

## Effects of Prosodic Cues and Semantic Plausibility on Japanese Learners of English's Processing of Structurally Ambiguous Utterances\*

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### Abstract

This study examined whether prosody cues and semantic plausibility can facilitate L2 ambiguous English sentence processing. Several studies have shown that prosody disambiguates syntactic structure and facilitates sentence processing in L1 (Snedeker and Trueswell 2003, Snedeker and Casserly 2010), but not in L2. This experiment was conducted to investigate the effect of prosody and semantic plausibility using spoken utterances with pause condition control. The results suggest that both verb bias and semantic plausibility factors are relevant to the processing of ambiguous utterances. In addition, the difference in reaction time was possibly caused by the strength of Garden pass effects depending on the change in thematic domain. Overall, this paper advocates for the necessity of including prosody and semantic effects on L2 structural ambiguity sentences.

### Key words

prosody, semantic plausibility, structural ambiguity, spoken utterances

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## 1. Introduction

This study examines whether prosody cues and semantic plausibility can facilitate L2 ambiguous English sentence processing. In SVO (subject-verb-object) languages such as English, verbs appear relatively early in the sentence and are used as important cues in determining the sentence structure. Garden path (GP) sentences, such as those containing Early/Late Closure, contain temporary structural ambiguities and require reanalysis (e.g., Kjelgaard and Dobroth 1996). Example (1) shows an instance of a GP sentence as follows:

- (1) While the man hunted the deer ran into the woods.

In sentence (1), the NP “the deer” is initially interpreted as an object of “hunted.” However, soon after the verb “ran” appears, parsers reanalyze the sentence structure, as NP “the deer” is not the object but the subject of the subsequent clause. In this process, the verb “ran” involves a reanalysis outside the current thematic domain. Therefore, this type of GP sentence is generally regarded as one involving a “strong” GP effect (Roberts and Felser 2011). In contrast, there is another type of GP sentence, a so-called “weak” GP sentence, where reanalysis occurs within the same thematic domain. As an example of a weak GP sentence, see example (2) below.

- (2) The inspector warned the boss would destroy very many lives.

In addition to the structural factor leading to GP effects, prosody is another factor that disambiguates syntactic structures and facilitates sentence processing in L1 (Snedeker and Trueswell 2003, Snedeker and Casserly 2010). However, few studies have examined the prosody effect on L2 processing. In a sentence like (3) below, the sentence structure can be disambiguated by putting prosodic boundaries after “boy” and “classroom.”

- (3) The boy insulted in the classroom ran away from his friend.

Likewise, semantic plausibility effects are observed in some types of GP sentences as a factor to facilitate sentence processing. However, few studies have examined the semantic plausibility effect in the case of spoken utterances. Based on this background, this study focused on prosody and semantic plausibility effects and investigated them using spoken utterances.

The organization of this paper is as follows: Previous studies regarding the use of prosody and semantic plausibility in L2 learners are discussed in the next section. The experimental procedure is presented in Section 3, followed by the results in Section 4. A general discussion and conclusions are presented in Section 5.

## 2. Previous studies

As I mentioned in the previous section, the effects of prosody and semantic plausibility have not been fully clarified in L2 processing: this phenomenon is worth investigating. Nakamura, Arai, and Harada (2015) is an important study because it investigated prosody effects for L2 learners. These authors used reduced relative clauses with the three conditions in the materials listed below. A prosodic boundary is represented as a comma.

- (4) a. No Prosody: The boy insulted in the classroom ran away from his friend.  
 b. Prosodic Boundary: The boy, insulted in the classroom, ran away from his friend.  
 c. Unambiguous: The boy, who was insulted in the classroom, ran away from his friend.

After the participants listened to a sentence utterance, they were asked to answer a comprehension question. Result showed that prosody was not an important cue for JLEs to activate their comprehension. In addition, even when they reanalyzed the utterance after the disambiguation segment, prosody was not an important factor for them. Although Nakamura et al. provided many insights on prosody in L2 processing, the target sentences were limited to one single type. This means that the results may differ depending on the strength of GP effects. According to the theory of Robert and Felser (2011), all the experimental sentences used in the study mentioned above were reduced relative clause sentences, which have “strong” GP effects. Therefore, it is necessary to compare those results to those of an experiment under the same conditions with a sentence with weak GP effects.

