Constructing Wh-in-situ Dependencies

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Wh-in-situ construction

警察 保护了 哪个人?
police officer protect which man?
"**Which man** did the police officer protect?"

约翰 想知道 警察 保护了 哪个人.
John wonder police officer protect which man.
"John wondered **which man** the police officer protected."

Building a wh-in-situ dependency

A dependency needs to be constructed between the in-situ wh-phrase and its scope position

[$_{CP}$ $_{+Q}$ [the police officer protected which man?]]

John wondered [$_{CP}$ $_{+Q}$ [the police officer protected which man]]

(Huang, 1982; Li, 1992; Aoun & Li 1993; Tsai 1994; Cheng, 1991; 2003)

The distance effect

Retrieving the scope position is costly if there is an intervening clause boundary

…wonder[$_{CP1}$……WH]] **easy**

…wonder[$_{CP1}$…….V[$_{CP2}$……WH]] **hard**

Xiang, Wang & Cui, 2015, JML

The distance effect

Retrieving the scope position is costly if there is an intervening clause boundary

…wonder[$_{CP1}$……WH]] **easy**

Mr. Wang **wonder** [$_{CP1}$the construction team rebuild **which dam**]

"Mr. Wang **wondered** ***which dam*** the construction team rebuilt."

…wonder[$_{CP1}$…….V[$_{CP2}$……WH]] **hard**

Mr. W. **wonder** [$_{CP1}$construction-team **know** [$_{CP2}$ villagers rebuild **which dam**]]

"Mr. W. **wondered** ***which dam*** the construction-team **knew** the villagers rebuilt."

Xiang, Wang & Cui, 2015, JML

The distance effect

Retrieving the scope position is costly if there is an intervening clause boundary

…wonder[$_{CP1}$……WH]] **easy**

…wonder[$_{CP1}$…….V[$_{CP2}$……WH]] **hard**

…wonder[$_{CP1}$…….V[$_{vP}$……WH]] **easy**

Mr. W. **wonder** [$_{CP1}$construction-team **lead** [$_{vP}$ villagers rebuild **which dam**]]

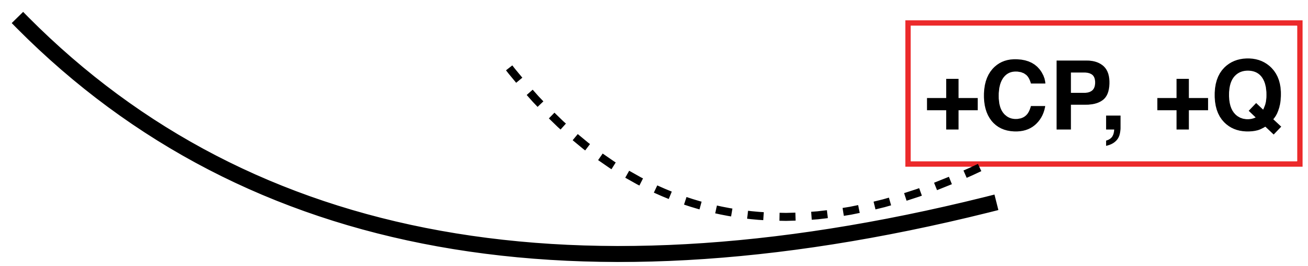
"Mr. W. wondered [$_{CP1}$ ***which dam*** the construction-team led [$_{vP}$ the villagers to rebuild]]"

Xiang, Wang & Cui, 2015, JML

The distance effect

Modeled under the general cue-based memory retrieval framework (e.g. Lewis & Vasishth 2005; Van Dyke & McElree 2006)

…wonder[$_{CP1,+Q}$…….V[$_{CP2}$……WH]]



retrieval cues

Similarity based interference

Xiang, Wang & Cui, 2015, JML

Incrementally encode the predictive +Q feature

…wonder[$_{CP,\ +Q}$…….]

✗ John **wondered** the police protected that man.

✓ John **wondered** which man the police protected.

Incrementally encode the predictive +Q feature

…wonder[$_{\text{CP, +Q}}$…….]

…wonder[$_{\text{CP, +Q}}$…….*WH*]

+CP, +Q retrieval cues

What happens when there is no predictive +Q feature encoded……

…find out [$_{CP,\ -Q}$ ……]

Preferred

✓ John **found out** the police protected that man.

✓ John **found out** which man the police protected.

What happens when there is no predictive +Q feature encoded……

…find out [CP, -Q ……]

…find out [CP, +Q ……*WH*]

Reanalyzing whether the clause boundary position could be +Q

What happens when there is no predictive +Q feature encoded……

✓ John **believed** the police protected that man.

✗ John **believed** which man the police protected.

…**believe** [$_{CP,\ -Q}$ …… *WH*] **Wrong !!!!**

Reanalysis failure if the relevant verb is incompatible with a +Q clause complement

Today's question:

- ✦ What exactly is the processing advantage of having a predictive feature "+Q"?
- ✦ The answer to this question contributes to a more precise understanding of the role of prediction in sentence comprehension.

