Is there 'default' in word order? –

Scrambling effects on the processing of Japanese and Korean sentences

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The present study investigated scrambling effects on the processing of Japanese and Korean sentences using the task of sentence correctness decision. All the experiments in the Japanese and Korean sentences showed that scrambled sentences were processed slower and less accurately than canonical sentences. Thus, we proposed that a canonical order of sentences must function as a 'default' in sentence processing.

Key words: Scrambling Effects, Word Order, Sentence Processing, Japanese, Korean

Japanese and Korean sentences are generally flexible in terms of subject-and-object word order. For example, a Japanese sentence of 'Hanako hits Taro' can be expressed in two ways of *Hanako-ga Taro-o nagutta* (canonical order of 'Hanako Taro hits') and *Taro-o Hanako-ga nagutta* (scrambled order of 'Taro Hanako hits'). This operation is also possible in the Korean language. Since Japanese and Korean have case makers for subjects and objects, native speakers can easily understand both types of sentences which have the same meaning. The previous studies found mixed results. Yamashita (1997) and Sakamoto (2001) found no difference in reading times between both Japanese sentence types while Chujo (1983) discovered differences. Therefore, in order to clarify these mixed findings, the present study investigated the difference between the canonical and scrambled orders using both Japanese and Korean sentences.

Experiment 1a (Japanese) and 1b (Korean) – Sentences with Verbs Having Two Arguments

Method

Subjects: Twenty-eight native Japanese speakers participated in Experiment 1a for the processing of Japanese sentences while 24 native Korean speakers participated in Experiment 1b for the processing of Korean sentences.

Stimuli: All sentences were constructed using verbs with two arguments. For the sentence correctness decision, 52 pairs of canonical and scrambled sentences were constructed for the correct 'Yes' responses while 32 pairs were constructed for the correct 'No' responses in both the Japanese and Korean languages. Stimulus sentences were divided into two counterbalanced lists with an equal number of canonical and scrambled sentences. In order to assign one of the two lists, the 28 Japanese subjects were also divided into two groups of 14 for Experiment 1a. Likewise, the 24 Korean subjects were also divided into two groups of 12 for Experiment 1b.

Procedure: Sentences were individually presented to subjects in the center of a computer display at a comfortable distance away in a dimly lit, quiet room. Stimuli were randomly presented after the appearance of an eye fixation point marked by an asterisk '*' for 600 milliseconds. Subjects were required to make a sentence correctness decision as quickly and as accurately as possible. The next fixation point was indicated 600 ms after the subject's response.

Results

A one-way ANOVA (canonical and scrambled) with repeated measures was carried out on reaction times and error rates separately for the correct 'Yes' and 'No' responses. Statistical tests follow analyses of both subject (F_1) and item (F_2) variability.

Table 1 Correctness decision for Japanese sentences with two-argumented-verbs

Response Type	Sentence Type	Reaction Time (ms)		Error Rate (%)	
		M	SD	M	SD
'Yes'	SOV	1209	238	3.02%	3.37%
Responses	OSV	1432	306	9.07%	6.96%
	OSV-SOV	Δ 223	F_1 ***, F_2 ***	Δ 6.04%	F_1 ***, F_2 ***
'No'	SOV	1297	224	4.91%	6.96%
Responses	OSV	1388	216	9.38%	9.95%
	OSV-SOV	Δ 91	F_1 ***, F_2 n.s.	Δ 4.47%	F_1 n.s., F_2 n.s.

Note: 28 subjects and 52 items for 'Yes' responses while 28 subjects and 32 items for 'No' responses.

Only correct responses were used as data in the analysis of reaction times. For the correct 'Yes' responses, the one-way ANOVA indicated that there was a significant difference between canonical and scrambled sentences in the

Japanese language $[F_1(1,27)=58.71, p<.001; F_2(1,51)=61.88, p<.001]$ and in the Korean language $[F_1(1,23)=48.48, p<.001; F_2(1,51)=19.01, p<.001]$. The same analysis for error rates also showed a significant difference in the Japanese language $[F_1(1,27)=15.71, p<.001; F_2(1,51)=17.14, p<.001]$ and in the Korean language $[F_1(1,23)=7.29, p<.05; F_2(1,51)=17.80, p<.001]$. Thus, the scrambled condition slowed down and produced many errors in the Japanese and Korean sentence processing.

Table 2 Correctness decision for Korean sentences with two-argumented-verbs

Response Type	Sentence Type	Reaction Time (ms)		Error Rate (%)	
		M	SD	M	SD
'Yes' Responses	SOV	1898	425	6.41%	5.40%
	OSV	2227	455	16.51%	17.99%
	OSV-SOV	Δ 328	F_1 ***, F_2 ***	Δ 10.10%	F_1 *, F_2 ***
'No' Responses	SOV	2013	428	10.16%	9.68%
	OSV	2163	440	6.51%	8.55%
	OSV-SOV	Δ 150	F_1 n.s., F_2 n.s.	Δ -3.65%	F_1 n.s., F_2 n.s.

