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

\[
[\text{CP } + \text{Q } [\text{the police officer protected which man?}]]
\]

John wondered \([\text{CP } + \text{Q } [\text{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

\[ \text{...wonder[CP}_1\text{……WH]} \]

\[ \text{....V[CP}_2\text{……WH]} \]

Xiang, Wang & Cui, 2015, JML
The distance effect

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

...wonder[CP1......WH]]
Mr. Wang wonder [CP1 the construction team rebuild which dam]
“Mr. Wang wondered which dam the construction team rebuilt.”

...wonder[CP1.......V[CP2.......WH]]
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]]
…wonder[CP1.......V[CP2.......WH]]
…wonder[CP1.......V[vP.......WH]]

Mr. W. wonder [CP1construction-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[\text{CP}_1, +Q \ldots \text{V}[\text{CP}_2 \ldots \text{WH}]]

Similarity based interference

Xiang, Wang & Cui, 2015, JML
Incrementally encode the predictive +Q feature

...wonder[\text{CP, +Q}.........]

\begin{itemize}
\item[\xmark] John \textcolor{red}{wondered} the police protected that man.
\item[\checkmark] John \textcolor{green}{wondered} which man the police protected.
\end{itemize}
Incrementally encode the predictive +Q feature

...wonder[CP, +Q .......]

...wonder[CP, +Q .......WH]

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[CP, +Q...
Experiment 1
conditions with an early +Q feature encoded

...wonder$_{CP}$, +Q...

Multiclausal-CP$_{2+Q}$

...wonder$_{CP1}$, +Q... know$_{CP2}$, +Q ... $WH$]

Multiclausal-CP$_{2-Q}$

...wonder$_{CP1}$, +Q... believe$_{CP2}$, -Q ... $WH$]
Experiment 1:
conditions with an early +Q feature encoded

...wonder[\textcolor{red}{CP}, +Q...]

...wonder[\textcolor{red}{CP_1}, +Q... know[\textcolor{red}{CP_2}, +Q ... \textit{WH}]}

...wonder[\textcolor{red}{CP_1}, +Q... believe[\textcolor{red}{CP_2}, -q ... \textit{WH}]}

...wonder[\textcolor{red}{CP_1}, +Q... lead[\textcolor{red}{vP} ... \textit{WH}]] \quad \text{Monoclausal-long}

...wonder[\textcolor{red}{CP_1}, +Q... \textit{WH}] \quad \text{Monoclausal-short}
Experiment 1: stimuli example

Matrix V “wonder” type

Mr. W. wondered which dam the team knew the villagers rebuilt.

“Mr. W. wondered which dam the team believed the villagers rebuilt.”

“Mr. W. wondered which dam the team led the villagers to rebuild.”

“Mr. Wang wondered which dam the construction team rebuilt.”
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 \([\text{CP}_1, -Q \ldots \text{know}\,[\text{CP}_2, -Q \ldots \text{WH} \, ]]\)

Reanalysis

...find out \([\text{CP}_1, +Q \ldots \text{know}\,[\text{CP}_2, +Q \ldots \text{WH} \, ]]\)

Globally ambiguous
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]]
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]]
Mr. W. found out which dam the team knew the villagers rebuilt.

Mr. W. found out which dam the team believed the villagers rebuilt.

Mr. W. found out which dam the team led the villagers to rebuild.

Mr. W. found out which dam the construction team rebuilt.
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

\[ \ldots V_{CP1} \ldots V_{vP} \ldots WH \]

\[ \ldots V_{CP1} \ldots WH \]

Acceptability Judgment

![Graphs showing acceptability judgments for "find out" and "wonder" with asterisks indicating significant differences.]

Log RT-Regression Path Time

![Graphs showing log RT-regression path times for "find out" and "wonder" with asterisks indicating significant differences.]

“find out”  “wonder”
Experiment 1

Acceptability Judgment

Multi-clausal conditions

- ...V[CP1, ..., V[CP2, -Q, ..., WH]]
- ...V[CP1, ..., V[CP2, +Q, ..., WH]]

Interaction

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"find out"  "wonder"

...find out[CP1, ... believe[CP2, -Q, ... WH]] Hard!!
Experiment 1

Acceptability Judgment

Multi-clausal conditions

- \[ \ldots V[CP_1 \ldots V[CP_2,-Q \ldots WH]] \]
- \[ \ldots V[CP_1 \ldots V[CP_2,+Q \ldots WH]] \]

“find out”  “wonder”  ungrammatical fillers
Experiment 1

Multi-clausal conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Graph</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{CP1}.V_{CP2,-Q}.WH )</td>
<td>![Graph 1]</td>
<td>“find out”</td>
</tr>
<tr>
<td>( V_{CP1}.V_{CP2,+Q}.WH )</td>
<td>![Graph 2]</td>
<td>“wonder”</td>
</tr>
</tbody>
</table>
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\text{[CP}_1, \ldots \text{ know[CP}_2, +Q \ldots \text{ WH}]\text{]} \quad \text{easy} \\

...find out\text{[CP}_1, \ldots \text{ believe[CP}_2, -Q \ldots \text{ WH}]\text{]} \quad \text{hard}

The closest clause boundary is available first for the reanalysis

...wonder\text{[CP}_1, +Q \ldots \text{ know[CP}_2, +Q \ldots \text{ WH}]\text{]} \quad \text{easy} \\

...wonder\text{[CP}_1, +Q \ldots \text{ believe[CP}_2, -Q \ldots \text{ WH}]\text{]} \quad \text{easy}

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

Mr. W. find out construction-team know villagers rebuild which dam

Mr. W. find out construction-team believe villagers rebuild which dam

Mr. W. know construction-team find out villagers rebuild which dam

Mr. W. believe construction-team find out villagers rebuild which dam
Experiment 2 (ongoing)

Acceptability Judgment

Log RT-Regression Path Time

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...V[CP1,+Q...V[CP2,-Q...WH]]

...V[CP1,+Q...V[CP2,+Q...WH]]

...V[CP1,-Q...V[CP2,+Q...WH]]

...V[CP1,+Q...V[CP2,+Q...WH]]
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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