Subject relative clauses are easier in Japanese regardless of working memory and expectation

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Abstract

As relative clauses are read in Japanese, alternative interpretations are often possible and may interfere in experiments testing factors such as working memory. We report fragment-completion and reading-time data providing evidence that subject-extracted relative clauses are easier to understand than object-extracted relative clauses even when the effects of ambiguity are minimized. The results provide further evidence that working-memory factors cannot explain the comprehension of relative clauses in Japanese and that a different type of factor is involved.

1 Introduction

For some 40 years, working-memory factors have been used to explain the comprehension of relative clauses (RCs) (King & Just, 1991; Gibson, 1998; and references therein). However, in languages such as Japanese (Miyamoto & Nakamura, 2003; Ueno & Garnsey, 2008; inter alia; also, Korean, Kwon et al., 2010), this prediction has been consistently challenged as SRCs are easier to comprehend even though their memory-load should be larger as dependencies are longer than those for ORCs, as shown in (1).

(1) a. SRC: △ Sato-kun-o aisiteita onnanoko (“the girl who loved Sato”)

b. ORC: Sato-kun-ga △ aisiteita onnanoko (“the girl who Sato loved”)

According to expectation-based models, ORCs are harder to understand because they have more competing alternatives (Gennari & MacDonald, 2008, 2009, and references therein). For example, in English, after reading (2a), it is unclear where the extraction position will be. It could be an indirect object as in (2b), the subject in a deeply-embedded clause as in (2c), and so on.

(2) a. the man that Mary…

b. …gave the book to △

c. …said John believes Bill thinks △ bought the book

Alternative interpretations may be particularly problematic in Japanese where continuations other than RCs are often possible. Previous studies have used complex contexts to induce RCs and suppress alternative interpretations. But these contexts used words and constructions repeated from the RC, and sometimes lead to spurious results (see Kwon et al., 2010, footnote 12, for Gibbon’s retraction of Ishizuka, Nakatani & Gibson, 2006).

In sum, the SRC preference in Japanese, Korean and other similar languages, cannot be explained by working-memory. However, RCs (and ORCs in particular) have competing alternative interpretations that may have obscured memory effects in previous experimental results.

We propose a simple context to induce RCs. We report norming results indicating that this type of context strongly favors RCs. We then use this context to provide evidence that there is indeed a preference for SRCs over ORCs in Japanese even when the effects of ambiguity are minimized.

2 Context

In order to bias readers’ interpretation towards RCs, the following context was used. Two people X and Y are talking about photographs they are looking at. X asks “who is this person?” and the crucial RC (either SRC or ORC) is included in Y’s reply.
(3) a. X-san: Kono hito-wa daredesuka?
   (X: “Who is this person?”)
   (SRC: “Y: It is the girl who loved handsome Sato for a while”)  
   (ORC: “Y: It is the girl who handsome Sato loved for a while”)

The context is simple but is enough to lead readers to expect RCs, as discussed next.

2.1 Norming 1
To verify the effectiveness of the context, a fragment-completion questionnaire was conducted with 28 native Japanese speakers who wrote replies to the question “who is this person?” using four types of fragments as the following.

   b. Y-san: Sato-kun-o __________________________ (“Y: Sato-acc”)
   d. Y-san: Sato-kun-o aisiteita __________________________ (“Y: Sato-acc loved”)

A total of 24 quadruples were created and distributed into four lists according to a Latin Square design so that each participant saw only one version of each quadruple.

For both fragments with the NP only (e.g., the nominative-marked NP in (4a) and the accusative NP in (4b)), more than 96% of the completions were RCs, suggesting that the context had the desired effect and favored RC readings.

However, extraction position in the RCs varied. For accusative NPs, 94.05% of the completions were SRC; whereas, for nominative NPs, only 39.29% were ORCs, as predicates subcategorizing for non-accusative objects were often used (e.g., hanasu “talk”, asobu “play”). Therefore, like in English (Gennari & MacDonald, 2008, 2009), ORCs suffer from more competition in Japanese as well, and readers expect various types of predicates after reading the initial nominative-marked NP (e.g., “handsome Sato-nom” in (3b)).

If such competition makes ORCs harder to read, then expectation models predict that difficulty should occur when the disambiguating word (the transitive verb, e.g. “loved”) is read. However, this prediction is not supported by previous reading-time results (e.g., Ueno & Garnsey, 2008, Experiment 1, where SRCs were slower than ORCs at the embedded verb).

Fragments starting with a subject-missing clause (as in (4c)) were completed as SRCs 97.62%, and those with an object-missing clause (as in (4d)) were completed as ORCs more than 83.33% of the time.

2.2 Norming 2
The results of Norming 1 were refined by using longer fragments as the following.

   b. Y-san: Hansamuna Sato-kun-o maekara aisiteita __________________________ (“Y: Handsome Sato-acc for-a-while loved”)

A new group of 20 native speakers completed virtually all fragments as the intended RCs (over 98%). This confirms that the context is constraining enough to lead to RCs in general and to the intended RCs in particular (i.e., SRCs and ORCs).

