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# Experimental Research into Significant Effects of Prior Discourse Contexts and Prosodic Information on Japanese EFL Learners' Syntactic Processing Strategies

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## 1. Introduction

The series of empirical researches have been conducted since 2002 regarding L2 syntactic processing in order to elucidate the difficulties in Japanese EFL learners' English reading comprehension. These researches have considered these following significant variables:

- (1) the ambiguity and complexity on the basis of the syntactic processing principles such as 'theta reanalysis constraints', 'closure; early closure and late closure', 'two sentences' and 'dual embedding'
- (2) the syntactic processing strategies such as 'serial processing', 'parallel distributed processing', 'immediate processing' and 'delayed processing',
- (3) Japanese EFL learners' specific reading comprehension strategies on the basis of the syntactic structural differences between Japanese and English.

From these research results, it can be acknowledged that these factors interactively cause the major difficulties concerning Japanese EFL learners' English reading comprehension.

These experimental researches have been carried out since 2006 concerning how discourses information, especially subsequent discourse contexts as well as prior discourse contexts, have significant effects on the ambiguity and complexity on the basis of the syntactic processing principles with a view to identify the major factors which contribute to resolving the difficulties in reading comprehension. It was statistically acknowledged from the series of research results that prior discourse contexts have greater effects on the

ambiguity resolutions and the complexity resolutions than subsequent discourse contexts did.

In addition, these empirical studies have been conducted since 2010 regarding how both prior discourse contexts and prosodic information have significant effects on the ambiguity resolutions and the complexity resolutions in Japanese EFL learners' syntactic processing in natural course of reading comprehension.

## 2. Principal aims of the present study

The principal aim of the present research is to investigate and compare the significant effects that prior discourse contexts and prosodic information have on the resolutions of ambiguities and complexities in Japanese EFL learners' syntactic processing.

## 3. Hypotheses

### 3.1 Hypotheses concerning the significant effects of prior discourse contexts

**Hypothesis 1** Prior discourse contexts contribute to resolving the ambiguities and complexities of stimulus sentences.

There are different research results concerning the effects which prior discourse contexts have on the ambiguities and complexities of stimulus sentences in overseas.

For example, Murray & Liversedge (1994) insisted that discourse information did not have greater effects on syntactic parsing decision. On the other hand, Sedivy & Spivey-Knowlton (1994) claimed that discourse information played a significant role through interacting with lexical information in syntactic parsing decision. Moreover, Spivey-Knowlton & Tanenhouse (1994) supported the results of Sedivy & Spivey-Knowlton (1994) and maintained that referential contexts had more influential effects on the syntactic processing of the reduced relative clause. Furthermore, Ying (1996) asserted that discourse

information had greater effects on the ambiguity resolutions than prosodic information did although both discourse contexts and prosodic information had significant effects on the ambiguity resolutions.

In Terauchi, Iino and Tomoe (2010) intended exclusively for Japanese EFL learners, it was suggested that prior discourse information contributed to resolving the ambiguities of stimulus sentences. From these research findings, this hypothesis is formed.

**Hypothesis 2** Discourse information is one of the most significant factors for accurate processing in the resolution of the ambiguity and resolution of complexity among syntactic, semantic and discourse information.

In Terauchi, Iino and Tomoe (2010), it was acknowledged that discourse contexts were recognized as the most important factor in sentence comprehension of stimulus sentences such as garden path sentences with prior discourse contexts functioning as discourse information. On the basis of this research results, this hypothesis is formed.

### 3.2 Hypotheses concerning the significant effects of prosodic information

**Hypothesis 3** Prosodic information is the most important factor for accurate and appropriate processing in the resolution of the ambiguity and complexity among syntactic information, semantic information and prosodic information.

Hypothesis 3 is principally based on Harley, Howard and Hart (1995). This study investigated how prosodic information had significant effects on the ambiguity resolution. As a result, it was considered that ESL learners were inclined to pay more attention to prosodic information than syntactic information. Therefore, this hypothesis is formed.

