

# Bound-Variables Reveal The Structure-Sensitivity of Search

Dave Kush, Akira Omaki, Brian Dillon, Pedro Alcocer, Jeff Lidz, Colin Phillips  
University of Maryland



## Background

This study uses Bound-Variable (BV) pronoun relations to address a current controversy in the nature of memory retrieval processes in sentence comprehension.

Interference effects are among the phenomena that motivate retrieval processes from cue-based retrieval from content-addressable memory [1,2]. Importantly, such retrieval processes are predicted to show limited structural sensitivity.

Previous studies have shown structure-sensitive retrieval in the case of reflexives, i.e., absence of interference effects in early measures, [3,4,5] but such successes could reflect clause-internal strategies.

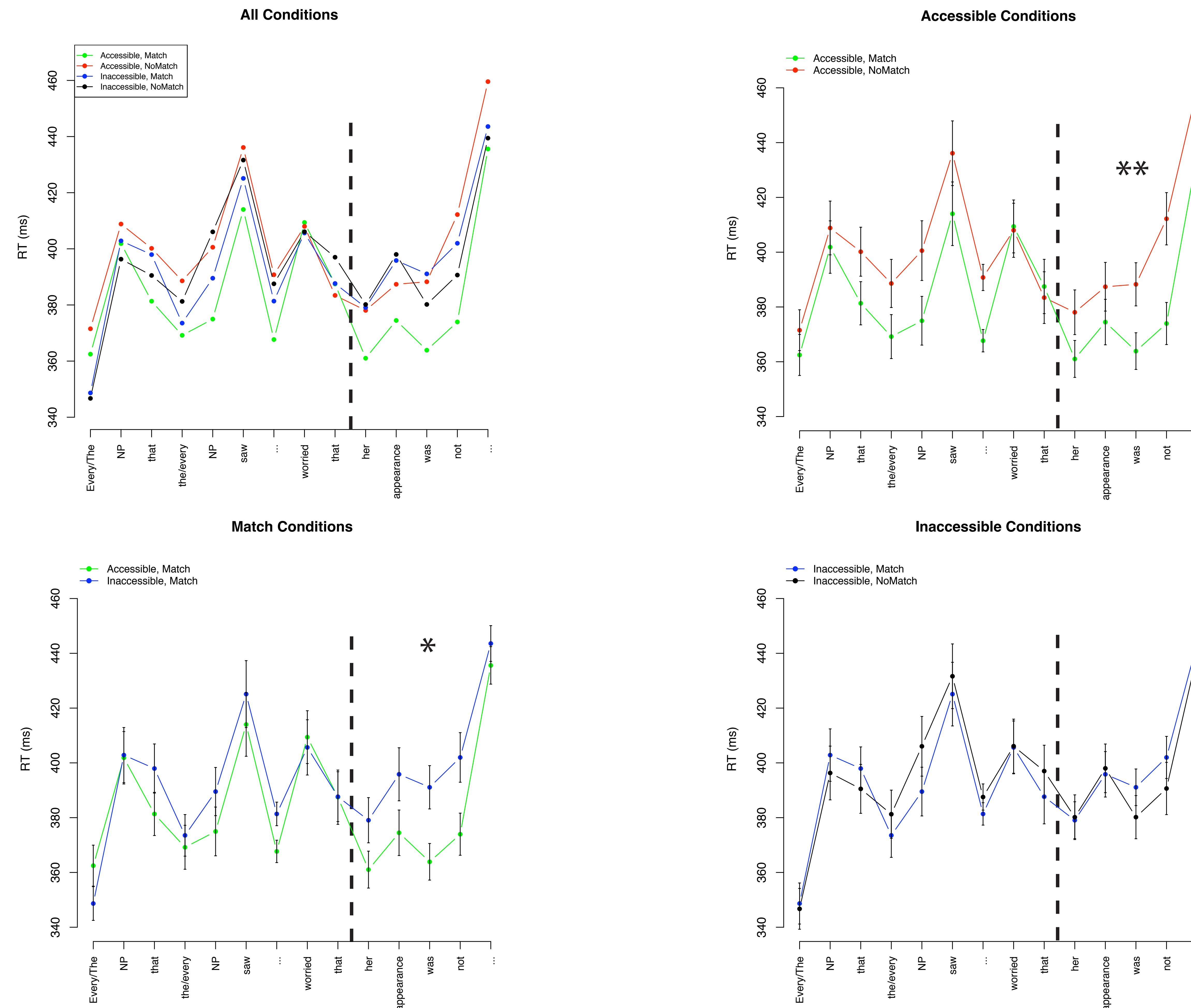
BV dependencies are potentially unbounded in length yet subject to the restriction that the QP antecedent must c-command the pronoun. Hence, they present excellent test cases for the structure-sensitivity of retrieval processes.

