Testing the real-time status of covert movement of wh-operators and QPs in English

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Introduction

- Syntax/semantics literature proposes that *in-situ wh*Ps and QPs **covertly move** to their scopal position [1,2,3,4].

- *wh*Ps move to fix scope; QPs move to a low position (Spec,*v*P) due to type mismatch [4]

- In processing, Mandarin Chinese speakers experience **interference** with multi-clausal sentences upon encountering an *in-situ wh*P [5,6]

- This implies that a **cue-based** memory retrieval mechanism is used to discover scope position for the *wh*P [7,8,9]; partial-matching Spec,CP positions cause interference

- But, processing of ACD constructions in English shows that QPs and *in-situ wh*Ps move to Spec,*v*P by the end of the sentence [10]

Q: Is a cue-based retrieval mechanism used to find scope position for *in-situ wh*Ps in English? What about QPs?
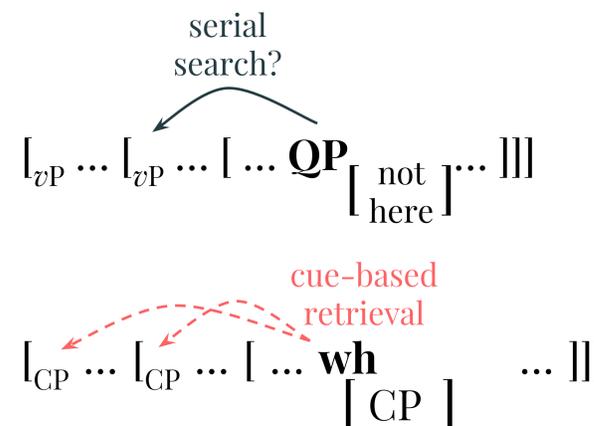

More scope positions ⇒ more difficulty?
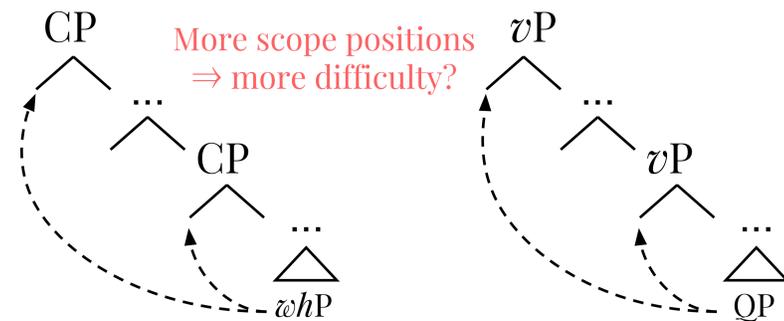
- **Hypothesis One:**
  - Covert movement happens to fix scope:
    - Cue-based search: More scope positions, **more interference for *wh*Ps and QPs**
    - Increased RTs for sentences with more CPs/*v*Ps

- **Hypothesis Two:**
  - *wh*Ps target Spec,CPs for scope; QPs just need to move! [4, 10]
    - Cue-based search for *wh*Ps
    - No differences for QPs (⇒ **serial search**?)

References: [1] May, R. 1977. MIT PhD Thesis. [2] May, R. 1985. *Logical Form: Its Structure and Derivation*. Cambridge: MIT Press. [3] Hornstein, N. 1999. In *Working Minimalism*, MIT Press. [4] Fox, D. 2000. *Economy and Semantic Interpretation*. Cambridge: MIT Press. [5] Xiang, M., B. Dillon, M. Wagers, F. Lin, T. Guo. 2014. *Journal of East Asian Linguistics* 23. [6] Xiang, M., S.P. Wang., Y.L. Cui. *Journal of Memory and Language* 84. [7] McElree, S. Foraker, L. Dyer. 2003. *Journal of Memory and Language* 48. [8] van Dyke, J., R. Lewis. 2003. *Journal of Memory and Language* 49(3). [9] Lewis, R., S. Vasishth. 2005. *Cognitive Science* 29(3). [10] Kotek, H., M. Hackl. 2013. MIT Ms. **Acknowledgments:** Jason Overfelt, MSPLab, Trey Sorensen, Annika Kohrt, Peter O'Neill.
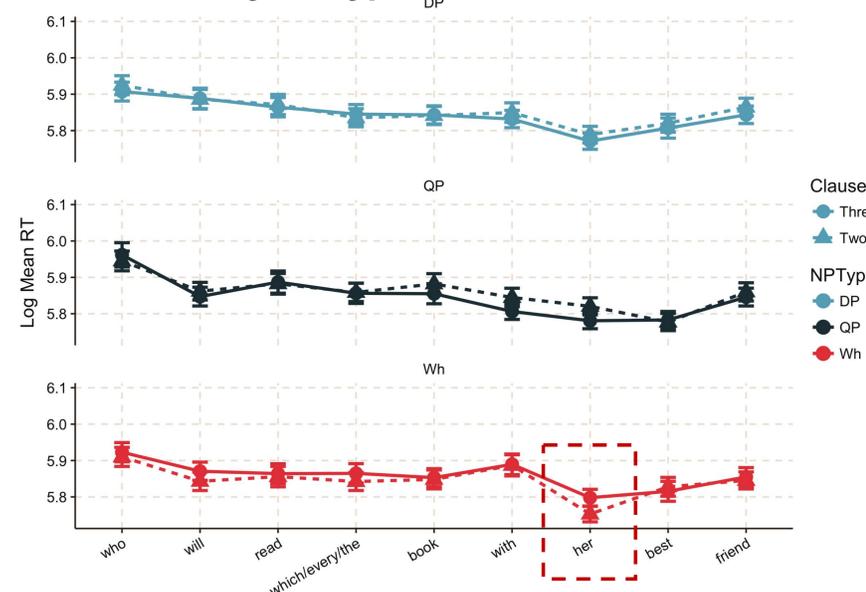
Experiment