**Hypothesis 4** Discourse information has greater effects on the ambiguity resolutions and complexity resolutions than prosodic information does.

Ying (1996) investigated and compared significant effects of both discourse information and prosodic information on the ambiguity resolutions. As a result, it was verified that discourse information had greater effects on the ambiguity resolutions than prosodic information did although both discourse information and prosodic information had

significant effects on the ambiguity resolutions. Thus, this hypothesis is formed.

## 4. Research Method

### 4.1 Participants

75 Japanese EFL learners (70 Hosei University students and 5 Hosei Graduate School students) participated in the study.

### 4.2 Stimulus sentences

The significant effects of three variables — the stimulus sentence, the stimulus sentence with prosodic information and the stimulus sentence with prior discourse context — were considered.

#### 4.2.1 Stimulus sentences

Sentence (1), Sentence (2) and Sentence (3) are the ones requiring the closure of phrase or clause in the processes of syntactic parsing. Sentence (4), Sentence (5) and Sentence (6) are defined as the centrally- embedded sentences. Below are the stimulus sentences.

- (1) While the boy scratched the big and hairy dog yawned loudly.
- (2) Without her contributions failed to come in.
- (3) The criminal confessed his sins harmed too many people.
- (4) The cotton clothing is made of grows in Mississippi.
- (5) I told the boy the dog bit Sue would help him.
- (6) The reporter who the senator who I met attacked disliked the editor.

#### 4.2.2 Stimulus sentences with prosodic information

A pause, functioning as prosodic information, was inserted at the point where the ambiguity or the complexity assumed to be resolved. Below are stimulus sentences with prosodic information included.

- (1) While the boy scratched...(pause) the big and hairy dog yawned loudly.
- (2) Without her...(pause) contributions failed to come in.
- (3) The criminal confessed...(pause) his sins harmed too many people.
- (4) The cotton clothing is made of...(pause) grows in Mississippi.
- (5) I told the boy the dog bit...(pause) Sue would help him.
- (6) The reporter who the senator...(pause) who I met attacked...(pause) disliked the editor.

#### 4.2.3 Stimulus sentences with prior discourse context

The appropriate prior discourse contexts were added for each stimulus sentence, with emphasis placed on semantic consistencies or referential relations with the stimulus sentence in order to help the students participated in this study, resolve the ambiguities or complexities. The following underlined stimulus sentences with prior discourse contexts were used in this study.

- (1) ① A boy was bitten by a mosquito in three places. ② While the boy scratched the big and hairy dog yawned loudly.
- (2) ① She played a significant role in collecting contributions in order to establish the museum. ② Without her contributions failed to come in.
- (3) ① The man who set off a bomb on the crowded street was finally arrested by the police. ② The criminal confessed his sins harmed too many people.
- (4) ① Cotton grows in warm climates and is mostly grown in the United States. ② The cotton clothing is made of grows in Mississippi.
- (5) ① A homeless dog bit a boy suddenly, and I recognized that the boy was Sue's brother. ② I told the boy the dog bit Sue would help him.
- (6) ① I met a senator who was angry with a reporter who wrote an article about him, but

actually it was the editor who distorted the truth. ② The reporter who the senator who I met attacked disliked the editor.

### 4.3 Procedure

The participants were given 30 minutes in each of three experiments to work on the stimulus sentences, the stimulus sentences with prosodic information and the stimulus sentences with prior discourse contexts. Each experiment was conducted at intervals of 2 weeks.

#### Experiment 1, single sentence condition:

For each of six stimulus sentences, the participants were required to translate them into Japanese, to write down the processes of translation regarding what kinds of grammar and sentence structure they utilized and what points they tended to mistranslate, and to write down and consider how they comprehended the subject, the verb, the modification, the distinction of the relative clause and the main clause. Participants were permitted to use dictionaries in order to conduct the translation task. After finishing these three tasks for each stimulus sentence, the participants were required to answer the following questions: (1) What was your initial syntactic analysis and/or interpretation of the sentence? (2) What did you do when you recognized that your initial syntactic analysis/interpretation of the sentence was incorrect? (3) Where did you begin with your reanalysis of the sentence?