Bando (2016) focused on the effects of subcategorization frequency and semantic plausibility for JLEs by using a self-paced reading task and eye-tracking method. When people read a sentence, they process it unconsciously, anticipating what will follow. English is a language in which sentence structure is determined by verbs. Therefore, verb bias is an important factor in English sentence processing. In Bando’s study, two types of verbs were used in the materials: DO verbs and SC verbs. DO verbs tend to be followed by a direct object, and this tendency is called DO bias. SC verbs tend to be followed by a complement clause, and this tendency is called SC bias. In his experiments, 20 DO and SC verbs were selected based on six previous studies that investigated the effects of verb subcategorization preference for native speakers of English using similar sentence structures. All sentences were weak GP sentences. Examples are shown in (5).

- (5) a. DO verb: The programmer found the error could not be avoided.  
 b. SC verb: The programmer sensed the error could not be avoided.

The results showed that JLEs use DO-plausibility in SC sentences, and that semantic plausibility affects JLEs’ processing. In addition, JLEs are more sensitive to DO-plausibility than are native speakers of English. However, spoken utterances were not analyzed by Bando.

### **3. Experimental Study**

#### **3.1 Purpose of this study**

This study aimed to target other types of GP sentences that have not been identified in previous studies and to see the tendencies in participants’ processing of spoken utterances. The research question was as follows: Can prosody and semantic plausibility cues facilitate L2 ambiguous English sentence processing?

#### **3.2 Participants**

Initially, a total of 55 college students participated in the study. However, 35 of the participants were eliminated because their scores on true/false comprehension questions in the experimental procedure were less than 70% or their average reaction time was more than 3,000ms. Thus, the final number of participants was 20, and they were mostly B2-level English speakers based on the TOEIC IP test.

### 3.3 Materials and procedure

Altogether, 37 experimental sentences with three constructions each were provided for the experiment: the relative clause construction given in (6) (Construction I), the Early/Late closure construction in (7) (Construction II), and the SC/DO structure and semantic plausibility in (8) (Construction III). There were three tokens per condition. In this study, the verbs were selected based on Bando (2016), as shown in Table 1. The sentences were constructed according to Bando's guidelines.

Table 1. List of verbs for each category (cf. Bando 2016)

DO verbs	SC verbs
found	realized
learned	noticed
wrote	believe
accepted	promised
ordered	claimed

In addition to the 37 experimental sentences, 10 filler sentences were presented. For Construction III, eight types of sentences were prepared according to the type of structure and verb, and the presence or absence of semantic plausibility. The utterances were recorded by a native English speaker who teaches English to Japanese university students. Examples are provided below; a prosodic pause is represented as a comma.

- (6) Construction I (Reduced/Unambiguous Relative Clause x With/Without Pause):
- The woman, invited to the party, made a speech. (Reduced, With Pause)
  - The woman invited to the party made a speech. (Reduced, Without Pause)
  - The woman, who was invited to the party, made a speech. (Unambiguous, With Pause)
- (7) Construction II (Early/Late closure x With/Without Pause):
- When she called, her father was out shopping. (Early closure, With Pause)
  - When she called her father was out shopping. (Early closure, Without Pause)
  - When he checked the door, it was locked. (Late closure, With Pause)
  - When he checked the door it was locked. (Late closure, Without Pause)
- (8) Construction III (DO/SC structure x DO/SC verb x Plausible/Implausible):
- The woman found the error could not be avoided. (SCs, DO, Plausible)
  - The woman wrote the potatoes were served to her son. (SCs, DO, Implausible)
  - The man realized the problem had already solved. (SCs, SC, Plausible)
  - The man claimed the childhood could be remembered. (SCs, SC, Implausible)
  - The man believed the report written by the professor. (DOs, SC, Plausible)
  - The man claimed the childhood to be memorable. (DOs, SC, Implausible)
  - The woman learned the language for daily conversation. (DOs, DO, Plausible)
  - The woman accepted the river as the candidate for our camp site. (DOs, DO, Implausible)

Participants responded to a comprehension question presented on the screen after listening to a spoken utterance. This study employed the PCIbex farm. First, the start instruction appeared on the screen. Then, participants were requested to press the space bar to proceed. After participants

listened to spoken utterances, they were asked to answer a true/false comprehension question. Reaction time was collected after listening to the answers to the comprehension question.

