

The High Attachment Preference in Japanese Relative Clause Processing: a Short Summary

Hajime Ono
Tsuda University

1 Introduction

This paper is a short summary of the project from the course LING 394 “Advanced Studies in Linguistics III”, which I am lucky to have a chance to teach at ICU in the past 5 years. Although one term at ICU is, as we all know, just about 10 weeks, I managed to squeeze a project in which students prepare and conduct an actual psycholinguistic experiment, and analyze data they obtain. Of course, they have to write a nice report based on their experiment in the end.

Because we ran the project of the same theme more than once, we gathered a lot of data from the experiments that are basically in the same design. In this paper, I will focus on the data from AY2017 and AY2018, in particular. I will analyze the combined data from those years, but also I would like to examine the data separately because the data were collected during those two years through different methods. In AY2017, the experiment was ran using a software called Linger (developed by Doug Rohde). Students in that year made an appointment with each participant, and s/he worked on the task in a laptop computer in front of the experimenter. On the other hand, in AY 2018, the experiment was done by using a web-based experiment tool Ibex farm (<http://spellout.net/ibexfarm/>, developed by Alex Drummond). Students in that year did not need to actually meet the participants. They sent out an URL for the experiment to their friends by email or LINE, and all they had to do is to wait for the data coming to their folder. How lucky they are! Because the manners of data collection are quite different, I will examine whether there is any difference between the data depending on the way that the data was collected.

In Section 2, I will introduce some more background of the project. In Section 3, the details of the experiment will be explained and I would provide analysis for the data. I will provide a summary in Section 4.

2 Background

This project is concerned with the structural ambiguity illustrated in (1). The relative clause (RC), marked with the square brackets, has two potential attachment sites. When the RC is attached to N1, it is interpreted as (2a), which is called the High Attachment interpretation because the RC is attached to the structurally higher noun. On the other hand, when the RC is attached to N2, it is interpreted as (2b), which is called the Low Attachment interpretation because the RC is attached to the structurally lower noun.

- (1) a. the servant_{N1} of the actress_{N2} [RC who is on the balcony]
b. [RC barukonii-ni iru] jyoyuu_{N2}-no mesitukai_{N1}
balcony-at be actress-GEN servant
- (2) a. The servant is on the balcony.
b. The actress is on the balcony.

It has been observed that native speakers of English have the Low Attachment bias; they preferably interpret (1a) as (2b). Interestingly, native speakers of Spanish, in which the RC structure is virtually identical to English, prefer the High Attachment structure (Cuetos and Mitchell, 1988). Such a cross-linguistic variation is certainly interesting with respect to the underlying processing mechanism that is based on the grammatical properties of the language as well as predictions by the native speakers of a given language.

The experiment in our project was mainly based on the study by Miyamoto, Nakamura and Takahashi (2004)

* I would like to thank the students in the seminar (Mana Asano, Takahiro Asayama, and Michinari Suzuki (from AY2017); Kanako Nagayama and Mana Ashida (from AY2018)), and also the participants for those experiments. I would like to thank Ken Nakatani also for his advice and help for running Ibex farm. All remaining errors are my own. Of course, I would like to acknowledge the generous and continued support from Yoshida sensee. Without his help and encouragement, I would not be doing this job with lots of excitement and joy.

(see Yamada, Arai and Hirose (2017) also as a related study measuring eye movements). Closely following Cuetos and Mitchell (1988), Miyamoto, et al. (2004) compared the reading time of the sentences in the paradigm below (the content of the materials seemed to be taken from Kamide and Mitchell (1997)). Miyamoto, et al. (2004) prepared two conditions. In the High Attachment RC condition, the RC has to be attached to the high noun ‘fingerprint’, while in the Low Attachment RC condition, the RC has to be attached to the low noun ‘the criminal’ due to its semantic content.