#### Experiment 2, prosodic information condition:

The participants were requested to listen to each of the same stimulus sentences, with pauses inserted as prosodic information, three times. After listening to each sentence, the participants were required to translate each stimulus sentence into Japanese and to prioritize which of three types of information—syntactic information, semantic information and prosodic information—they used (from most to least often), and then note down the cognitive process of translation which they adopted as concretely as possible.

#### Experiment 3, prior discourse contexts condition:

The participants were required to translate in Japanese each of the same stimulus sentences with prior discourse context and prioritize which of three types of information—syntactic information, semantic information, and prior discourse context information—they had used (from most to least) to come to understand the sentences, and then noted down the process of translation they used.

## 5. Results

### 5.1 Comparison of the stimulus sentences, the stimulus sentences with prosodic information and the stimulus sentences with prior discourse contexts

The average percentage correct translations of the stimulus sentences was 38% for the stimulus sentences without prosodic information and prior discourse contexts, compared to 63% for those with prosodic information and 62% for those with prior discourse contexts.

#### 5.1.1 Stimulus sentences requiring resolution by phrase or clause closure

According to Table 1, in Sentence (1) requiring ambiguity resolution by clause closure, the percentage correct translations of stimulus sentence with prior discourse context was 92%, which was the highest among three conditions. However, in Sentence (2) requiring ambiguity resolution by phrase closure and Sentence (3) requiring ambiguity resolution by clause closure, the percentage correct translations of stimulus sentences with prosodic information were 91% and 55%, which were the highest among three conditions.

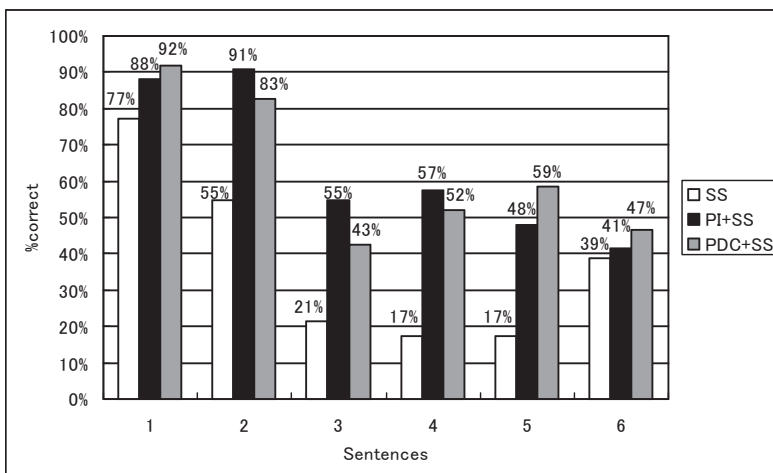
#### 5.1.2 Stimulus sentences requiring the resolution of complexity

According to Table 1, in Sentence (4), the percentage correct translations of stimulus sentence with prosodic information was 57%, which was the highest among three conditions. However, in Sentence (5) and Sentence (6), the percentage correct translations of stimulus sentences with prior discourse contexts were 59% and 47%, which were the highest among three conditions.



Table 1. Comparison of percentage correct translations for stimulus sentences, stimulus sentences with prosodic information and stimulus sentences with prior discourse contexts

Sentence No.	Condition (%correct)			<i>F</i> -value	multiple comparison		
	stimulus sentences	prosodic information + stimulus sentences	prior discourse contexts + stimulus sentences		[SS]– [PI+SS]	[SS]– [PDC +SS]	[PI+SS]– [PDC +SS]
1	77%	88%	92%	4.86		*	
2	55%	91%	83%	31.38	*	*	*
3	21%	55%	43%	20.12	*	*	
4	17%	57%	52%	35.08	*	*	
5	17%	48%	59%	31.11	*	*	
6	39%	41%	47%	1.89			
Total	38%	63%	62%	96.18	*	*	

\* $p < .05$  \*\* $p < .01$ Figure 1. Comparison of percentage correct translations in the three different conditions of stimulus sentences, stimulus sentences with prosodic information and stimulus sentences with prior discourse contexts to sentence processing ( $n=75$ )

SS: Stimulus Sentence      PI: Prosodic Information      PDC: Prior Discourse Context

## 6. Verifications of Hypotheses

**Hypothesis 1** Prior discourse contexts contribute to resolving the ambiguities and complexities of stimulus sentences.