To preview the findings

- An early encoded **predictive** “**+Q**” feature guides the later memory retrieval to directly target the relevant scope position, even when the scope position is distant.
- Without the predictive +Q feature, the retrieval process takes a different **“locality/recency” strategy**: the most recent clause boundary is examined before the further away clause boundaries are examined

Experiment 1

Conditions with an early +Q feature encoded

…wonder[$_{\textbf{CP, +Q}}$…

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conditions with an early +Q feature encoded

…wonder[CP, +Q…

Multiclausal-CP2+Q

…wonder[**CP1, +Q**… know[**CP2, +Q** ... ***WH***]]

Multiclausal-CP2-Q

…wonder[**CP1, +Q**… believe[**CP2, -Q** ... ***WH***]]

Experiment 1:
conditions with an early +Q feature encoded

…wonder[CP, +Q…

…wonder[**CP1, +Q**… know[**CP2, +Q … *WH***]]

…wonder[**CP1, +Q**… believe[**CP2, -Q … *WH***]]

…wonder[**CP1, +Q**… lead[**vP … *WH***]] **Monoclausal-long**

…wonder[**CP1, +Q**… ***WH***]] **Monoclausal-short**

Experiment 1: stimuli example

Matrix V "wonder" type

小王 想弄明白 工程队 知道 村民们 扩建了 哪座水坝.
Mr. W. **wonder** construction-team **know** villagers rebuild **which dam**
"Mr. W. wondered **which dam** the team **knew** the villagers rebuilt."

Multiclausal-CP2+Q

小王 想弄明白 工程队 相信 村民们 扩建了 哪座水坝.
Mr. W. **wonder** construction-team **believe** villagers rebuild **which dam**
"Mr. W. wondered **which dam** the team **believe** the villagers rebuilt."

Multiclausal-CP2-Q

小王 想弄明白 工程队 带领 村民们 扩建了 哪座水坝.
Mr. W. **wonder** construction-team **lead** villagers rebuild **which dam**
"Mr. W. wondered **which dam** the team **led** the villagers to rebuild."

Monoclausal-long

小王 想弄明白 工程队 扩建了 哪座水坝.
Mr.Wang **wonder** construction-team rebuild **which dam**
"Mr. Wang wondered **which dam** the construction team rebuilt. "

Monoclausal-short

Experiment 1:
conditions **without** an early +Q feature encoded

…find out [$_{CP1,-Q}$ … know[$_{CP2,-Q}$…]]

Experiment 1:

conditions **without** an early +Q feature encoded

…find out [$_{\mathrm{CP1,-Q}}$ … know[$_{\mathrm{CP2,-Q}}$ … ***WH***]]

Reanalysis

…find out [$_{\mathrm{CP1,+Q}}$ … know[$_{\mathrm{CP2,+Q}}$ … ***WH***]]

? ?

Globally ambiguous

Experiment 1:

conditions **without** an early +Q feature encoded

…find out[$_{\textbf{CP1, +Q}}$… know[$_{\textbf{CP2,}\ \textbf{\textit{+Q}}}$ ... ***WH***]]

…find out[$_{\textbf{CP1, +Q}}$… believe[$_{\textbf{CP2,}\ \textbf{\textit{-Q}}}$ ... ***WH***]]

Experiment 1:
conditions **without** an early +Q feature encoded

…find out[$_{CP1,\ +Q}$… know[$_{CP2,\ +Q}$ ... ***WH***]]

…find out[$_{CP1,\ +Q}$… believe[$_{CP2,\ -Q}$ ... ***WH***]]

…find out[$_{CP1,\ +Q}$… lead[$_{vP}$ ... ***WH***]]

…find out[$_{CP1,\ +Q}$… ***WH***]]

Experiment 1: stimuli example

Matrix V “find out” type

小王 打听到 工程队 知道 村民们 扩建了 哪座水坝.
Mr. W. **find out** construction-team **know** villagers rebuild **which dam**
“Mr. W. found out **which dam** the team **knew** the villagers rebuilt.”

Multiclausal-CP2+Q

小王 打听到 工程队 相信 村民们 扩建了 哪座水坝.
Mr. W. **find out** construction-team **believe** villagers rebuild **which dam**
“Mr. W. found out **which dam** the team **believe** the villagers rebuilt.”

Multiclausal-CP2-Q

小王 打听到 工程队 带领 村民们 扩建了 哪座水坝.
Mr. W. **find out** construction-team **lead** villagers rebuild **which dam**
“Mr. W. found out **which dam** the team **led** the villagers to rebuild.”