- (3) a. High Attachment RC
 hoosekibako-no sumi-ni nokotteita hannin-no simon-o . . .
 jewelry.box-GEN corner-LOC remained criminal-GEN fingerprint-ACC
- b. Low Attachment RC
 gojyudai dansei-to suiteisareru hannin-no simon-o . . .
 50s male-as supposed criminal-GEN fingerprint-ACC
- c. Matrix clause material
 keisatu-ga nantoka mitukedasita.
 police-NOM somehow found
 “The police somehow found the fingerprint of the criminal that was remained at the corner of the jewelry box.”
 “The police somehow found the fingerprint of the criminal that was supposed to be a male in his 50s.”

The critical region was the head noun of the RC ‘the fingerprint of the criminal’. In (3a) and (3b), due to the semantic compatibility, one of the interpretations is forced upon seeing the critical region. Examining the reading time at that region, they should be able to tell whether native speakers of Japanese prefer the High Attachment or Low Attachment RC.

They observed that, in the critical region, the mean reading time in the High Attachment RC condition was longer than that in the Low Attachment RC condition. Furthermore, the reading time pattern flipped in the following matrix clause region. In the matrix clause region shown in (3c), the participants took longer to read in the Low Attachment RC condition than in the High Attachment RC condition. Miyamoto, et al. (2004) suggest that there was an initial Low Attachment preference (i.e., a longer mean reading time in the High Attachment RC condition), but the preference changes toward the end of the experimental sentence.

Although their attempt to figure out the attachment preference in Japanese is quite suggestive, there were some concerns with respect to the materials they used. First, looking at the particular set of target sentences in (3), one may have noticed that the sentence in (3b) is still ambiguous although the Low Attachment interpretation is to be forced in (3b). Under the intended interpretation, the criminal is supposed to be a male in his 50s; unfortunately, (3b) can be interpreted as the fingerprint is supposed to be one from a male in his 50s. It is very crucial to make sure that the target sentence is unambiguous. Other than that, I would like to point out two features of the experimental sentences shown in (4) that may have influenced the results of the experiment in Miyamoto, et al. (2004). As we have seen in (3), the phrases in RCs in the High Attachment and the Low Attachment conditions were quite different. Even within the same pair of target sentences, the parts of speech were also not well controlled. Of course it is not possible to have the completely matched phrases, it would be preferable to use “similar” words and phrases. Also, it seems problematic to have a variety of phrases in the region that is immediately before the critical region. It is well known that, in the self-paced reading paradigm, a reading time slowdown may occur not in the region where the trigger is evident, but in the immediately following region. Such an effect is quite well known as the “spill-over” effect. Note that in the materials in (3), the phrases appearing just before the critical region were not controlled, then the reading time difference observed at the critical region (the head noun of the RC) might be based on some processing difference at the end of the RC regions.

- (4) a. The phrases used in the relative clause were quite different depending on the condition.
 b. The phrase immediately preceding the critical region was not matched.

In order to overcome those problems noted above, we decided to match the phrases in RC as much as possible (see the actual sample set of items in Section 3). In addition, a phrase such as *-to omowareru* ‘be thought that’ was added at the end of RC so that the materials immediately preceding the critical region was completely matched within the target pairs. Therefore, we investigate the structural bias by the native speakers of Japanese with respect to the RC attachment ambiguity using an improved set of target sentences.

3 Experiment

3.1 Participants In the project in AY2017, 52 students, mostly from the ICU community, participated in the experiment. In the project in AY2018, 41 students did so. They are all native speakers of Japanese.

3.2 Stimuli Sixteen sets of target sentence pairs were prepared in AY2017 and AY2018, respectively. Those target sentences were divided into two lists by the Latin Square design, and 35 filler sentences of various types were added to each list. A sample set of target sentence pairs is shown in (5). In Miyamoto, et al. (2004), the whole RC was presented as one region; in our experiment, the RC part was divided into 4 regions. In region 3, we had to use different verbs in order to set up the forced interpretation, but we tried to match the number of characters and length of the verbs within a given pair. For instance, in (5), the verbs in region 3 had two Chinese characters and five kana characters. In region 2, the same noun phrase was used, but they were usually followed by a different Case-marker. Region 1 and 4 were matched in that way within the pair. The number shown at the end of some of the phrases represents the region number.