Note: 24 subjects and 52 items for 'Yes' responses while 24 subjects and 32 items for 'No' responses.

On the contrary, for the correct 'No' response, there was no significant difference between canonical and scrambled sentences in both the Japanese and Korean languages, except subject analysis of reaction times for the Japanese sentences $[F_1(1,27)=14.49, p<.001; F_2(1,31)=0.02, n.s.]$.

Experiment 2a (Japanese) and 2b (Korean) – Sentences with Verbs Having Three Arguments

Method

Subjects: The same as Experiment 1a and 1b.

Stimuli: All sentences were constructed by using verbs with three arguments. For the sentence correctness decision, 20 pairs of canonical and scrambled sentences were constructed for the correct 'Yes' responses while 20 pairs were constructed for the correct 'No' responses in both the Japanese and Korean languages. These sentences were divided into two counterbalanced lists with an equal number of canonical and scrambled sentences. As in Experiment 1a and 1b, the subjects were divided into two groups to be assigned one of the two stimulus lists.

Procedure: The same as Experiment 1a and 1b.

Results

The same analyses were carried out for Experiments 2a and 2b. For the correct 'Yes' responses, the one-way ANOVA indicated a significant difference between canonical and scrambled sentences in the Japanese language $[F_1(1,27)=56.36, p<.001; F_2(1,19)=70.25, p<.001]$ and in the Korean language $[F_1(1,23)=15.68, p<.001; F_2(1,19)=40.82, p<.001]$. The same analysis for error rates also showed a significant difference in the Japanese language $[F_1(1,27)=10.80, p<.01; F_2(1,19)=24.18, p<.001]$ and in the Korean language $[F_1(1,23)=15.58, p<.001;$

$F_2(1,19)=7.84, p<.05]$. Thus, as in Experiment 1a and 1b, the scrambled condition slowed down and produced many errors in the Japanese and Korean sentence processing.

Table 3 Correctness decision for Japanese sentences with three-argumented-verbs

Response Type	Sentence Type	Reaction Time (ms)		Error Rate (%)	
		M	SD	M	SD
'Yes' Responses	SOV	1359	320	1.79%	3.90%
	OSV	1963	643	11.79%	17.44%
	OSV-SOV	Δ 604	F_1 ***, F_2 ***	Δ 10.00%	F_1 **, F_2 ***
'No' Responses	SOV	1436	265	1.79%	4.76%
	OSV	1597	395	4.29%	10.34%
	OSV-SOV	Δ 161	F_1 ***, F_2 **	Δ 2.50%	F_1 n.s., F_2 n.s.

Note: 28 subjects and 20 items for both 'Yes' and 'No' responses.

For the correct 'No' response, there was also a significant difference in reaction times between canonical and scrambled sentences in both the Japanese language $[F_1(1,27)=16.07, p<.001; F_2(1,19)=8.58, p<.01]$ and the Korean language $[F_1(1,23)=15.58, p<.001; F_2(1,19)=7.84, p<.05]$. However, error rates did not show any difference in either Japanese or Korean.

Table 4 Correctness decision for Korean sentences with three-argumented-verbs

Response Type	Sentence Type	Reaction Time (ms)		Error Rate (%)	
		M	SD	M	SD
'Yes' Responses	SOV	1870	377	10.83%	9.97%
	OSV	2485	776	28.33%	25.44%
	OSV-SOV	Δ 615	F_1 ***, F_2 ***	Δ 17.50%	F_1 ***, F_2 *
'No' Responses	SOV	1933	409	4.17%	6.40%
	OSV	2080	493	3.33%	4.71%
	OSV-SOV	Δ 147	F_1 *, F_2 *	Δ -0.83%	F_1 n.s., F_2 n.s.

Note: 24 subjects and 20 items for both 'Yes' and 'No' responses.

General Discussion

The present study sought to reveal how a scrambled condition affects the processing of Japanese and Korean sentences. Throughout the experiments, correctly-constructed scrambled Japanese and Korean sentences (i.e., stimuli for the correct 'Yes' responses) were slower in reaction times and higher in error rates than canonical sentences. This tendency was congruent in the both sentences of verbs with two and three arguments. In addition, the incorrectly-constructed sentences (i.e., stimuli for the correct 'No' responses) with verbs having three arguments also showed scrambled effects in terms of the processing speed of the Japanese and Korean sentence. Based on these results, the present study proposed that canonical order functions as a 'default' which assume that, in order to understand the meaning of scrambled sentences, the word order is re-constructed into the canonical order (accepting 'movement' or 'trace' in a scrambled sentence structure). In this sense, we support the syntactic theory of 'configurational structure with movement' (Saito, 1985; Hoji, 1985 and among others), rather than 'noncofigurational structure without movement' or 'flat structure' (Farmer, 1980; Hale, 1980).