Monoclausal-long

小王 打听到 工程队 扩建了 哪座水坝.
Mr.Wang **find out** construction-team rebuild **which dam**
“Mr. Wang found out **which dam** the construction team rebuilt. ”

Monoclausal-short

Experiment 1 procedure

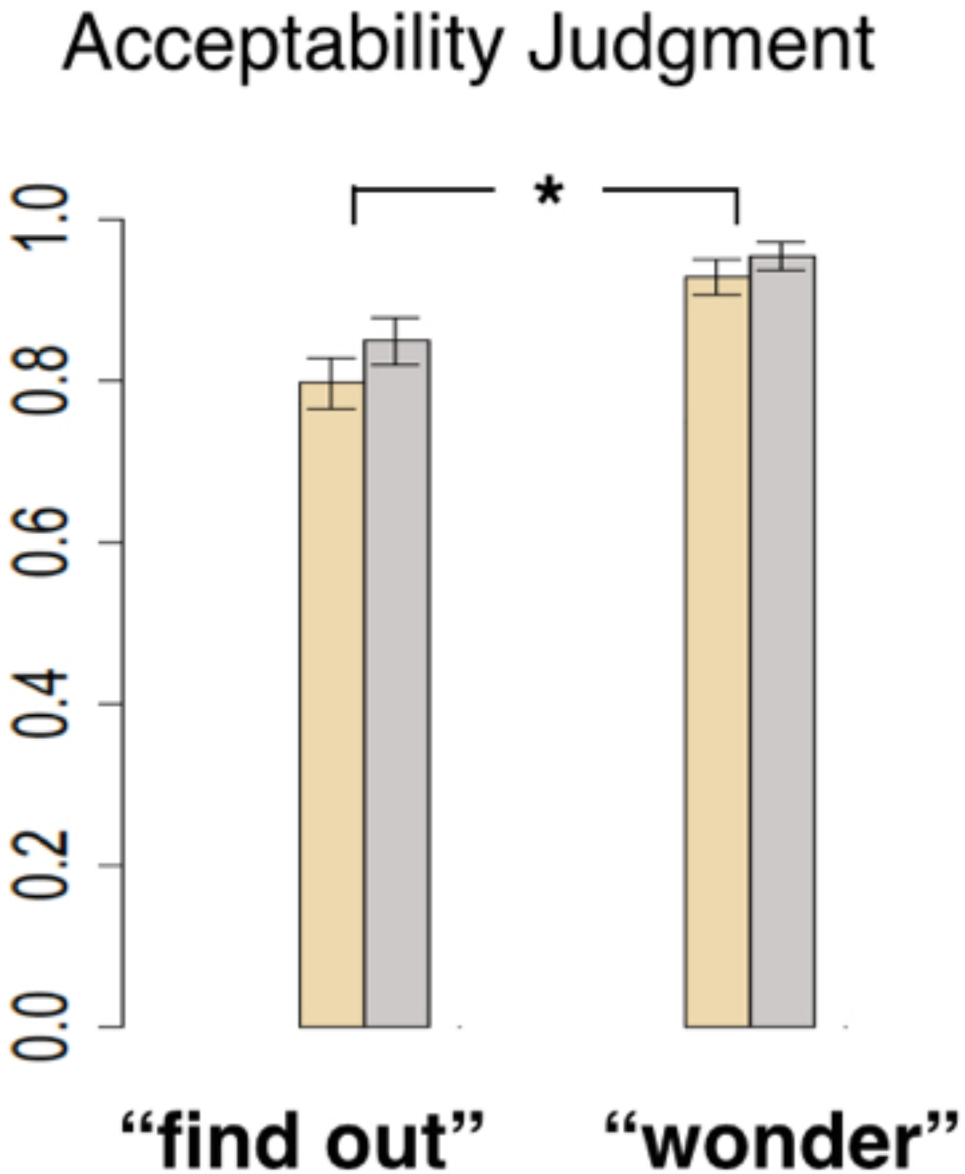
- Eyetracking reading
- acceptability judgment task after each trial
- Critical word (CW) is the sentence final wh-phrase
- 40 8-condition items
- 40 subjects