- (5) a. High Attachment RC
 keesatu-niyoruto kyooki-ni hutyakusiteita-to omowareru₄ . . .
 police-according.to lethal.weapon-to adhere-C was.thought
 “According to the police, (the fingerprint of the criminal) that was thought to be adhered to the lethal weapon . . .”
- b. Low Attachment RC
 keesatu-niyoruto kyooki-o ikisiteita-to omowareru₄ . . .
 police-according.to lethal.weapon-ACC threw.away-C was.thought
 “According to the police, (the fingerprint of the criminal) that was thought to have thrown away the lethal weapon . . .”
- c. . . hannin-no simon-wa₅ hankoogenba-no₆ yokusitu-kara hakkensareta.
 criminal-GEN fingerprint-TOP crime.scene-GEN bathroom-from was.found
 “the fingerprint of the criminal [RC] was found from the bathroom that was the crime scene.”

We also controlled other properties of the materials. The phrases in the critical region (region 5) were compounds *kango* consisting of two or three Chinese characters. We avoid using phrases showing a large category such as *dansee* ‘male’ or *kyosee* ‘female’ because they tend to be non-referential.

Every experimental sentence was followed by a comprehension question asking the content of the sentences they just read. Those questions can be answered by yes or no.

3.3 Procedure As noted in Introduction, the experiment in AY2017 was conducted using Linger, and Ibx farm in AY2018. Usually it takes about less than 30 minutes to complete the experiment. In AY2017, the experimenter went through the instruction and closely watched the participants in the practice session, but in AY2018, the participants were instructed to read the instruction carefully, and go through the practice session by themselves. The contents of the instruction and practice items were identical between those years.

A self-paced reading paradigm was used. The participants were instructed to read the sentence in a phrase-by-phrase manner (i.e., non-cumulative moving-window fashion), by pressing the space bar on the keyboard. They are invited to read the sentence in a natural speed, and to comprehend who is doing what in the sentence. A feedback was given when they wrongly answered the comprehension question.

3.4 Results and Discussions Based on the mean accuracy rates for comprehension questions in the target items, data from one participant (50% accuracy rate) and two items (56% and 51%) were eliminated from the further analyses. That participant and items are from the experiment in AY2018.

Figure 1 showed the mean accuracy rates for the comprehension questions in the target items. There was a significant main effect of YEAR ($F_1(1,90) = 6.05, p < .02$), showing that the participants in AY2018 performed better in general. There was also a significant main effect of ATTACHMENT ($F_1(1,90) = 24.21, p < .01$), showing that the participants answered more accurately for the comprehension questions in the High Attachment RC condition in general than those in the Low Attachment RC condition. Furthermore, there was a significant interaction between the two factors ($F_1(1,90) = 4.28, p < .05$). Planned-pairwise comparisons show that there was a significant effect of YEAR in the Low Attachment RC condition ($p < .01$), but not in the High Attachment RC condition. Also, the effect of ATTACHMENT was significant in both AY2017 and AY2018 ($p < .01$ and $p < .05$, respectively).

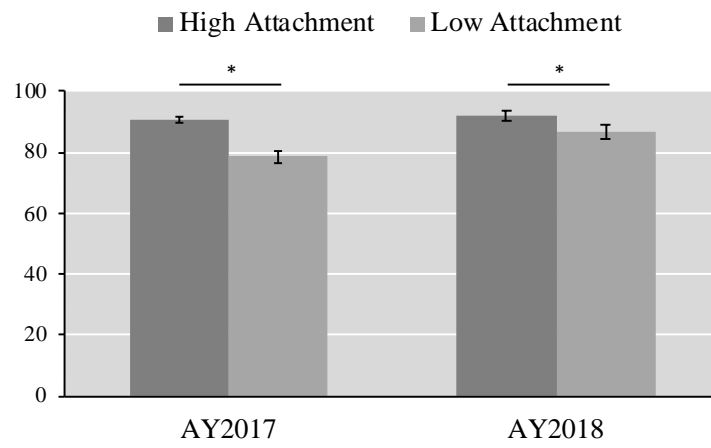


Figure 1. Mean accuracy rates by condition, with standard errors.