- **Every farmer** knows shoppers bought **his** fruit.
- \*The lady who **every farmer** met bought **his** fruit.

### QUESTION:

Is retrieval of antecedents for BV pronouns structure-sensitive or interference-prone?

## Results



SPR times were fit to a linear mixed-effect model, simultaneously controlling for participants and items as random effects.

## Discussion

Baseline differences in the relative clause across conditions can be attributed to complexity effects of i) adjunction of an RC to a definite DP and ii) encoding two feature-matching NPs.

The **[Accessible Match]** condition was read more quickly than all other conditions following the critical pronoun. The difference reached significance 2 words after the pronoun ( $p = .01$ ). No effect of gender within the **INACCESSIBLE** conditions ( $p > 0.16$ ).

At no point was there a significant effect of gender match within the **INACCESSIBLE** conditions, i.e. not even delayed interference.

These findings do not challenge findings of structure-insensitive retrieval [1,2,7], but they raise the question of why some phenomena are more sensitive than others.

## Conclusion

We argue that in certain constructions **configurational information is available as an initial constraint on retrieval processes** and not a “defeasible filter” as sometimes suggested [4].

It is not clear how to capture sensitivity to relational notions such as c-command in models of retrieval from content-addressable memory.

## References

- [1] Lewis, Richard L., and Shrvan Vasishth. 2005. *Cognitive Science* 29:375-419.
- [2] Vasishth, Shrvan et al. 2008. *Cognitive Science*, 32:685-712.
- [3] Sturt, Patrick. 2003. *Journal of Memory and Language*, 48:542-562.
- [4] Nicol, Janet, and Swinney, David. 1989. *Journal of Psycholinguistic Research* 18:5-19.
- [5] Xiang et al. 2008. *Brain and Language*, 108: 40-55.
- [6] Evans, Gareth. 1980. *Linguistic Inquiry* 11:337-362.
- [7] Wagers, M., Lau, E., Phillips, C. In Press. Agreement attraction in comprehension: representations and processes. *Journal of Memory and Language*.
- [8] Badecker, William, and Kathleen Straub. 2002. *Journal of Experimental Psychology*, 28:748-769.

### Acknowledgments:

Thanks to the participants of LING 641 in Spring 2008 for discussion of design and to Ann Gagliardi, Norbert Hornstein, Bill Idsardi, Ellen Lau and Terje Lohndal for helpful comments. This work was supported in part by NSF IGERT award DGE-001465 to the U of Maryland. For further information, please contact Dave Kush: [kush@umd.edu](mailto:kush@umd.edu)

## Experimental Design

QP-POSITION      QP-GENDER  
{ ACCESSIBLE | INACCESSIBLE } x { MATCH | NoMATCH }

### [Accessible Match]

Every boy [that the majorette saw at the parade] worried that his appearance was not very appealing.

### [Inaccessible Match]

The majorette [that every boy saw at the parade] worried that his appearance was not very appealing.

### [Accessible NoMatch]

Every girl [that the majorette saw at the parade] worried that his appearance was not very appealing.

### [Inaccessible NoMatch]

The majorette [that every girl saw at the parade] worried that his appearance was not very appealing.

Sentences contained one of two quantifiers { every | no } and matching NPs were strongly-gender biased, or inherently gendered. Sentences were constructed to avoid e-type readings. [6] Object relatives were employed to ensure both licit and illicit antecedents were subjects. Genitive pronouns were used to avoid effects of parallel grammatical function between subjects and antecedents, and ii) to increase the length of the spillover region.

## Predictions

### Structure-Sensitive Retrieval:

A contrast due to accessible gender should be visible in the RTs at first sign of search in critical region. RTs in **[Accessible Match]** should diverge from all other conditions. RTs in **[Inaccessible Match]** should track NoMATCH conditions.

### Structure-Insensitive Retrieval:

RTs in critical region should show sensitivity to gender of inaccessible subject NP. In **[Inaccessible Match]** RTs should differ from NoMATCH conditions. Differences may still exist between **[Inaccessible Match]** and **[Accessible Match]**.