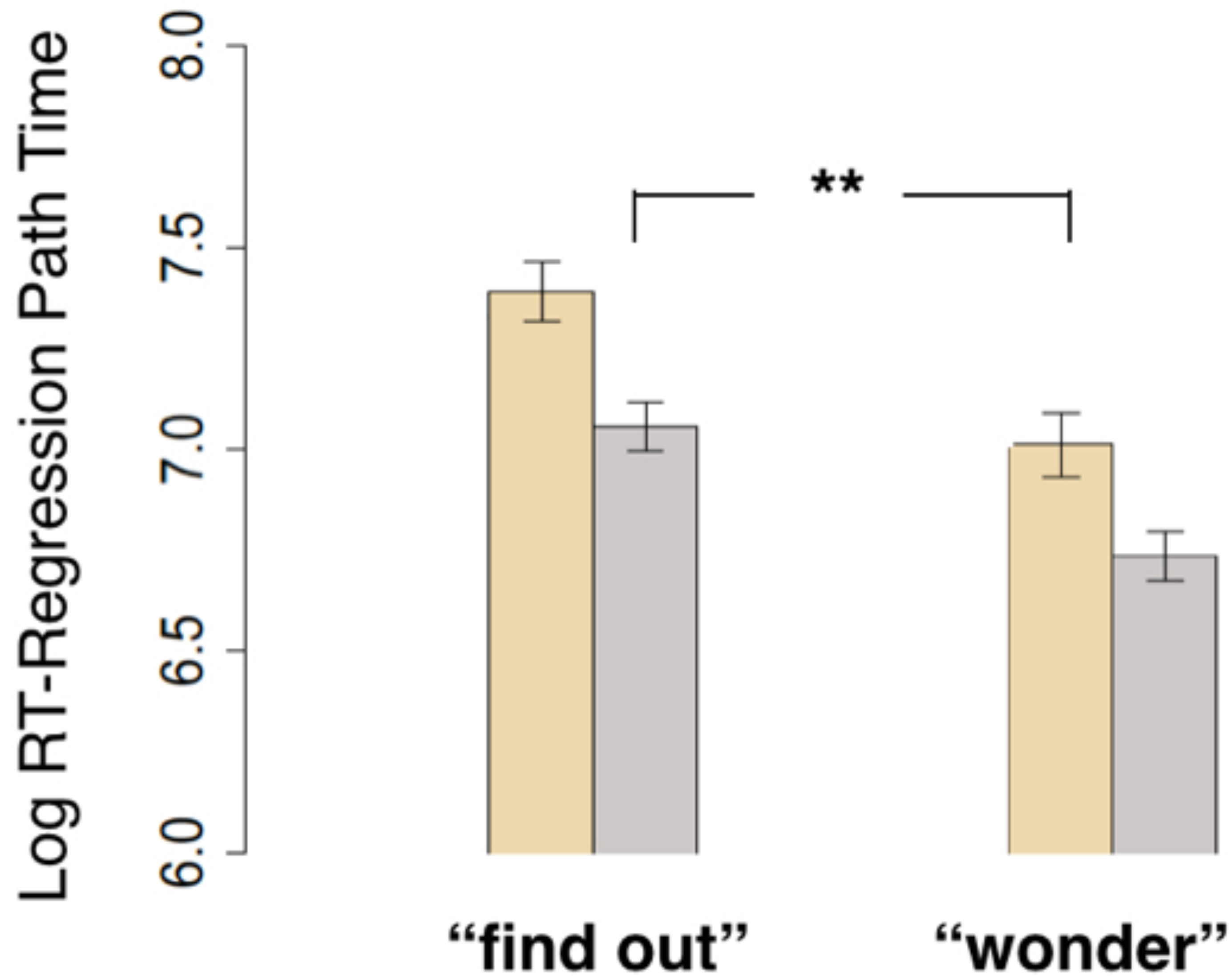
Experiment 1 Results

Mono-clausal conditions

…V[CP1….V[vP….WH]]

…V[CP1….WH]]