- $\mathcal{N}$ = 48; self-paced reading task
- 36 items, 48 fillers (100% grammatical)
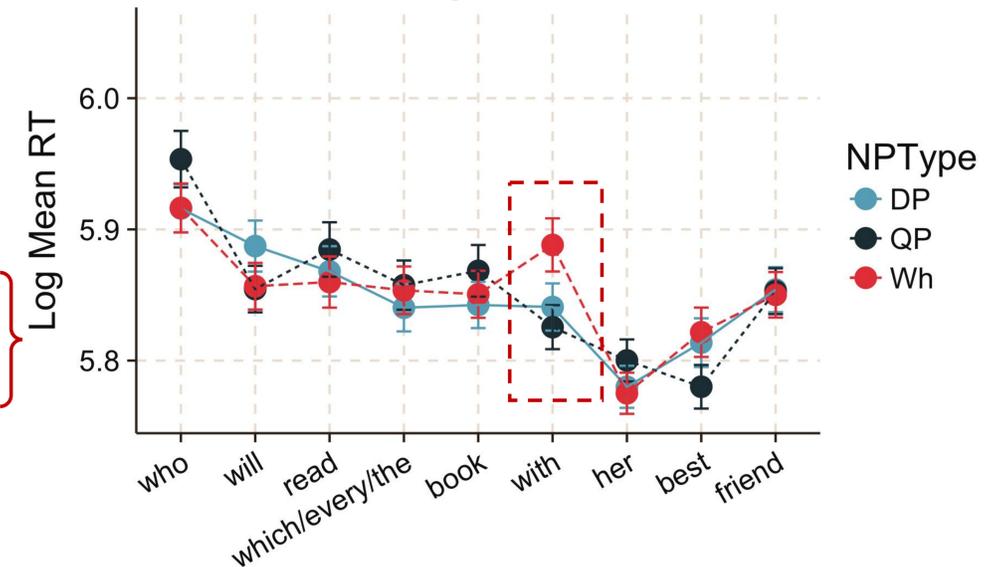- {2 clauses, 3 clauses} × {DP, QP, *wh*P}

{ According to John, / John [$_{v}$P said [$_{CP}$ that } the student

[$_{v}$P wondered [$_{CP}$ who will [$_{v}$P read { the / **every** / **which** }

book with her best friend at the library.

serial search?

[$_{v}$P ... [$_{v}$P ... [... **QP** [not here] ...]]]

cue-based retrieval

[$_{CP}$ ... [$_{CP}$ ... [... **wh** [CP] ...]]]

Results, by NPType

Results, Collapsing over Clause

- 2 (sum-coded) LMEMs at spillover regions; only RTs 200–5000ms included
  `Log RT ~ Clause * NPType + (1|Subject) + (1|Item)`
- At *with*...
  - **wh**P conditions are longer than **QP** or **DP** conditions
    (Main effect of NP:+WhP; β = 0.06±0.03, $t(1306)$=2.34, p = 0.02; Pairwise comparisons with Tukey adjustment: WhP > DP and QP; ps < 0.03)
  - *wh-in-situ* harder than QP or DP
- At *her*...
  - No main effects or interaction effects (all ps > 0.05)
  - Marginal 3 Clause vs. 2 Clause contrast within **wh**P
    (Pairwise comparisons with Tukey adjustment: 3 Clause – 2 Clause; β = 0.04±0.02, $t(1308)$ = 1.93, p = 0.054; all other ps > 0.05)
  - More clauses ⇒ more difficulty for *in-situ wh*Ps

A: *In-situ wh*Ps recruit **cue-based memory retrieval** for scope positions; QPs do not!

Conclusions

- *In-situ wh*Ps are **harder** to process than QPs or DPs: May be due to the need to identify a scope position for *in-situ wh*P

- Adding more clauses increases difficulty for *in-situ wh*Ps, suggestive of **cue-based memory retrieval**, as in Mandarin [5,6]

- Covert movement of QPs shows no effect of clause number, no differences from DP control: **covert movement of QPs = serial search?**