

A large-scale evaluation of bidirectional self-paced reading

Dario Paape & Shravan Vasishth (University of Potsdam)

paape@uni-potsdam.de

In the classic “moving window” self-paced reading paradigm, participants can only proceed forward through the sentence. By contrast, bidirectional self-paced reading (BSPR) allows participants to also move backward through the sentence. This enables the researcher to investigate regression patterns, similarly to eye tracking. Given that regressions in BSPR are made by pressing a key, and thus likely to be under conscious control (Paape & Vasishth, 2021), the paradigm is uniquely suited to studying conscious rereading strategies that participants use when confronted with problematic input, such as garden-path sentences, implausibility, or apparent feature mismatches. In addition, BSPR studies can be easily run over the Internet, which is an advantage during the current COVID-19 pandemic.

Given the novelty of the BSPR paradigm, we are currently conducting a large-scale exploratory evaluation. We selected four manipulations from the psycholinguistic literature (theoretically relevant regions underlined, critical regions boxed, · indicates chunk boundaries):

NP/Z ambiguity (e.g., Mitchell et al., 2008)

(1) ... while · the team · trained(,) · the striker · wondered · whether · the damage · would take long to heal.

RRC ambiguity (e.g., Trueswell, Tanenhaus & Garnsey, 1994)

(2) ... the lawyer/package · sent · by the governor · was neglected · by the officials · in the town hall.

Inter-sentence inconsistency (e.g., Connor et al., 2015)

(3) Rover · barks · at all passing animals · on the street. He's · the most alert puppy/kitten · in the whole neighborhood, · in fact.

Similarity-based interference in reflexives (e.g., Sturt, 2003)

(4) Jennifer/Jonathan · was pretty worried · at the City Hospital. · She/He · remembered · that · the surgeon · had pricked herself · badly · with a used syringe needle.

The manipulations cover a wide array of phenomena: (1) syntactic processing difficulty, (2) interaction of syntactic difficulty and semantic information, (3) world knowledge and discourse integration, and (4) memory-related processing difficulty. All sentence types were combined into one web-based BSPR experiment, which was completed by 100 English native speakers on Prolific. Participants read the sentences chunk by chunk and judged their acceptability.

The results are as follows:

- **NP/Z:** At the disambiguating region (*wondered*), longer first-pass reading times (FPRTs) in the no-comma condition (95% CrI: [166 ms, 237 ms]), plus more regressions (CrI: [2%, 7%]). Longer regressive rereading times (RRTs) on the subject (CrI: [118 ms, 367 ms]) and the verb (CrI: [185 ms, 405 ms]) in the no-comma condition.
- **RRC:** Shorter FPRTs at *by*-phrase for plausible themes versus agents (*package sent* versus *lawyer sent*; CrI: [−186 ms, −78 ms]), fewer regressions from *by*+1 region (CrI: [−4%, 0%]).
- **Inter-sentence inconsistency:** Increased FPRTs and regressive RRTs at inconsistent continuations (*kitten* versus *puppy*; CrIs: [3 ms, 60 ms], [31 ms, 297 ms]), more regressions from *kitten*+1 region (CrI: [0%, 4%]).
- **Reflexives:** Longer FPRTs at the reflexive+1 region in the presence of gender-matching distractor (*Jennifer* versus *Jonathan*; CrI: [1 ms, 69 ms]), plus longer regressive rereading times at reflexive (CrI: [−19 ms, 274 ms]).

All findings are theoretically plausible and compatible with previous results from the eye-tracking literature (assuming inhibitory interference in reflexives is task-related). BSPR can detect processing effects in different domains, including conscious regressions. There was also some indication of selective rereading in NP/Z sentences, as revealed by a scanpath analysis (von der Malsburg & Vasishth, 2011; see **Figure 1**), which frequently resulted in negative grammaticality judgments. We are currently running a direct replication study.

