Delayed attachment commitments for parenthetical relative clauses: An eye-tracking study

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Background: Sentence processing research has only begun to address when not-at-issue-content is integrated into the broader discourse context [1]. Parenthetical relative clauses (ParRCs) offer a rich testing ground for discourse integration, as they permit syntactic attachment ambiguities, much like restrictive relative clauses (ResRCs). However, we propose that the factors guiding the online integration of English ResRCs and ParRCs are distinct. Whereas structural biases (e.g., *Late closure* [2] or *Recency* [3]) are thought to resolve attachment ambiguities for ResRCs early in processing, the processor delays when integrating ParRCs, possibly constructing a preliminary or underspecified parse. We hypothesize that the independent discourse status of ParRCs [4] results in delayed structural integration until information about the discourse properties (e.g. salience) of attachment sites is acquired, thereby allowing early locality preferences to be circumvented during sentence parsing.

In both our norming and the eye-tracking experiment, high and low RC attachment were disambiguated with grammatical number, forcing the RC-internal verb to agree with one of two nouns in a complex object NP, e.g., *brother* (high) or *hosts* (low) in (1).

Offline norming: A **naturalness ratings** task (N=44) found that items with ParRCs (M=5.03, SE=0.08) were rated as more natural than those with ResRCs (M=4.70, SE=0.08) in a linear mixed effect regression model (as below), p<.01, but there was no effect of attachment, p=.59, and no interaction between clause type and attachment, p=.94. In a **fill-in-the-blank task** (N=38) where the RC verb (*was/were*) was replaced with a blank (3), roughly equal high attachment completions were provided for ParRCs (58%) and ResRCs (54%), p=.22. Overall, the two offline norming tasks showed no differences in attachment preferences between ResRCs and ParRCs [vs. 1].

Online processing: In an **eye-tracking experiment** (N=36), half of the experimental items were followed by a non-trivial comprehension question (2) to discourage shallow processing. We excluded participants with comprehension question accuracy below 70%. The overall pattern suggests an early processing asymmetry in attachment sensitivity between ParRCs and ResRCs; see Figure. In LMER models, we observed an interaction between clause type and attachment in first pass times, p<.05. ResRCs showed a penalty for high attachment on the RC verb (*who was/were*) region (diff=63ms), as previously observed for English [e.g., 2]. In ParRCs, high attachment did not increase first pass times on the RC verb (diff=21ms). This interaction is compatible with the hypothesis that the parser immediately resolves attachment for ResRC, but that ParRC attachment may initially be left underspecified, despite disambiguation from grammatical number. There was some suggestive evidence that ParRCs preferred high attachment at a delayed time course. Namely, there was a crossed interaction for first pass times on the sentence-final region (*was really crowded*), with a low attachment penalty for ParRCs (diff=49ms) and a high attachment penalty for ResRCs (diff=67ms), p<.001. The effects on the final region may reflect post-syntactic discourse-integration processes associated with sentence-final "wrap up" processes [5], at which point we hypothesize that ParRCs are fully integrated into the main structure, guided by factors such as discourse salience. We do, however, suspect that participants engaged in shallow processing, as second pass times following the RC verb region were shorter for ParRCs (on NP2 and RC verb) compared to ResRCs, which suggests reduced rereading of the disambiguating material.

Summary: The results suggest that ResRCs and ParRCs yield distinct processing commitments at different stages in sentence processing. We posit that this finding is linked to the discourse status of the two clause types, in that attachment of independent or non-at-issue content (ParRCs) is delayed, a finding that is broadly compatible with Construal Theory [6] and other frameworks in which some elements of a parse may go underspecified in early stages of comprehension.

Materials.

(1) **Sample item** for the naturalness rating and eye-tracking experiments. Plurality of NP1 vs. NP2 was balanced across items.

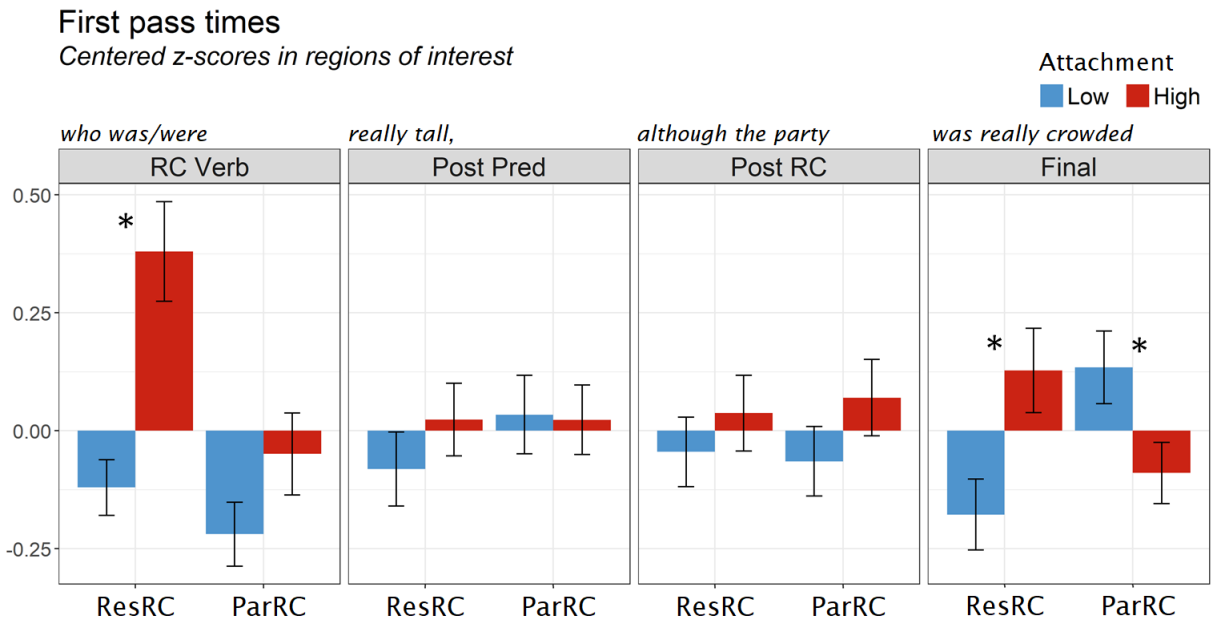
a. **ResRC High:** Everybody met the brother of the hosts who was really tall,
b. **ResRC Low:** Everybody met the brother of the hosts who were really tall,
c. **ParRC High:** Everybody met the brother of the hosts (who was really tall),
d. **ParRC Low:** Everybody met the brother of the hosts (who were really tall),
... although the party was really crowded.

(2) **Sample comprehension question** (in the eye-tracking experiment):
Were the hosts really tall? Yes No

(3) **Sample item** from the fill-in-the-blank offline norming study.

a. **ResRC:** Everybody met the brother of the hosts who ___ really tall, [54% High]
b. **ParRC:** Everybody met the brother of the hosts (who ___ really tall), [58% High]
... although the party was really crowded

Figure: First pass times from the eye-tracking experiment on RC and post-RC regions



References:

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