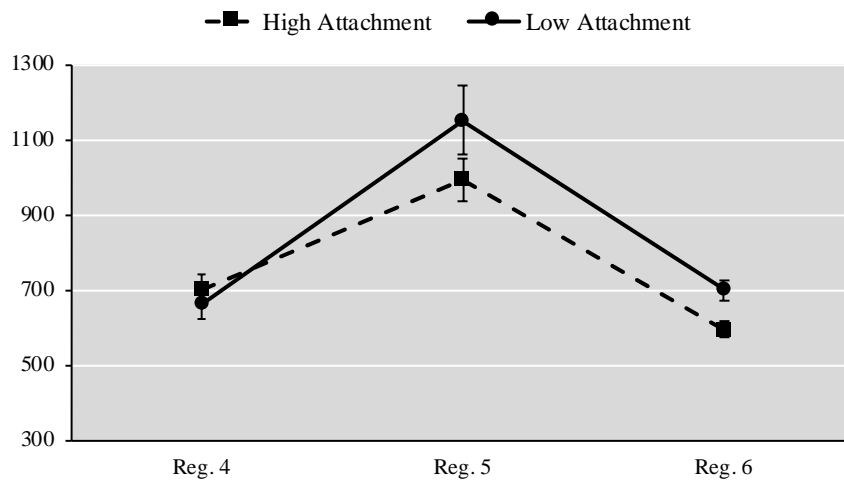


Figure 2. Mean reading time by condition, from AY2017, with standard errors.

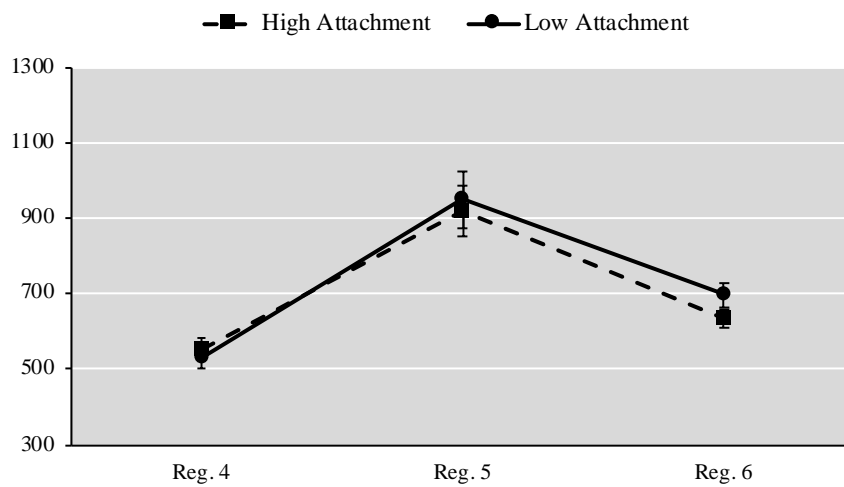


Figure 3. Mean reading time by condition, from AY2018, with standard errors.