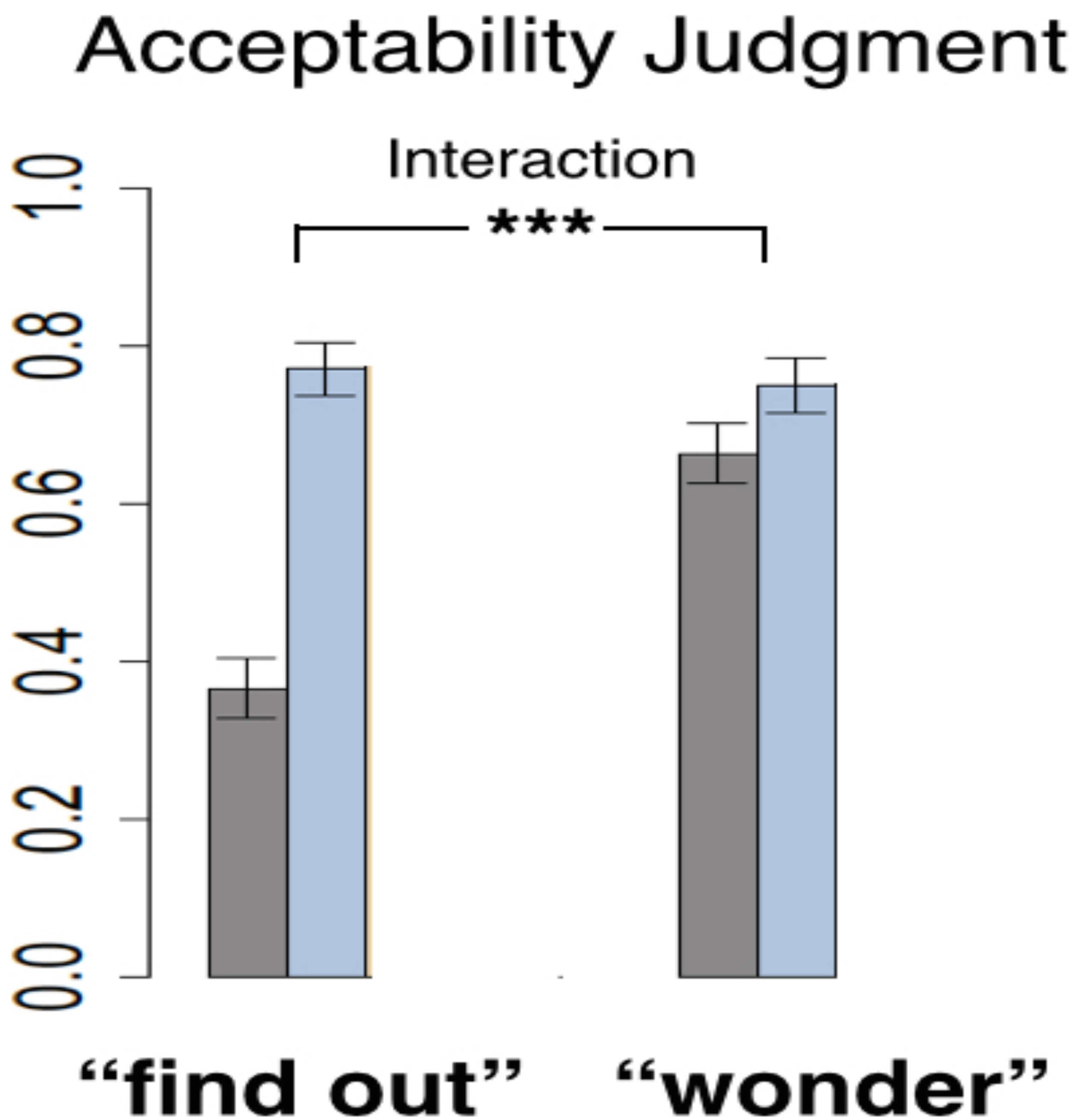


Experiment 1

Multi-clausal conditions

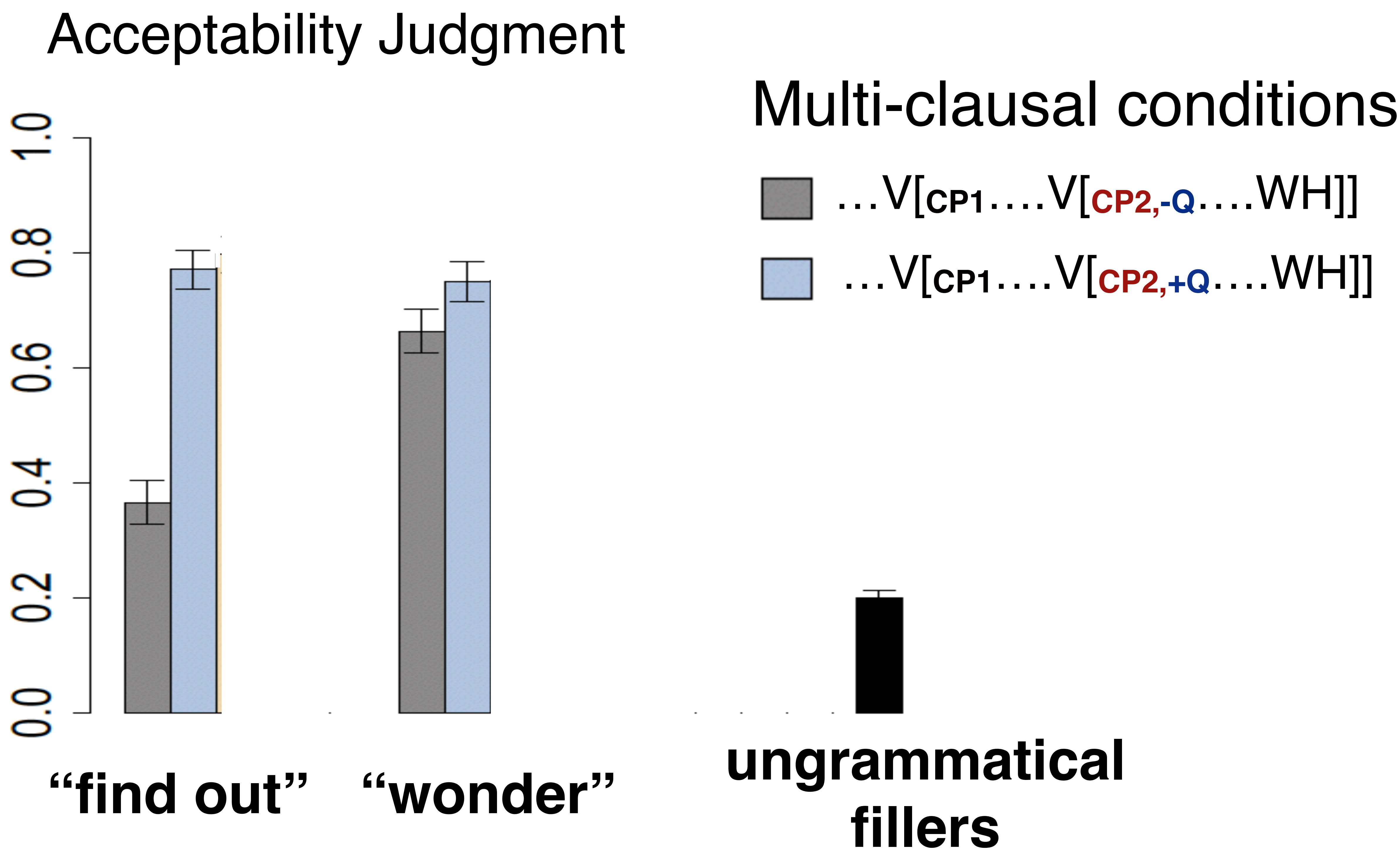
…V[CP1….V[CP2,-Q….WH]]

