Mandarin Relative Clauses in the Maze: Expectations over Memory

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Does evidence from the highly incremental maze task support the findings in support of expectation-based accounts of Mandarin relative clause processing from Jäger et al 2015 (JCLLV)[1], and can it provide new insight into the specific regions triggering processing costs?

Background: Processing Mandarin relative clauses (RCs) has been a topic of great interest because two major theories—memory-based and expectation—yield opposite predictions. The memory-based theory [2] predicts an advantage for object relative clauses (ORs) because the distance between the head noun and the gap is shorter. In contrast, expectation theory predicts the opposite, as subject relative clauses (SRs) are more frequent. While cross-linguistically many studies show an SR advantage, findings from Mandarin are mixed between SR advantage (e.g., [3]), and OR advantage (e.g., [4], [5], [6]). [5] used a maze task in an attempt to better localize effects over regions, and found an OR advantage in the relative clause region, but an SR advantage after the relative marker. The maze task has been shown to force more incremental interpretation [7]. However, [5]'s stimuli contained potentially confounding local ambiguities. JCLLV attempted to remove such ambiguities from their stimuli. They found an SR advantage in self-paced reading and eye-tracking, supporting the expectation theory. The results from these methods, however, revealed effects at and after the head noun that were not predicted by expectation- or memory-based accounts. This leaves open the question of the precise linguistic trigger of these effects, which can be hard to isolate in SPRT or eye tracking.

Current Study: For the current study, we aimed to combine the more incremental maze task with the more finely disambiguated stimuli used in JCLLV to address these open questions. In the maze task, participants were asked to choose the best continuation when presented with the target and a low probability distractor/alternative, generated using a Python-based a-maze tool for Mandarin [8]. Based on the JCLLV's findings, we hypothesized that Mandarin RCs would exhibit a SR advantage at the SR/OR disambiguation point; however we did not predict the sustained SR advantage which might be due to spillover or delayed commitment in other tasks.

Methods: After exclusions due to low Lextale vocabulary and other linguistic background criteria, 69 US-based simplified-Mandarin-reading participants raised in China until at least age 15 completed an online Ibex-based [9] A-maze [10] task. The experimental stimuli (32 quadruplets), adapted from JCLLV's eye-tracking study, were split into 4 counterbalanced lists with 64 fillers and use a 2x2 design crossing modification type and RC type (see 1-4 below).

Results and Conclusions: Word-by-word mean RTs around the critical region are summarized in Figs 1 & 2. We focus here on results at the disambiguating region (highlighted in 1-4), where participants first read a noun (SR) or verb (OR) after the adverbial phrase. Following JCLLV, LME models were fit on log-transformed RTs testing for main effects of RC type, Modification type and their interaction. RTs at the disambiguating region were summed to match across RC types. As predicted by the expectation-based accounts, a main effect of RC type (SR advantage) was significant in this sentence region (β = .20, se = .02, p < .001). Nested models also showed significant effects of RC type (SR advantage) within SM and OM conditions (SM: β = .22, se = .04, p < .001; OM: β = .19, se = .03, p < .001). Preliminary results from the post-RC regions suggest an SR advantage specific to subject-modifier RCs starts at the FreqP and fades at the head noun, in contrast with the later effect found in other tasks by JCLLV. These results support the expectation-based account for Mandarin RCs, but do not support their proposal that integration of the head itself might be a source of late expectation-based effects.

Sample Stimuli

1. Subject modifying SR

   Nage   shanggeyue [__ yaoqing-le   nanhai ji-ci   de]   **nuhai** renshi Wang laoshi
   Det-CL last month   invite-Asp   boy   several Rel   girl   know   Wang teacher
   'The girl who invited the boy several times last month knows teacher Wang ….''

2. Subject modifying OR

   Nage   shanggeyue [nanhai yaoqing-le __ ji-ci   de]   **nuhai** renshi Wang laoshi
   Det-CL last month   boy   invite-Asp   several Rel   girl   know   Wang teacher
   'The girl who the boy invited several times last month knows teacher Wang ….''

3. Object modifying SR

   Wang laoshi   renshi   nage   shanggeyue [__ yaoqing-le nanhai ji-ci   de]   **nuhai**
   Wang teacher know   Det-CL last month   invite-Asp boy   several REL   girl
   'Teacher Wang knows the girl who invited the boy several times last month ….'

4. Object modifying OR

   Wang laoshi   renshi   nage   shanggeyue [nanhai yaoqing-le __ ji-ci   de]   **nuhai**
   Wang teacher know   Det-CL last month   boy   invite-Asp   several REL   girl
   'Teacher Wang knows the girl who the boy invited several times last month ….'

Figure 1:   **Figure 2:**

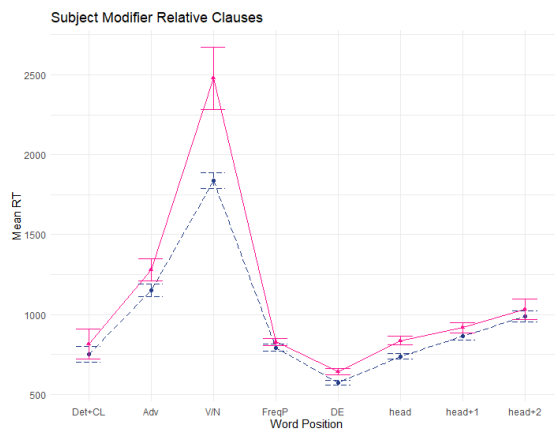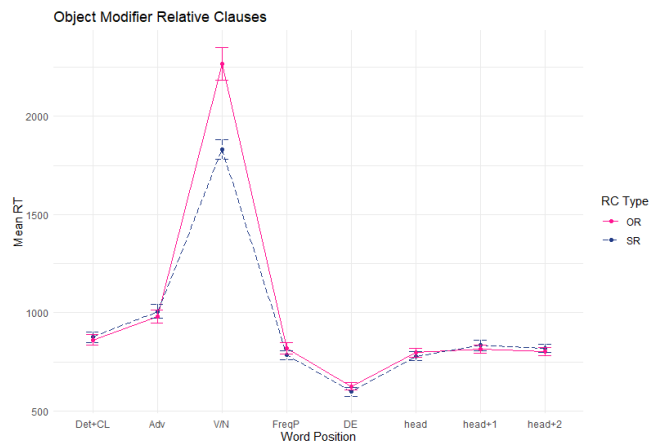Subject Modifier Relative Clauses

Object Modifier Relative Clauses

Selected References: [1] L. Jäger et al. (2015) *Journal of Memory and Lang* vol. 79-80. [2] E. Gibson (2000) In *Image. Lang, brain*. [3] C. Lin, and T. Bever (2006) *Proc. 25th WCCFL*, vol. 25. [4] F. Hsiao, and E. Gibson (2003) *Cognition*, vol. 90, no. 1.[5] X. Qiao et al. (2011) *Lang and Cogn Processes*, vol. 27, no. 4. [6]E. Gibson and H. Wu (2011) *Lang and Cogn Processes*, vol. 28, no.1–2. [7] K. I. Forster, C. Guerrera, and L. Elliot (2009). *Behav. Res. Methods*. [8] L. Levinson et al. (2023) HSP 2023 https://github.com/UMWordLab/multilingual_amaze/ [9] F. Schwarz and J. Zehr, (2021) *Proc. Annu. Meet. Cogn. Sci. Soc.*, vol. 43. [10] V. Boyce, R. Futrell, and R. P. Levy (2020) *J. Mem. Lang.*, vol. 111.