This suggests that once the embedded predicate is read, participants should favor the intended interpretation. Therefore, differences after the embedded predicate are unlikely to be related to interference from alternative interpretations.
3 Experiment

A self-paced reading experiment was conducted using items based on the fragments from Norming 2, for which no differences in the completions were detected. Hence, reading-time differences after the predicate are unlikely to be marred by expectation.

3.1 Method

3.1.1 Participants

Twenty-six native Japanese speakers, students at the University of Tsukuba, who had not participated in the normings, were paid to participate in the reading-time experiment.

3.1.2 Stimuli

Sixteen pairs of dialogues were used (see (6) for an example pair) with the crucial RCs in (6d) based on the fragments from Norming 2.

(6) a. X-san: Kore-wa dokono syasin desuka? (X: “Where was this photo taken?”)
    b. Y-san: Kanada-no sukiizyo-no syasin desu. (Y: “It is a photo of a Canadian ski resort.”)
    c. X-san: Kono hito-wa daredesuka? (X: “Who is this person?”)
    d. Y-san: Hansamuna Sato-kun-[o/ga] maekara aisiteita onnanoko desu. (Y: “It is the girl who [loved handsome Sato / handsome Sato loved] for a while”)

Working-memory related slowdowns in RCs have been claimed to be more evident with extra memory load (King & Just, 1991). Therefore, the first question (in (6a) about the place or about the time that the photo was taken) was included to increase memory load. Participants had to remember the answer in (6b) for later recall after the dialogue was read. The assumption was that participants had to store the answer while reading the crucial RC in (6d), therefore working-memory related slowdowns should be more evident.

A proper name was used in the embedded clause (e.g., Sato) because it sounded more natural than having a common noun. Another advantage is that it minimizes similarity with the modified noun, therefore decreasing the influence of factors such as confusability in working memory (e.g., Gordon, Hendrick & Johnson, 2001)

An advantage of using the simple matrix clause (e.g., “it is the girl. . .”) is that it avoids possible effects from the matrix clause as it has been claimed that there is a preference to keep the point of view in the matrix and embedded clauses constant (MacWhinney, 1977).

Twenty filler dialogues were created following the general format of the test trials. The RC was replaced by constructions such as genitives (e.g., genkina Yamanakan-san-no se-no-hikui senpai desu. “it is cheerful Yamanaka’s short senior.”) and multiple sentences (Kazuko-san-to iimasu. Kensuke-kun-no obaasan-desu. “Her name is Kazuko. It is Kenksuke’s grandmother.”).

A norming questionnaire was conducted with a new group of 16 native Japanese speakers to make sure that the two interpretations (e.g., “the girl loved handsome Sato for a while” and “handsome Sato loved the girl for a while”) were equally natural. Mean plausibility ratings were included as a factor in the reading time analyses.

3.1.3 Procedure

A moving-window non-cumulative self-paced reading presentation was adopted (using Doug Rohde’s linger program). The context was shown sentence-by-sentence and the crucial sentence region-by-region (the segmentation for the test items is as show in (6d)).

After each dialogue, participants rated the difficulty of reading the dialogue and answered three comprehension questions on successive screens. For the test items, the first question was a forced-choice asking Xsan-wa syasin-o mite, dare-o sasimasitaka. a) Sato-kun b) onnanoko (“who did X point at while
looking at the picture? a) Sato b) the girl”) and tested whether participants could recall which entity was the modified noun. In the second question, the choices were two paraphrases using the clause-internal predicate: a) onnanoko-ga aisiteia “the girl was in love with somebody” b) onnanoko-o aisiteia “somebody was in love with the girl”. Participants typed in the answer to the third question which was about the context (e.g., “where was the photo taken?”).

Mixed-effects models were used to analyze the reading times as well as the responses to the questions (ordinal for the ratings, logit for correct response; by-subject means are reported).

3.2 Results
There were no reliable differences in the 5-point difficulty ratings (SRC: 2.77; ORC: 2.74; p > .6), the first (SRC: 95.67%; ORC: 96.63%; p > .3) or the third comprehension questions (SRC: 73.08%; ORC: 79.33%; p > .2). In the second comprehension question, SRCs (86.54%) were marginally worse than ORCs (92.79% p = .089).

Reading times were included in the analyses if the questions referring to the relative clause (questions 1 and 2) were answered correctly. There were no differences in RC type (ps > .2) except at two points. First, there was a spurious difference in the reading times to the question “who is this person?”, therefore reading times to this region were included as a factor in the crucial analysis of the last region of the sentence in (6d). Backward selection was used to select the best model. Inverse reading times were used as dependent variable, similar trends were observed when untransformed raw reading times were analyzed.

For the last region (desu “is”), SRCs were faster than ORCs (p = .039). Moreover, log of the number of trials was also reliable as participants got faster as the session progressed (p = .002). However, the other two fixed factors included, namely, reading times to the question in (6c) and mean plausibility ratings were not reliable (ps > .17).

4 Discussion
Despite the extra memory load, memory-related difficulty was not detected as SRCs were easier than ORCs. The results are not explained by working-memory or expectation-related factors, but are compatible with proposals suggesting that there is an overall advantage for SRCs over ORCs as the meaning of SRCs is more easily computed when the RC is applied as a statement about the modified noun (Miyamoto & Nakamura, 2012).

References