

Subject to search: Sustained search targets subjects, not objects

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Introduction. Cataphoric pronoun dependencies involve a non-local dependency formed between a pronoun (e.g., she, him) and a subsequent, appropriate antecedent. In real-time comprehension, this linking process has been suggested to be predictive. Under an Active Search account, the sentence processor actively anticipates upcoming plausible antecedents to resolve the dependency and suspend the search ASAP [1]. However, in cataphora, there is evidence that the search for antecedents is not suspended but rather sustained [2, 3]. For example, in (1), the first possible antecedent of *she* is the subject *Kathryn/Kevin* where only *Kathryn* matches the gender requirements of the pronoun. Under an Active Search account, the pronoun dependency should be resolved if the antecedent matches the pronoun gender, and no other antecedents should be considered. On the other hand, the Sustained Search account would predict that subsequent possible antecedents should be considered. A previous study found evidence supporting the Sustained Search account [3], whereby gender mismatch effects were observed in the second subject position (Megan/Morty).

- (1) While she was taking classes full-time, {Kathryn/Kevin} was working two jobs and yet {Megan/Morty} was raising four kids.

Note that both of the possible antecedents in (1) are in the subject positions, which are highly predictable positions [2]. This observation leads to the question of whether the parser tries to locate the antecedent in less predictable positions, such as the object position (Megan/Morty) in (2).

- (2) While she was taking classes full-time, {Kathryn/Kevin} was dutifully tutoring {Megan/Morty} for the exam.

A G(rammaticality)-maze experiment [4] tested whether possible subsequent antecedents in pronoun resolution are considered when the antecedent occurs in the object position. The Active Search account predicts that there should not be a difference at the object NP if the subject NP matches the pronoun gender. On the other hand, the Sustained Search account predicts that reading times at the object NP should be slower when both the subject and object NPs match the pronoun gender, as there would be reanalysis to determine which antecedent resolves the dependency.

Experiment. In a G-maze experiment ($n=100$, 24 items, 72 fillers), a 2×2 factorial design manipulated **Subject Match** (Match vs. MisMatch) $\times$ **Object Match** (Match vs. MisMatch), as shown in Table 1. Five participants were removed for extreme reading times throughout the study. The results of the linear mixed effects model (Figure 1) revealed a main effect of **Subject Match** ($\beta = -0.042$, $p < .001$) and **Object Match** ($\beta = -0.027$, $p = .015$) as well as a significant **Subject Match** $\times$ **Object Match** interaction ($\beta = 0.078$, $p < .001$) at the object name region (Megan/Morty). Pairwise comparisons showed that reading times were slowest when both the subject and object mismatched in gender with the pronoun ($\beta = 0.065$, $p < .001$), but there was no difference in reading times in the Subject Match condition ($\beta = -0.012$, $p = 0.43$), suggesting that the object NP was not considered as a potential antecedent.

Conclusion. Given these results and prior work, it appears that Sustained Search may occur in cataphoric dependencies but only in positions that are highly predictable, such as the subject position.

References

- [1] Nina Kazanina, Ellen Lau, Moti Lieberman, Masaya Yoshida, and Colin Phillips. The effect of syntactic constraints on the processing of backwards anaphora. *Journal of Memory and Language*, 56(3):389–409, 2007.
- [2] Anna Giskes and Dave Kush. Processing cataphors: Active antecedent search is persistent. *Memory Cognition*, 49(7):1370–1386, 2021.
- [3] Wes Orth and Masaya Yoshida. Antecedent search is both persistent and sustained, forthcoming.
- [4] Veronica Boyce, Richard Futrell, and Roger P. Levy. Maze Made Easy: Better and easier measurement of incremental processing difficulty. *Journal of Memory and Language*, 111:104082, 2020.

Figures and Tables

Condition	Example
Subject Match/ Object Match	While she was taking classes full-time, <u>Kathryn</u> was dutifully tutoring <u>Megan</u> for the exam.
Subject Match/ Object MisMatch	While she was taking classes full-time, <u>Kathryn</u> was dutifully tutoring <u>Morty</u> for the exam.
Subject MisMatch/ Object Match	While she was taking classes full-time, <u>Kevin</u> was dutifully tutoring <u>Megan</u> for the exam.
Subject MisMatch/ Object MisMatch	While she was taking classes full-time, <u>Kevin</u> was dutifully tutoring <u>Morty</u> for the exam.

Table 1: Example set of experimental stimuli.

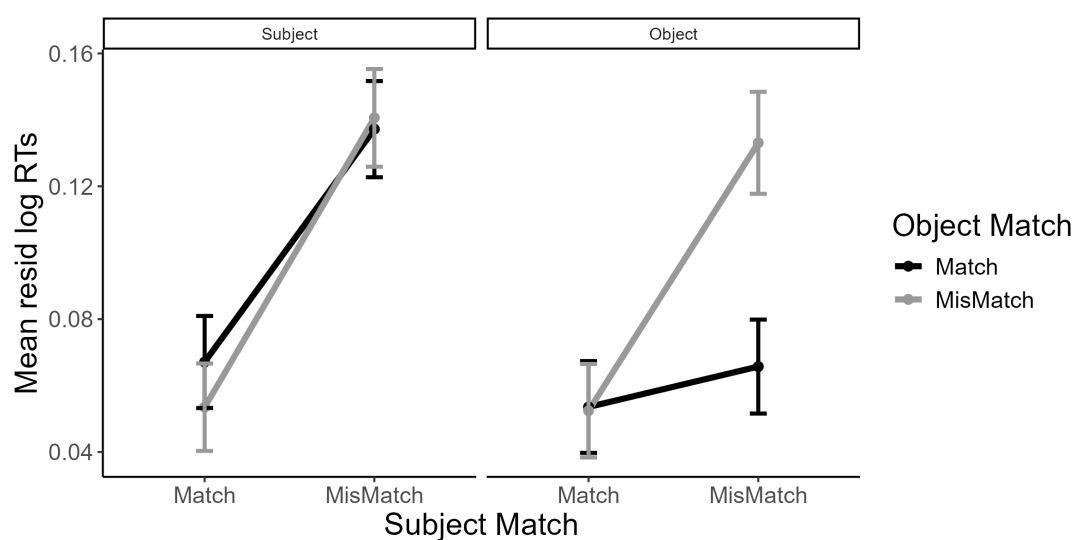


Figure 1: Mean residualized log reaction times at the subject and object regions.