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Processing object-subject word order by L2 learners of German

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This study investigated how L2 learners of German (Japanese L1) process an embedded clause in which the subject follows the object (OS order) when reading German sentence. The results of the self-paced reading experiment showed that the OS order clause required a longer reading time than the clause in which the subject precedes the object (SO order) in good learners of German, while the effect of the word order was not observed in poor learners. The longer reading time for the OS order is regarded as attributed to the extra processing cost such as constructing filler-gap dependency in non-canonical word order. This suggests that the way learners process OS order sentences is similar to that of the native speakers of German along with their progress of the literacy of German.

Introduction

In the psycholinguistic field, the one of the main purposes of the study of second language learning is to uncover the processing mechanism of a second language and the effect of the native language of the learner and the influence of the human language competence. This study aims to examine how learners of a second language process a sentence in which the subject follows the object (OS order) when reading.

As shown in (1) below, Japanese grammar permits the word order not only (1a) — the subject precedes the object (SO order) —, but also (1b) — the subject follows the object. Basically, they both have the same meaning, but they are analyzed as having different syntactic structures (Hoji, 1985; Saito, 1985). Many studies have analyzed that (1a) has the simplest syntactic structure and the structure of (1b) is derived from (1a), with the object preceding the subject and leaving a gap in the original object position.

(1) a. $[_S$ Hiro-ga $[_{VP}$ robotto-o suku-u]].
Hiro-NOM robot-ACC save
"Hiro saves a robot."

b. $[_S$ Robotto$_i$-o $[_S$ Hiro-ga $[_{VP}$ gap$_i$ suku-u]]].
robot-ACC Hiro-NOM save
"Hiro saves a robot."

Much of the psycholinguistic literature of Japanese has reported that the OS order induces a greater processing cost than the SO order (Hagiwara, Soshi, Ishihara, & Imamura,

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2007; Mazuka, Itoh, & Kondo, 2002; Tamaoka et al., 2005). When native Japanese speakers first read an OS order sentence such as (1b), when they read *Robotto-o* 'robot-acc', and especially observe the accusative marker *-o*, they may notice that this marker indicates an object noun, not a subject. Next, they read *Hiro-ga* 'Hiro-nom' with the subject marker *-ga*. Here, they posit a gap that will be associated with a sentence initial accusative marked noun and a more complex structure that includes filler-gap dependency. Finally, when they read the verb as expected, *Robotto-o* is associated with the gap as a filler. Such a series of processing is called gap-filling parsing. Due to this gap-filling parsing, a greater processing cost is required for the OS order than for the SO order in Japanese (Miyamoto, 2008 for review). These SO order preferences are also observed in many other languages (Kaiser & Trueswell, 2004 for Finnish; Kim, 2012 for Korean; Sekerina, 1997 for Russian; Tamaoka, Kanduboda, & Sakai, 2011 for Sinhalese)[3].

Regarding how the learners of a second language process OS order sentences, Tamaoka (2005) measured reaction times for a grammaticality judgment task and their correction rates of the L2 learners of Japanese (Chinese L1). Tamaoka (2005) reported that the SO order sentences were judged faster and more correctly than the OS order sentences. These results were interpreted as the learners of Japanese processing the OS order sentences to the same way as the native speakers of Japanese, and the gap-filling processing eliciting a larger processing cost than the SO order sentences.

Jackson (2008) focused on L2 learners of German (English L1). She studied how native speakers of English learning German comprehend SO word order sentences and OS word order sentences. She compared the reading time of the SO order of German with that of the OS order with transitive verbs in subordinate clauses. The advanced learner of German read the SO order sentences faster and more correctly than the OS order sentences. Based on these results, Jackson (2008) concluded that the OS dispreference is attributed to the learners' appropriate knowledge to the case marking of German. Because the advanced learner of German can use the knowledge of the German case marking system correctly, the definite accusative case marker den causes the learner to find unfamiliar word order, and then the processing cost becomes greater for at least the advanced learner of German.