…V[CP1….V[CP2,+Q….WH]]

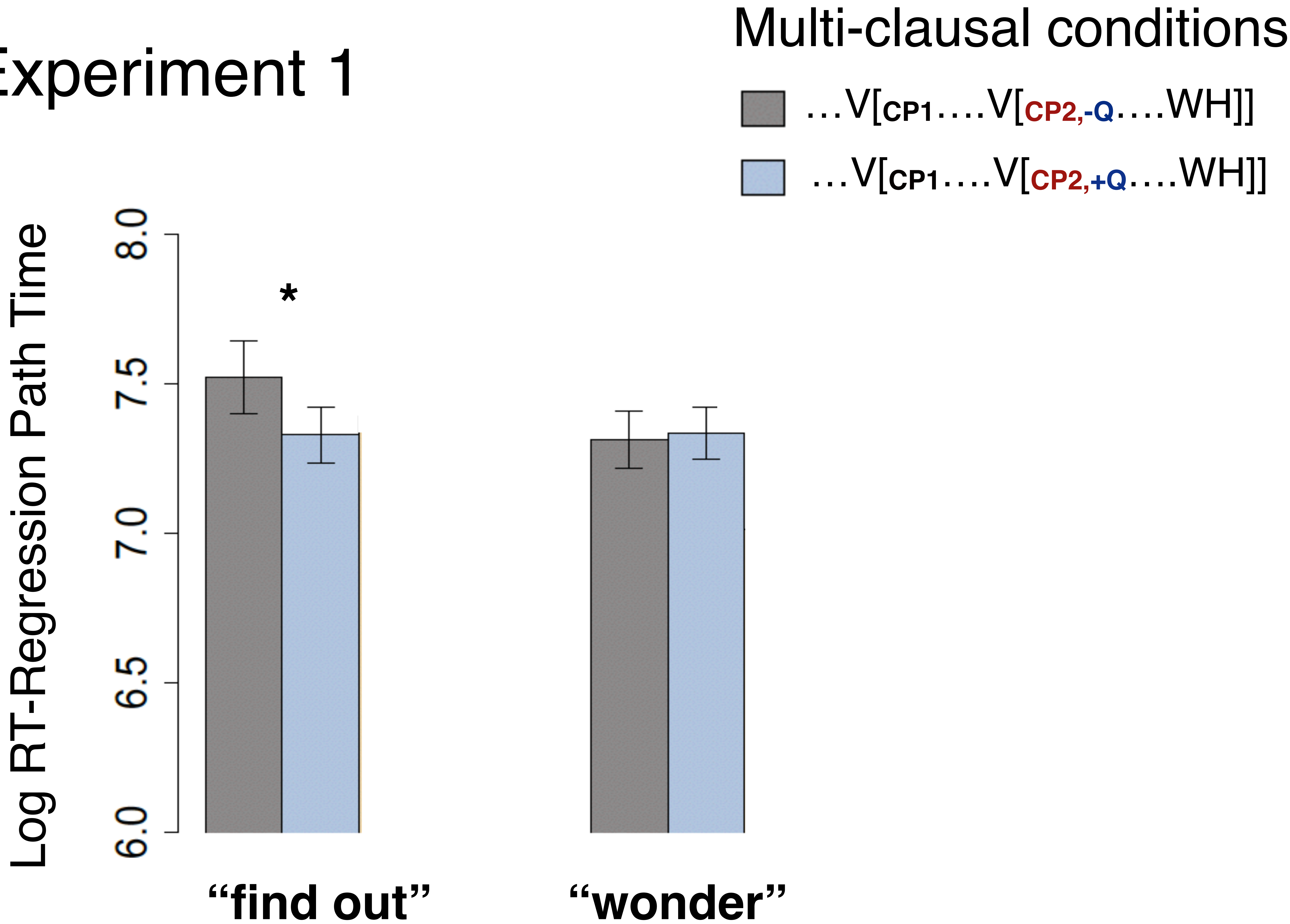


…**find out**[CP1, … **believe**[CP2, *-Q* … *WH*]] **Hard!!**

Experiment 1



Experiment 1



The locality effect asymmetry in multi-clausal conditions

…**find out**[CP1, … know[CP2, *+Q* … ***WH***]] easy

…**find out**[CP1, … believe[CP2, *-Q* … ***WH***]] hard

…**wonder**[CP1,… know[CP2, *+Q* … ***WH***]] easy

…**wonder**[CP1,… believe[CP2, *-Q* … ***WH***]] easy

Explaining the locality effect asymmetry

…**find out**[**CP1,** … know[**CP2, *+Q*** … ***WH***]] **easy**

…**find out**[**CP1,** … believe[**CP2, *-Q*** … ***WH***]] **hard**

The closest clause boundary is available first for the reanalysis

…**wonder**[**CP1,+Q**… know[**CP2, *+Q*** … ***WH***]] **easy**

…**wonder**[**CP1, +Q**… believe[**CP2, *-Q*** … ***WH***]] **easy**

The predictive +Q feature guides the direct access to the correct scope position

Experiment 1 Summary

A **predictive '+Q'** feature significantly aids processing:

- It avoids the need of reanalysis at the wh-in-situ phrase
- It guides the parser directly to the correct scope position, instead of checking the closer potential scope position first (clause boundary).