The difference of 24 percentage points between the average percentage correct 38% and 62% for stimulus sentences without and with prior discourse information was statistically significant ( $t=11.00$ ,  $df=449$ ,  $p<.01$ ). From the results, it was verified that prior discourse contexts contributed to resolving the ambiguities or complexities of stimulus sentences. Therefore, Hypothesis1 was supported.

**Hypothesis 2** Discourse information is one of the most important factors for accurate processing in the resolution of the ambiguity and complexity among syntactic information, semantic information and discourse information.

Based on the responses to the questionnaire provided immediately after the translation task, the relative priority was represented as one, two or three points, for low, medium, and high priority, respectively.

The average score for priority of syntactic information was 1.90, that for semantic information was 1.64 and that for prosodic information was 2.35 points. A one-way ANOVA revealed a significant difference between these three average scores ( $F(2,898)=67.91$ ,  $p<.01$ ). Paired comparisons through Bonferroni method showed that the difference between syntactic information and semantic information was significant ( $p<.05$ ), as it was between syntactic information and discourse information and between semantic information and discourse information ( $p<.05$ ).

From these results, it was acknowledged that the participants were likely to make the most use of discourse information in the syntactic processing of sentences with ambiguities or sentences with complexities. Therefore, Hypothesis 2 was supported.

**Hypothesis 3** Prosodic information is the most important factor for accurate processing in the resolution of the ambiguity and complexity among syntactic information, semantic information and prosodic information.

Based on the responses to the questionnaire provided immediately after the translation task, the relative priority was represented as one, two or three points, for low, medium, and high priority, respectively.

The average score for priority of syntactic information was 1.87, that for semantic information was 1.48 and that for prosodic information was 2.56 points. A one-way ANOVA displayed a significant difference between these three average scores ( $F(2,898)=194.22$ ,  $p<.01$ ). Paired comparisons through Bonferroni method showed that the difference between syntactic information and semantic information was significant ( $p<.05$ ), as it was between syntactic information and prosodic information and between semantic information and prosodic information ( $p<.05$ ).

From these results, it was verified that the participants were inclined to put the most importance on prosodic information in the sentences parsing of sentences with ambiguities or sentences with complexities. Therefore, Hypothesis 3 was supported.

**Hypothesis 4** Discourse information has greater effects on the ambiguity resolutions and complexity resolutions than prosodic information does.

The average percentage correct for stimulus sentences without prosodic information and prior discourse contexts was 38%, that for stimulus sentences with prosodic information was 63% and that for stimulus sentences with prior discourse contexts was 62%. A one-way ANOVA revealed a significant difference between these three average points ( $F(2,898)=96.18$ ,  $p<.01$ ). Paired comparisons through Bonferroni method displayed that the difference of average percentage correct between stimulus sentences and stimulus sentences with prosodic information was significant ( $p<.05$ ), as it was between stimulus sentences and stimulus sentences with prior discourse contexts. However, there was no significant difference between stimulus sentences with prosodic information and stimulus sentences with prior discourse contexts.

From these results, it was acknowledged that both the prior discourse contexts and prosodic information contributed to the ambiguity resolutions and complexity resolutions. Although it was not statistically accepted that prosodic information contributed to the ambiguity resolutions and the complexity resolutions more influentially than prior discourse

contexts did. Therefore, Hypothesis 4 was not supported.

## 7. Discussions

From the above results, Hypothesis 1, Hypothesis 2 and Hypothesis 3 were supported.

Through the verification of Hypothesis 1, the results of Ying(1996) that discourse information and prosodic information influenced the ambiguity resolutions and in addition, the results of Terauchi, Iino and Tomoe(2010) that the prior discourse contexts contributed to the ambiguity resolutions were supported.