#### 4. Results

For Construction I, Reduced/Unambiguous Relative Clause, the results showed that there was no significant difference between the conditions (See Figure 1). This suggests that in Construction I, JLEs did not use prosody information as a cue for processing. In Construction II, Early/Late Closure constructions, there was a statistical interaction between Early/Late Closure and Pause/No\_Pause conditions ( $F(1,19)= 24.72, p < .000^{***}$ , partial  $\eta^2 = .565$ ), as shown in Figure 2. This means that, early closure is relatively easier for JLEs to process. In addition, prosody facilitates in Early closure conditions, but not Late closure conditions. In Construction III, SC/DO biases and semantic plausibility construction, the result was that SC/DO verb and semantic plausibility showed a significant interaction ( $F(1,19)= 8.72, p = .008^{**}$ , partial  $\eta^2 = .315$ ), as Figure 3 shows. Three important points should be considered when describing this result. The first point concerns the general tendencies. In both SC/DO conditions, the reaction time was shorter when DO verbs were used. This means that JLEs tend to interpret a subsequent NP as a DO even if the verb is a SC verb. This result is similar to that in Bando's research on the tendency of the DO bias. Thus, JLEs expand more resources processing SC verbs than DO verbs. The second point concerns semantic plausibility. In both SC/DO structure conditions, the reaction time of DO x Plausibility sentences was the shortest. Therefore, the DO verb condition and plausibility facilitate JLEs' sentence processing. In contrast, in the SC verb condition, there was no interaction depending on semantic plausibility. This means that semantic plausibility is not a relevant factor when SC verbs are used. The last point concerns the characteristics of DO verbs. A significant difference was found in SCs x DO and, DOs x DO. This means that when JLEs interpret the following NP as a DO, they process the sentence relying on plausibility information. This also leads to the conclusion that verb type (DO vs SC) affects processing.

Figure 1: Reaction time (relative clause)

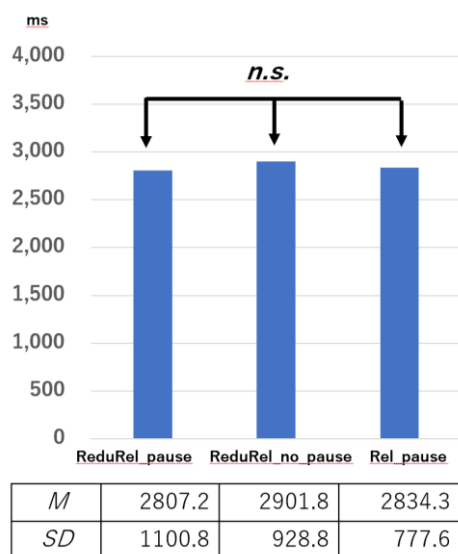
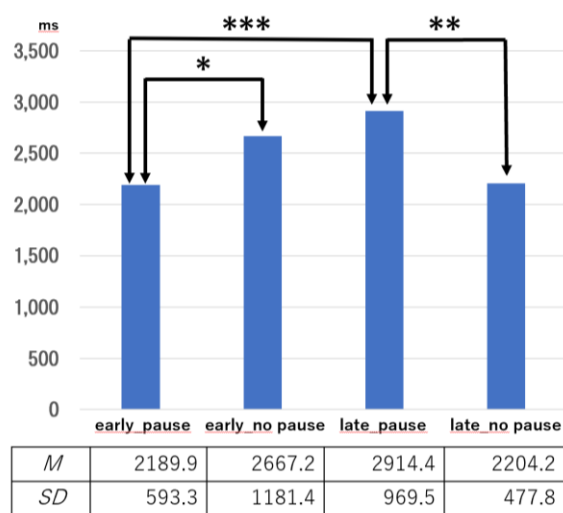


Figure 2: Reaction time (early/late closure)