The mean reading time data for region 4 through 6 was calculated only from the data where the participants accurately answered the comprehension questions. Furthermore, the reading time data longer than 5,000 ms for the region were eliminated as well. Figure 2 showed the mean reading time for each condition in the experiment from AY2017, and Figure 3 showed the data from AY2018. In region 4 (verb immediately before the RC head noun), the mean reading time from AY2017 was longer than that from AY2018 ($F_1(1,90) = 7.78, p < .01$). There was no significant effect of ATTACHMENT nor interaction. In region 5 (the critical region, the RC head), there was a significant main effect of ATTACHMENT ($F_1(1,90) = 6.61, p < .02$), showing that the Low Attachment condition was read slower than the High Attachment condition in general. Also there was a marginally significant interaction ($F_1(1,90) = 2.94, p < .09$), then planned-pairwise comparisons were conducted. When we analyzed the data from each year separately, it was found that the Low Attachment condition was read slower in the experiment from AY2017 ($p < .01$), but such a pattern was not seen in the experiment from AY2018. There was also a marginally significant effect of YEAR within the Low Attachment conditions ($p < .07$). In region 6 (a spill-over region), there was a significant main effect of ATTACHMENT ($F_1(1,90) = 22.28, p < .01$), showing that the Low Attachment condition was read slower than the High Attachment condition.

In sum, native speakers of Japanese took more time to read the RC head noun (and the following region) when the semantic contents of the RC force them to attach the RC to the lower noun. This suggests that the attachment preference in Japanese is not based on the linear distance between the RC and the head noun. The high attachment preference was also found in Spanish (Cuetos and Mitchell, 1988), and it could be that the consistency of the modification direction is playing an important role. In Spanish, not only RCs, but also adjectives follow the noun which they modify. Cuetos and Mitchell (1988) suggest that such a grammatical property makes the high head noun active even after the noun itself is modified by a PP. Following their suggestions, we could hypothesize that the high noun is active in Japanese due to its strict head-finality. Although there are many interesting issues left unsolved, this grammar-processing interaction may provide some fruitful suggestions to the field.

In comparing two experiments of the identical design, we found some interesting similarities and differences. Although further detailed analyses must be conducted, we observed relatively similar reading time patterns despite of the difference with respect to the data collection method. On the other hand, it is surely too strong to claim, only from the current set of experiments, that participants in the web-based experiments tend to read faster, or the effects get smaller. The current analysis used a very simple data processing (i.e., very simple cut-off, etc.), so a more careful data processing, and of course more experiments, are required to make a strong claim.

4 Conclusion

In this short summary, I have reported the results of the psycholinguistic experiment conducted in LING 394 in AY2017 and AY2018. By using a self-paced reading paradigm, we have shown that Japanese has a High Attachment bias in relative clause processing. Although there still remain a few hypotheses that can account for cross-linguistic variations found in this paradigm, we suggest that a consistent modification directionality might play an important role. We also observed some differences of the data between AY2017 and AY2018, probably due to the way the data was collected. More specifically, the reading times obtained through the web-based program (in AY2018) were shorter than those obtained through the software functioning within the local computer (in AY2017). The participants received the instructions for the experiment in different ways; the participants in AY2017 received the instructions in person while the participants in AY2018 were told to read the instructions on screen (and without any supervision). This could have influenced the way the participants engaged in the experiment. The web-based experiment is certainly very convenient, but each researcher needs to find a way to lead the participants to engage in the task in a good manner.

References

- Cuetos, Fernando, & Mitchell, Don C. (1988). Cross-linguistic differences in parsing: Restrictions on the use of the Late Closure strategy in Spanish. *Cognition*, 30, 73–105.
- Kamide, Yuki, & Mitchell, Don C. (1997). Relative clause attachment: Nondeterminism in Japanese parsing. *Journal of Psycholinguistic Research*, 26, 247–254.
- Miyamoto, Edson T., Nakamura, Michiko, & Takahashi, Shoichi. (2004). Processing relative clauses in Japanese with two attachment sites. In *Proceedings of the 34th annual meeting of the North Eastern Linguistic Society* (Vol. 1, pp. 441–452). Amherst, MA: GLSA Publications.
- Yamada, Toshiyuki, Arai, Manabu, & Hirose, Yuki. 2017. Unforced revision in processing relative clause association ambiguity in Japanese: Evidence against revision as last resort. *Journal of Psycholinguistic Research*, 46, 661–714.