By the verification of Hypothesis 2, the results of Terauchi, Iino and Tomoe(2010) that the most importance was put on discourse information among syntactic, semantic and discourse information were supported.

On the basis of the verification of Hypothesis 3, the results of Harley et al (1995) that prosodic information contributed to the ambiguity resolutions and more importance was put on prosodic information than syntactic information were supported.

However, Hypothesis 4 was not completely supported. Only 1% difference between 63% correct of stimulus sentences with prosodic information and 62% correct of stimulus sentences with prior discourse contexts did not show the statistical difference. The result was contrary to those of Ying(1996) that discourse information are more effective clues than prosodic information in the sentence parsing of ambiguous sentences. It might be partially influenced by prosodic information which was more effective in clarifying the sentence structure of each stimulus sentence than prior discourse information. That is, in stimulus sentence3 *Without her contributions failed to come in.*, it was verified that there were significant differences between 91% correct of stimulus sentences with prosodic information and 83% correct of stimulus sentences with prior discourse contexts, as there were between 91% correct of stimulus sentences with prosodic information and 55% correct of stimulus sentences and there were between 83% correct of stimulus sentences with prior discourse contexts and 55% correct of stimulus sentences. It can be difficult for Japanese EFL subjects participated in the present research to syntactically process stimulus sentence 3 because 'her

contributions’ has stronger and closer semantic relation and Japanese linguistic property ‘pro-drop language’ leads them to parse ‘*Without her contributions failed to come in*’. as a sentence without a subject.. In stimulus sentence 3, the pause was put after ‘*Without her*’ as prosodic information. It can be considered that this prosodic information helped participants to parse ‘*Without her*’ as a prepositional phrase and ‘*contributions*’ as a subject. Further research needs to be conducted with a view to verify this research hypothesis.

## 8. Implications to TESOL

On the basis of the results of this study, the following three significant implications to TESOL can be considered.

- (1) When Japanese EFL learners meet with an English sentence with the ambiguity regarding principles of closure in reading, instructors should help them to make effective use of syntactic principles of closure which means where phrase or clause starts and where phrase or clause closes. Moreover, when they come across a centrally-embedded sentence with syntactic complexity in reading comprehension, teachers need to help them to make grammar-consciousness-raising to the embedded structure through bracketing the embedded structure in the English sentence and recognizing it.
- (2) When Japanese EFL learners cannot comprehend the meanings of sentences with syntactic ambiguity or syntactic complexity, teachers should help them to consider the meanings of the prior discourse contexts. Moreover, instructors need to ask them induced questions with elicitation on the basis of notice-the-gap principle through thinking of the semantic cohesion between the English sentence and the prior discourse context and making the English sentence syntactically clearer.
- (3) In English interactions with Japanese EFL learners regarding the sentence comprehension, instructors should utilize prosodic information and place a pause on the

part of an English sentence where the ambiguity or the complexity can be resolved. By resolving the ambiguity or the complexity of the English sentence, they lead Japanese EFL learners to recognize the correct syntactic structure of the English sentence implicitly or explicitly and teachers are able to encourage Japanese EFL learners to conduct the appropriate syntactic processing.

## 9. Implications to the further study

In this present study, the data collection was conducted on the basis of offline processing, taking into consideration the proficiency of English of Japanese EFL learners. In our future research, the data collection on the basis of online processing needs to be carried out and both data obtained from offline and online processing should be compared.

Moreover, in this study, the self-paced reading task was conducted and the understanding of syntactic structure was focused on. For the further research, the data obtained from the discourse completion task and the discourse integration task and the data placing more emphasis on production need to be analyzed, and both input data and output data require to be compared.

Furthermore, in order to establish the effective teaching methods on the basis of the second language sentence processing research and the discourse processing research, the measurements intended for Japanese EFL learners with different proficiencies will be conducted regarding the above three main implications to TESOL and teaching methods taking into consideration differences of their proficiencies will be considered.

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