To sum up these two previous studies, although learners of a second language experience difficulties in reading the OS sentences even in Japanese and German, the source of difficulty is stated differently between Tamaoka (2005) and Jackson (2008). Tamaoka's discussion detailed that leaners apply gap- filling parsing to OS word order sentences and this extra parsing procedure leads to a greater processing cost in the OS order, which is called as the Filler-Gap Hypothesis (FGH), hereafter. Jasckson's discussion states that the unfamiliar order of the input enlarges the processing difficulty, which is called as the UnFamiliar Hypothesis (UFH), hereafter. Now let us consider about the mother tongues of these studies — Chinese in Tamaoka (2005) and English in Jackson (2008). The OS order is basically ungrammatical

3. Some languages indicate OS order preference, such as Kaqchikel Maya, due to the canonical syntactic structure (see Yasunaga et al., 2015).

and is, therefore, hardly seen in both languages. Thus, both FGH and UFH predict that SO order is preferred in languages in which the OS order is ungrammatical. To determine which of these two hypotheses is valid, it is necessary to examine the case for which the two hypotheses offer different predictions, namely, the mother language that permits the OS word order grammatically.

Contrary to Chinese and English, Japanese permits the OS word order and has a more complex syntactic structure including filler-gap dependency as in (1). Therefore, the FGH predicts a greater processing cost for the OS order of the second language, while the UFH does not predict a difference in the processing cost between the SO order and the OS order. To address which hypothesis is more valid, we conducted a self-paced reading experiment targeting L2 learners of German (Japanese L1).

Experiment

Materials

Regarding the grammar of German, the definite article has some ambiguity in terms of its case and gender. For example, *der* indicates not only the nominative case of masculine nouns but also the dative or genitive case of feminine nouns. To minimize this ambiguity as much as possible, we used the noun for which gender bears explicitly. In German, many of the *-er* ending nouns bear the masculine gender and many of the *-erin* ending nouns bear the feminine gender shown in (2). The *der* N-*er* provides strong evidence that it is a nominative masculine noun, because the *-er* ending noun has a high likelihood of being a masculine noun.

(2) a. *-er* ending noun: Lehrer (male teacher), Schüler (male student) etc.
b. *-erin* ending noun: Lehrerin (female teacher), Schülerin (female student) etc.

(3) a. $S_{[mas]}$-O order
Ich glaube, dass der Künstler den Arbeiter malt.
I think that the:NOM artist the:ACC worker paints.
"I think that the artist paints the worker."
b. O-$S_{[mas]}$ order
Ich glaube, dass den Arbeiter der Künstler malt.
I think that the:ACC worker the:NOM artist paints.
c. $S_{[fem]}$-O order
Ich glaube, dass die Künstlerin den Arbeiter malt.
I think that the:NOM female artist the:ACC worker paints.
"I think that the female artist paints the worker."
d. O-$S_{[fem]}$ order
Ich glaube, dass den Arbeiter die Künstlerin malt.
I think that the:ACC worker the:NOM female artist paints.

Twelve sets of sentences yielding a total of 48 target sentences were prepared as shown in (3). Half of them are paid attention to the case ambiguity that is mentioned above using a masculine noun as the subject and a masculine noun as the object. The other half of sentences include ambiguous definite case markers such as *die* — indicating both nominative and accusative cases of feminine nouns — as the subject and unambiguous accusative masculine nouns as the object. All sentences include psych verbs, such as *glauben* 'think', and *wissen* 'know' as matrix verbs and have an embedded *dass* 'that' clause in which the word order of the embedded subject and object varies. Another 48 sentences added as distractor stimulus. All materials were checked in terms of naturalness and grammaticality by a native speaker of German[4]. In total 96 sentences were presented in randomized order to each participant.