A closer look at the locality effect

….find out[**CP1, +Q**… know[**CP2, *+Q*** ... ***WH***]] **easy**

….find out[**CP1, +Q**… believe[**CP2, *-Q*** ... ***WH***]] **hard**

Our proposal: the closest CP boundary is accessed for reanalysis first

An alternative proposal: The ambiguous condition is independently easier than the unambiguous one? (e.g. *the ambiguity advantage*, Traxler, Pickering, and Clifton, 1998; Logacev and Vasishth, 2015; Swets et al. 2008)

Experiment 2 conditions

…find out[**CP1, +Q**… know[**CP2, *+Q*** ... ***WH***]] **easy**

…find out[**CP1, +Q**… believe[**CP2, *-Q*** ... ***WH***]] **hard**

…know [**CP1, +Q**…find out[**CP2, *+Q*** ... ***WH***]] **easy**

…believe [**CP1, -Q**…find out[**CP2, *+Q*** ... ***WH***]] **???**

Experiment 2: stimuli example

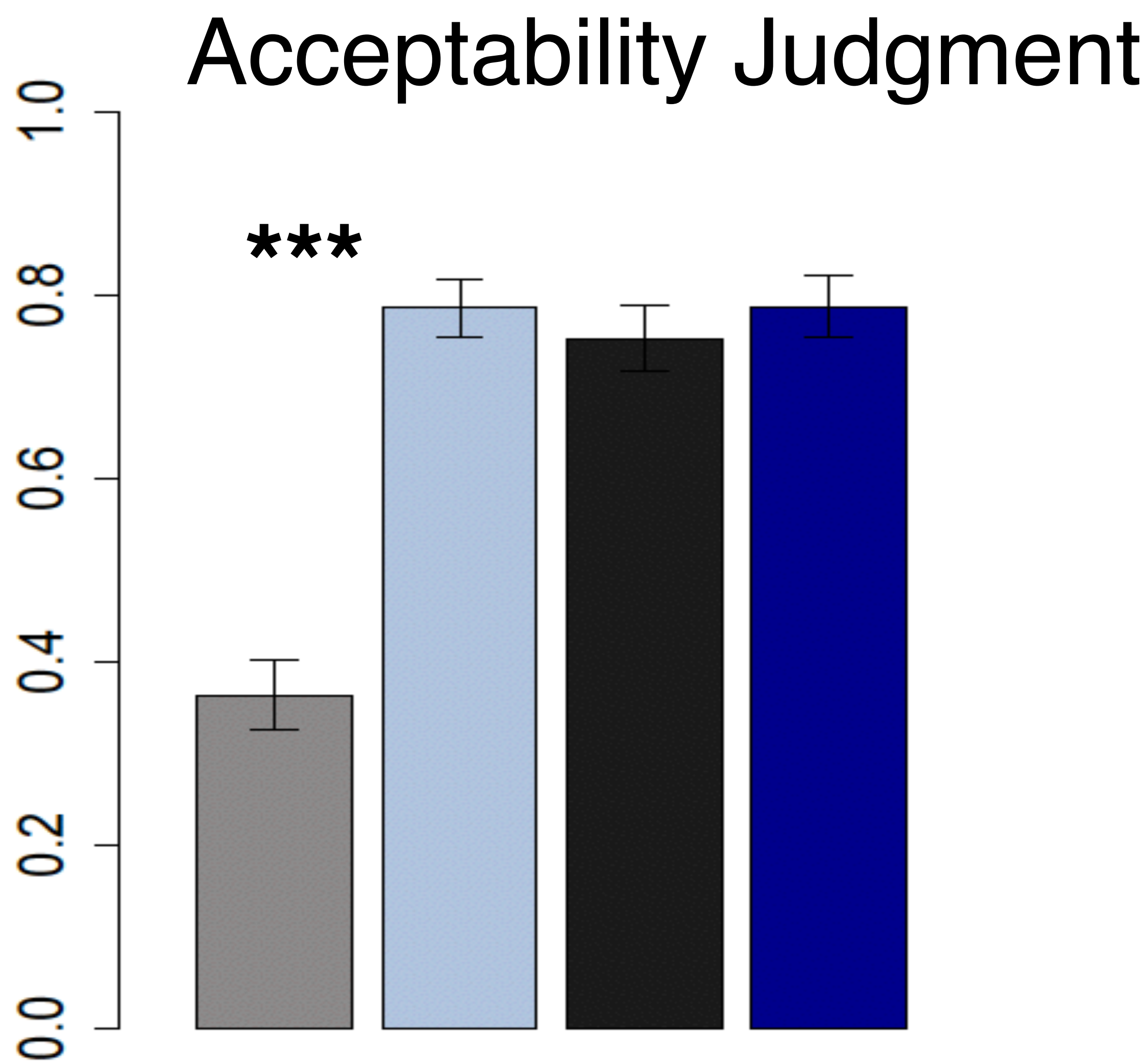
小王 打听到 工程队 知道 村民们 扩建了 哪座水坝.
Mr. W. **find out** construction-team **know** villagers rebuild **which dam**