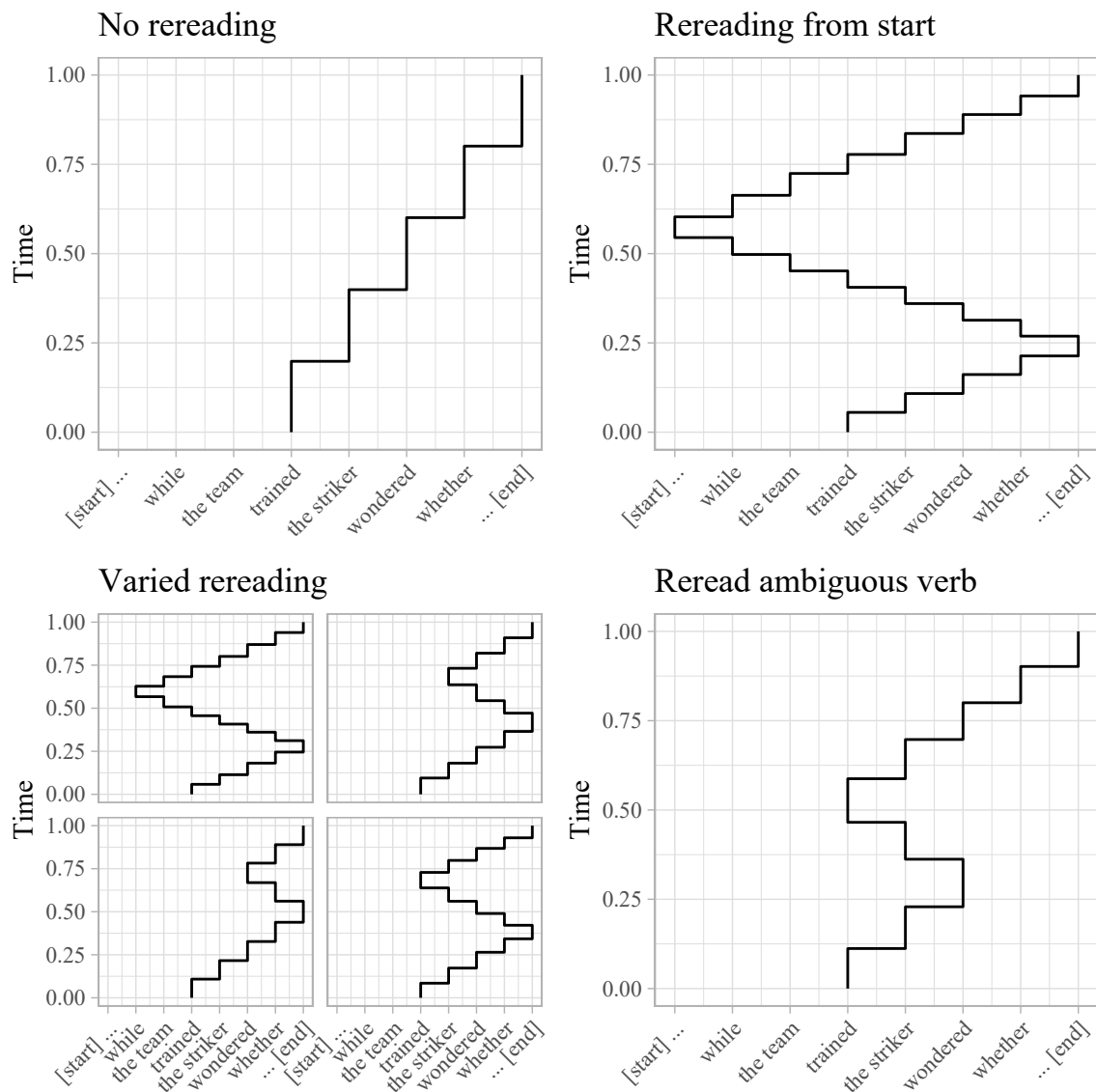


Figure 1: Representative scanpaths from the four scanpath clusters identified for NP/Z sentences. In the no-comma compared to the comma condition, scanpaths were less likely to belong to the “no rereading” cluster, and more likely to belong to the “varied rereading” and “reread ambiguous verb” clusters. Within the latter two clusters, about 75% of grammaticality judgments were negative.

References. Connor et al. (2015). *Scientific Studies of Reading*, 15(2). von der Malsburg & Vasishth (2011). *Journal of Memory and Language*, 65(2). Mitchell et al. (2008). *Journal of Memory and Language*, 59(3). Paape & Vasishth (2021). <https://psyarxiv.com/gnehs>. Sturt (2003). *Journal of Memory and Language*, 48(3). Trueswell, Tanenhaus & Garnsey (1994). *Journal of Memory and Language*, 33(3).