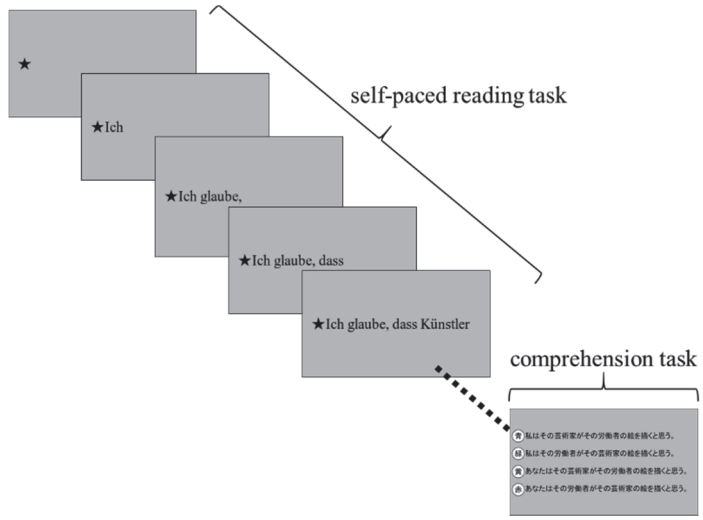
Procedure

The experiment consisted of two stages. First, a stage of measuring the participants' literacy of German, the participants were asked to consider the meaning and the grammatical category such as masculine noun, feminine noun, or verb of the presented word. If s/he did not know the word, the participant was urged to memorize the word. In the second part of the experiment, a stage of a self-paced reading task, the participants were required to read a German sentence and to answer a comprehension task. When the participants pressed the button of the response box (Cedrus RB-530), the next region emerged in a moving-window manner. The participants had to press the button repeatedly to read an experimental sentence until the end of the sentence. The interval of the button pressing was recorded as a reading time of that region (Figure 1A). In the comprehension task, participants had to choose a Japanese sentence with the most appropriate meaning of the German sentence presented previously (Figure 1B).

Participants

The participants of the experiment were thirty students from Kanazawa University who had been learning German for more than one year. Nine participants were rejected because of a low correction rate in the comprehension task (less than 50 %). Twenty-one students (1 male and 20 females; mean age of 21.7 years-old, range 20–23) were selected as the participants of the analysis. The written informed consent document used to manage the personal information was distributed to all participants prior to the experiment. They were given a bookstore gift card (¥1,000) for their participation. Based on the result of the measuring of their literacy of German (the first part of the experiment), participants were grouped into two categories. The participants who scored 85% or more were placed in the group of good-learners, and who scored less than 85 % were in the group of poor-learners.

4. We would like to thank Prof. Sabine Randhage (Kanazawa University) for her cooperation



B

青 私はその芸術家がその労働者の絵を描くと思う。

緑 私はその労働者がその芸術家の絵を描くと思う。

黄 あなたはその芸術家がその労働者の絵を描くと思う。

赤 あなたはその労働者がその芸術家の絵を描くと思う。

Figure 1. [A] An example of the stimulus presentation. [B] An example of the comprehension task.

Results

The experimental design was 2 × 2. The first factor was the word order (SO vs. OS) and the second factor was the case ambiguity of the definite marker (ambiguous vs. unambiguous). The two-way repeated measures analysis of variance (ANOVA) were used to statistically analyze the mean correction rate and reaction time of the comprehension task (Table 1), and the reading time of the self-paced reading task for good-learners and poor-learners respectively[5] (Table 2).

The correctness of the comprehension task for SO order and OS order did not reveal significant differences in both good- and poor-leaners [good: $F_1(1,10)=1.41$, *n.s.*, $F_2(1,11)=1.00$;

5. All the main effects of the case ambiguity and the interaction were not significant. To save the number of pages and to clarify the main effect of word order, these statistical results have been skipped.

poor: $F_1(1,9)=0.03$, *n.s.*, $F_2(1,11)=0.01$, *n.s.*]. In the reaction time of the comprehension task, OS order took a longer reaction time than SO order in the good-learner group [$F_1(1,10)=10.03$, $p<.05$, $F_2(1,11)=12.14$, $p<.01$]. In the poor-learner group, the difference did not reach the significance [$F1(1,9)=0.12$, *n.s.*, $F2(1,11)=0.37$, *n.s.*].