Note. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

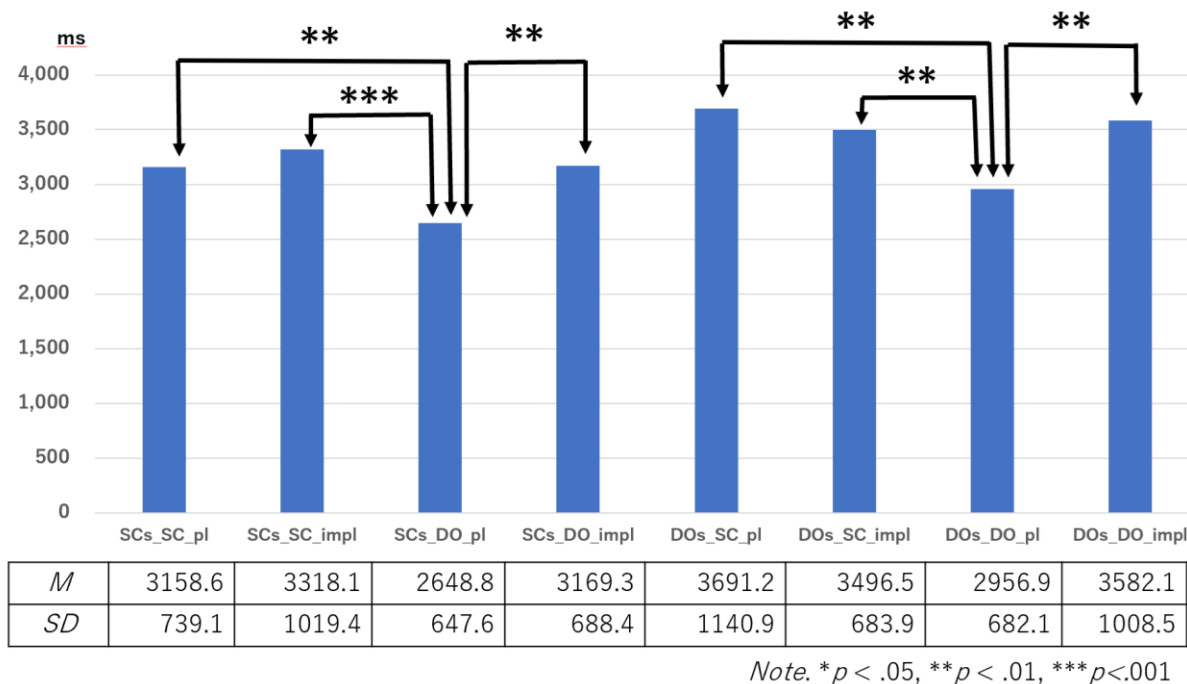


Figure 3: Reaction time (SC/DO interactions)

## 5. General discussion and conclusion

In conclusion, as the answer to the research question, prosody facilitates processing in the Early/Late Closure condition but not in the Reduced/Unambiguous Relative Clause condition. Semantic plausibility is a strong cue for JLEs as they process GP sentences. Verb type and semantic plausibility are more relevant factors than prosody information in the processing of ambiguous utterances.

### 5.1 The thematic domain and its effect on reanalysis

While no significant difference was found in Construction I, a statistical interaction between the Early/Late Closure and Pause/No \_Pause conditions was observed in Construction II. The reason why these two results are different can be explained in terms of the strength of the GP effects. As introduced in section 1, Roberts and Felser (2011) analyzed the differences in reaction time for reanalysis of the NP as the result of the “cost” of reanalysis. That is, the cost is large in the case of the Early/Late closure paradigm because it involves the reanalysis of changing thematic domains before/after the reanalysis, which the reason that the GP effect is strong (See Figure 4). In the case of SC/DO sentences, however, the reanalysis does not change thematic domains to disambiguate NP, leading to a weak GP effect (See Figure 5). The relative clause paradigm in this research might be the case of a weak GP effect, whereas the Early /Late Closure paradigm results in a strong GP effect. The “cost” is determined depending on whether the change of the thematic domain is involved. In reduced relative clause sentences, even if the GP phenomenon occurs, parsers can immediately conduct a reanalysis because the processing cost is low, as the thematic domain does not change. In this way, whether prosody information exists did not matter in the relative clause condition. On the other hand, in Early/Late Closure sentences, reanalysis was triggered by relying on prosody, since the thematic domain changes and the cost is higher than for reduced relative clause sentences. It can be said that the difference in construction properties is influential in

processing in L2.

