NP, the NP should be information that has appeared previously or is otherwise already known. The condition (8b) without preceding context or referent to the fronted object-NP was not sufficient to establish the topic-hood of the fronted object-NP in scrambled sentences.

The discussion above about native Japanese speakers' processing is summarized as follows: preceding context that includes the fronted object's referent facilitates faster processing by native Japanese speakers, but definiteness of the fronted object-NP alone and without referent does not.

As for the results from the native English speakers, first, when observing their accuracy scores, (8c) sentences with previous context were comprehended significantly more accurately than the other conditions. However, when the fronted object-NP was definite but with no preceding context as in (8b), comprehension was not improved compared to when the fronted-NP was indefinite as in (8a). Second, in observing the native English-speaking participants' reading time for the verb, it was faster when preceding context was provided as in (8c), compared to the other conditions. These outcomes should be, similarly to native Japanese speakers, indications of the facilitatory effect from the preceding context; the presence of the referent for the fronted object-NP successfully helped participants quickly process scrambled sentences.

However, the native English-speaking participants' reading times exhibit a more radical effect compared to that of native Japanese speakers. Their sentential reading times and the reading times per the first NP show that (8b) sentences with definite object-NP but with no preceding context were read significantly slower than the other two conditions. Definiteness without preceding context seemed to have penalized participants' processing. Marking of definiteness for an NP logically requires the presence of its referent. Because a definite NP is not preceded by its referent, the English-speaking readers may have kept searching for it, which appeared as the longest reading time for the first NP (i.e., definite object-NP) in the condition (8b).

In summary, the definiteness of the fronted object-NP with the presence of its referent facilitated the processing of scrambled sentences both for native Japanese and English speakers. Furthermore, definiteness alone without referent penalized native English speakers' processing.

XI. Conclusions and Limitations

From the results of the first experiment, we found that native Japanese speakers equally rely on both the syntactic cues from word order and semantic cues from NP animacy, whereas animacy difference contributes more than word order for native English-speaking L2 Japanese learners. This finding is plausible considering that information regarding whether an entity is animate or inanimate completely overlaps in English and Japanese as a cue for sentence comprehension. The information from word order only partially overlaps in English and Japanese because the default SO word order is generally always present in English, but not Japanese. Thus, this supports Clahsen and Felsher's (2006) claim that, while adult L2 learners access lexical and semantic cues in the same ways as native speakers, syntactic information is less accessible to them.

From the results of the second experiment, it was shown that the preceding context significantly facilitated both the native Japanese and English speakers' comprehension of the scrambled OSV sentences. With no cue from animacy difference nor default word order available, the participants accurately processed the scrambled sentences when a preceding context and the referent of the scrambled object-NP was provided. The second experiment also revealed the significantly slower reading speed of the sentences with definite fronted object-NP without preceding context for native English speakers. They took a comparably longer time when reading the fronted definite object-NP without preceding context, which indicates the penalty from the absence of the referent of the definite NP.

Another finding from the current study is that both native Japanese and English speakers' reliance on case markers is relatively small. Their comprehension accuracy for scrambled sentences was low when no distinction was made between subjects and objects with respect to animacy, despite all being marked by correct case markers. The results imply that the effect from syntactic cue (word order) and semantic cue (animacy) may be stronger than morphological cues (case markers): a possible research topic in further studies.

While the two experiments in this study exhibited plausible findings, there are some limitations in this study. One possible limitation is that the words used in the experiment were presented both in Japanese texts and English translation for each content word as shown in (5) and (9), which may bias analysis of reading times. Another possible limitation of the experiments is the small number of participants. Outcomes may potentially differ given more participants.

In addition, the results for the native English speakers could vary depending on the participants' L2 Japanese proficiency level. Participants in the current study were enrolled in the first or second semester of Japanese classes, which is why we had to provide English translations for content words. Further research is required to determine whether highly proficient L2 Japanese speakers may exhibit performance more similar to that of native Japanese speakers.

In conclusion, this study investigated the effects of the word order and animacy with respect to accuracy and processing time of Japanese scrambled sentences for native Japanese speakers and native English speakers. The findings from this study should be tested again after addressing the limitations. Additional research might furthermore clarify the validity of the findings of this study and contribute to a more comprehensive understanding of how Japanese sentences are processed.

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