Table 1. The mean correction rate and reaction time of the comprehension task

	correcntion rate (%)				reaction time (ms)			
	good-learner		poor-learner		well-learner		poor-learner	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
S[mas]-O	81.1	12.4	80.0	13.5	5,282	1,209	5,540	865
S[fem]-O	78.0	9.6	72.5	12.9	5,806	1,905	6,093	1,531
O-S[mas]	81.8	11.1	80.0	10.7	5,944	1,820	5,403	676
O-S[fem]	85.6	8.8	73.3	12.3	6,305	1,578	6,069	953
avg.	81.6	10.5	76.5	12.4	5,834	1,628	5,776	1,006

Table 2. The mean reading time of the subordinate clause (ms)

	good-learner		poor-learner	
	M	*SD*	*M*	*SD*
S[mas]-O	5,320	1,647	8,041	2,977
S[fem]-O	5,554	1,681	8,353	2,529
O-S[mas]	5,613	1,547	8,091	1,691
O-S[fem]	5,976	1,747	5,893	2,401
avg.	5,616	1,656	7,595	2,400

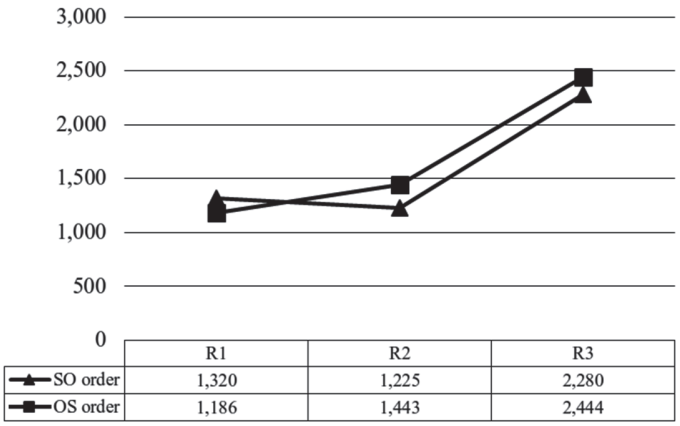


Figure 2. Reading time shift per phrase in subordinate clauses of the good-learners (ms)

In the self-paced reading task, the mean reading time of the subordinate clause of the OS order showed a statistically longer reading time than that of SO order in the good-learner group [$F1(1,10)=10.51$, $p<.01$, $F2(1,11)= 0.48$, $p<.05$]. In contrast, the same effect was not observed in the poor-learner group [$F1(1,9)=0.09$, *n.s.*, $F2\ (1,11)=0.94$, *n.s.*]. To examine the word order effect in the good-learner group in more detail, the comparison was made per phrase (Figure 2). In the region of the first noun in the subordinate clause, the effect of word order was not detected [$F1(1,10)=2.59$, *n.s.*, $F2(1,11)=4.74$, $p<.1$]. In the second noun region of the subordinate clause, the OS order required longer reading time than the SO order [$F1(1,10)=9.58$, $p<.05$, $F2(1,11)=13.48$, $p<.01$]. In the verb region of the subordinate clause, no statistical effect was observed [$F1(1,10)=2.62$, *n.s.*, $F2(1,11)=3.15$, *n.s.*].

Discussion

This study examined two types of hypotheses to explain the source of difficulty regarding processing OS word order sentence for the learners of a second language. The filler-gap hypothesis (Tamaoka, 2005) accounts for the SO preference in terms of the extra processing procedure to establish the filler-gap dependency. Thus, the SO preference of the Japanese L2 learners of German was predicted because the German OS word order includes filler-gap dependency. However, the unfamiliar hypothesis (Jackson, 2008) explains the difficulty of the OS order in terms of the unfamiliarity of the input of object preceding subject. This hypothesis did not predict the asymmetry of the processing cost between the SO and the OS of the Japanese L2 learners of German, because the native speakers of Japanese are familiar with the input of the OS order.

Based on the results of the comprehension task and the self-paced reading task, the Japanese good L2 learners of German experienced more difficulty in the OS word order than the SO word order. These results are consistent with the prediction influenced by the filler-gap hypothesis. This suggests that the learners' way of processing OS order is similar to that of the native speakers of German, as well as their progress of the literacy of German.

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