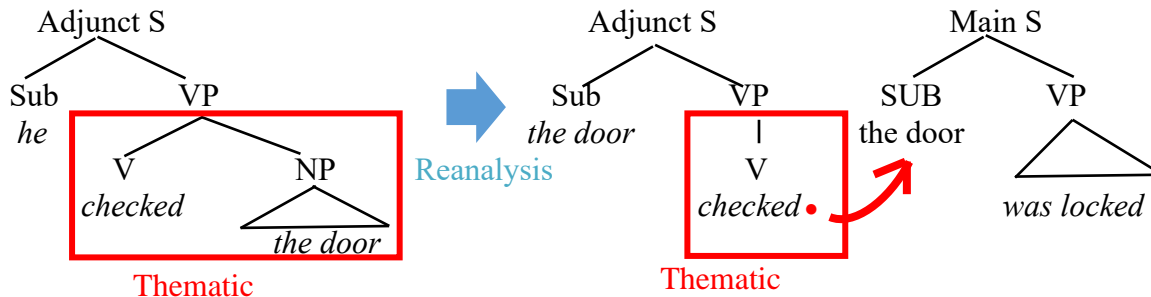


Figure 4: Thematic domain in early/late closure: Strong GP

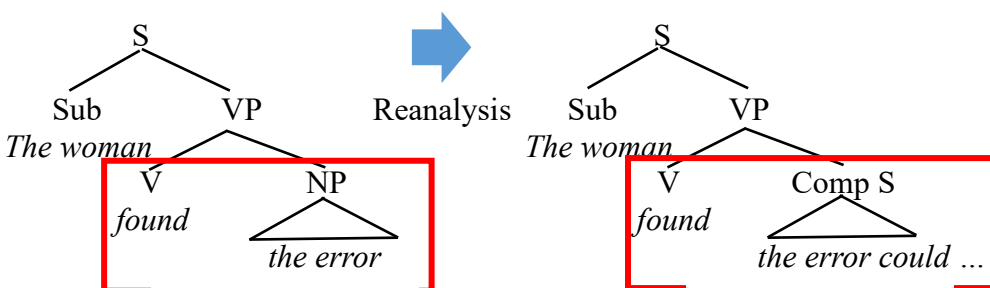


Figure 5: Thematic domain in SC/DO structure: Weak GP

### 5.2 JLEs' preference for DO bias

In the results of Construction III, JLEs' tendency of DO bias which also appeared in Bando, was found. The difference in preference between L2 learners and native speakers has been argued for in several previous studies. Bando (2013) conducted an English sentence completion task with four groups: native speakers of English, high-proficiency earners, intermediate-proficiency learners, and lower-proficiency learners. In this way, he investigated whether the verb combinations and their subcategorization information differ depending on the differences in L1 and proficiency level. The results showed that each group had different preferences for verbs and subcategorization information. For example, the verb "prove" was more often followed by a complement clause in native speakers of English, while it was more often followed by an NP in JLEs. Thus, JLEs may have a DO bias as a default when they process English sentences using verbs as cues. Another possible factor is the difference in the frequency of DO and SC verbs. Similar to Bando, there was a difference in the average frequency rank (based on JACET8000) of the DO and SC verbs used in the current experiment. In this sentence, the following DO verbs were used (The numbers in parentheses indicate rank. Verbs other than "found" are ranks in their original form): found (1,200), learned (240), wrote (216), accepted (514), and ordered (341). In SC verbs, we used realized (724), noticed (473), believed (208), promised (789), and claimed (1192). The average rank of the DO verbs was 287, and that of the SC verbs was 677. From this, it can be seen that DO verbs were more frequently used than were SC verbs, which could be why JLEs are more affected by DO bias.

### 5.3 Limitations and future research

There are three limitations to the current research. First, materials need to be controlled more strictly in terms of the length of the sentence. Second, in this study, we conducted an experiment with 20 JLEs as participants, but we need to increase the number of participants. Finally, we need to conduct replication research involving learners who speak languages other than Japanese and English.

### References

- Bando, Takao. (2013) eibun kansei kadai-ni-yoru dousikaihantyuukajouho-ni kansuru tyousa -DO biasu-to SC biasu-no hattatsuteki henka- (英文完成課題による動詞下位範疇化情報に関する調査 -DOバイアスとSCバイアスの発達的变化-) [An Investigation of Verb Subcategorization Information Using English Sentence Completion Tasks: Developmental Changes in DO Bias and SC Bias]. *Kukurosu: kokusai komyunike-syon ronjuu* (ククロス: 国際コミュニケーション論集) [Kyklos: International Communication] 10, 1-15.
- Bando, Takao. (2016) *The Influence of Verb Subcategorization Information and Plausibility on English Garden-Path Sentence Processing by Japanese Learners of English*. Doctoral dissertation. Graduate school of International Development, Nagoya University.
- Leah, Roberts and Claudia Felser. (2011) Plausibility and recovery from garden paths in second language sentence processing. *Applied Psycholinguistics* 32, 299–331.
- Nakamura, Chie, Manabu Arai, and Yasunari Harada. (2015) Effect of Prosody on Resolving Reduced Relative Clause Ambiguity in L2 Sentence Processing. *Proceedings of the 44th Annual Meeting of the English Language Education of Japan*. 61–68.
- Pritchett, Bradley L. (1992) *Grammatical Competence and Parsing Performance*. Chicago: University of Chicago Press.
- Snedeker, Jesse and Elizabeth Casserly. (2010) Is it all relative? Effects of prosodic boundaries on the comprehension and production of attachment ambiguities. *Language and Cognitive Processes* 25, 1234–1264.
- Snedeker, Jesse and John Trueswell. (2003) Using prosody to avoid ambiguity: Effects of speaker awareness and referential context. *Journal of Memory and Language* 48, 103–130.
- Speer, Shari R., Margaret M. Kjelgaard and Kathryn M. Dobroth. (1996) The influence of prosodic structure on the resolution of temporary syntactic closure ambiguities. *Journal of Psycholinguistic Research* 25, 249–271.