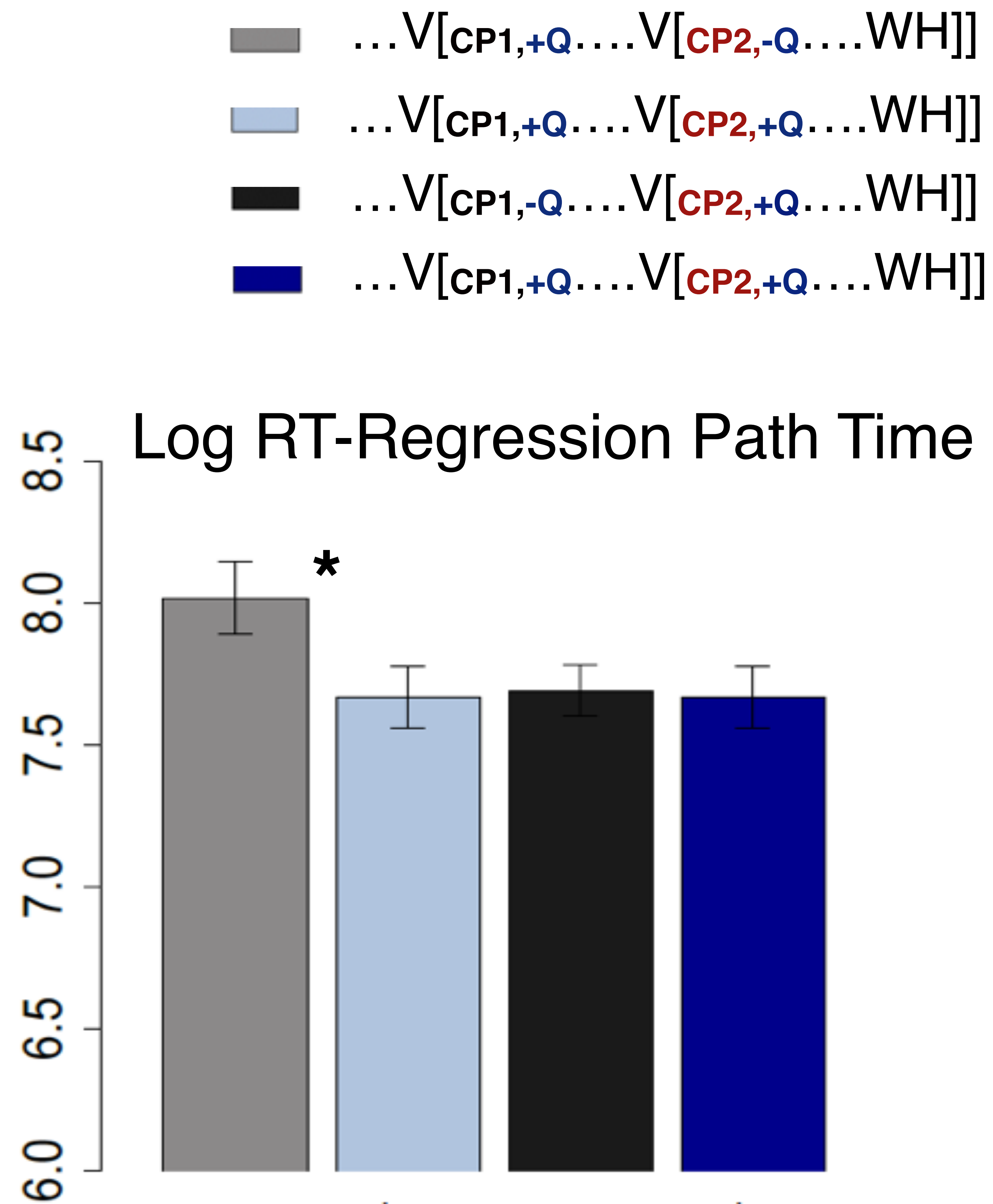
小王 打听到 工程队 相信 村民们 扩建了 哪座水坝.
Mr. W. **find out** construction-team **believe** villagers rebuild **which dam**

小王 知道 工程队 打听到 村民们 扩建了 哪座水坝.
Mr. W. **know** construction-team **find out** villagers rebuild **which dam**

小王 相信 工程队 打听到 村民们 扩建了 哪座水坝.
Mr. W. **believe** construction-team **find out** villagers rebuild **which dam**

Experiment 2 (ongoing)





Conclusions

- Processing wh-in-situ questions involves retrieving the correct scope position
- The processing strategy is significantly modulated by whether there exists an early predictive cue:
  - Early prediction facilitates the direct retrieval of the the scope position
  - Without a predictive cue, the closer clause boundary is more accessible for the memory retrieval

Thank you!

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