Locality and anti-locality in the comprehension of wh-in-situ questions

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How is grammatical knowledge deployed in language comprehension?
Cross-linguistic variation

Higher level abstraction — the grammar

**Overt** syntactic dependency

Which guest did John like __?

**Covert** syntactic dependency

约翰 喜欢 哪个 客人？

J. xihuan nage keren

John like which-CL guest

John like which guest?
In comprehension, the same mental structure could be established in different ways for different languages.
Experiment 1&2:

Processing evidence for a covert non-local syntactic dependency

Xiang, Wang and Cui, 2015, JML
Experiment 3&4: Finding the scope position

Locality: sometimes we see it, sometimes we don’t
Experiment 5-6: Interpreting the scope

Anti-locality:

Parsing complexity (structural complexity) does not (entirely) determine the scope interpretation preference
Syntactic assumptions

John hide-perf what thing?

(Huang, 1982; Li, 1992; Aoun & Li 1993; Tsai 1994; Cheng, 1991; 2003)
Experiment 1

- The processing of a wh-in-situ sentence is sensitive to intervening CP positions.
- Intervening CP positions increase processing cost.

\[ [\text{CP} + \text{Q} \ldots [\text{CP} \ldots \text{wh-in-situ}]] \]
The processing of a wh-in-situ sentence is sensitive to intervening CP positions.

Intervening CP positions increase processing cost.

String identical wh-in-situ sentences without an intervening CP position do not show the same cost.

\[[\text{CP} + \text{Q} \ldots [\text{FP} \ldots \text{wh-in-situ}]\]
The reporters wondered which officials the mayor led the city council to punish.
The critical comparison

Mono-CP structure

Multi-CP structure

(Grano 2012; Paul 2005; Tang 2000)
How to test the size of the embedded clause in Mandarin?

市长 宣布 那些 官员， 市政府 严惩了。

shizhang xuanbu naxie guanyuan, shizhengfu yanchengle
mayor announce that-CL officials, city-council punished
“The mayor announce that those officials, the city council punished.”

*市长 带领 那些 官员， 市政府 严惩了。
shizhang dailin naxie guanyuan, shizhengfu yanchengle
mayor lead that-CL officials, city-council punished
"The reporters were happy that the mayor led the city council to punish those officials."
Eyetracking reading results (n=50)

Regression-path time at the WH-morpheme

- n.s.
- Interaction

Log RT

- 5.0
- 6.0
- 7.0

Declarative

WhQ

- Multi-CP
- SerialV
Experiment 1: Rating results

Interaction *

<table>
<thead>
<tr>
<th>Condition</th>
<th>Multi-CP</th>
<th>SerialV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declarative</td>
<td>0.79</td>
<td>0.92</td>
</tr>
<tr>
<td>WhQ</td>
<td>0.70</td>
<td>0.91</td>
</tr>
</tbody>
</table>
Experiment 2: production

Sentence completion task (N V N V___):

记者们 想知道 市长 宣布/带领 ________
jizhemen xiangzhidao shizhang xuanbu /dailing
reporters wonder mayor announce/lead

WH-Multi-CP /Serial Verb

记者们 知道 市长 宣布/带领 ________
jizhemen zhidaoshizhang xuanbu /dailing
reporters know mayor announce/lead

Declarative-Multi-CP /Serial Verb
The reporters wondered which plan the mayor announced that she canceled.
Sentence completion possibility II: Relative clause structure

“The reporters wondered about the reason that the mayor announced that she canceled that plan”
Local complexity:
Right branching vs. relative clauses

N1 V1 N2 V2

Diagram: 

- Local complexity: Right branching vs. relative clauses
- Diagram illustrating the structure of sentences with different branching patterns.
Sentence completion results

- **Declarative Serial V**
  - Right branching clauses: 14%
  - Right branching direct object: Unknown
  - Relative clause object: Unknown
  - Relative clause subject: Unknown
  - Sentential subject: Unknown
  - Other: Unknown

- **Declarative Multi-CP**
  - Right branching clauses: 23%
  - Right branching direct object: Unknown
  - Relative clause object: Unknown
  - Relative clause subject: Unknown
  - Sentential subject: Unknown
  - Other: Unknown
Experiment 2 results

- Declarative Serial V: 79% Right branching clauses, 23% Relative clause object, 14% Other
- Declarative Multi-CP: 70% Right branching clauses, 8% Relative clause object, 11% Other
- WH Serial V: 29% Right branching clauses, 47% Relative clause object, 8% Other
- WH Multi-CP: 13% Right branching clauses, 56% Relative clause object, 7% Other
Experiment 2 results

Speakers avoid producing a covert long distance dependency at the cost of producing an otherwise dispreferred structure.
Experiment 1 & 2 summary

Both comprehension and production data suggest the construction of a covert dependency for wh-in-situ constructions.

**Comprehension:** The parser is sensitive to the intervening CP boundaries.

**Production:** Speakers avoid wh-in-situ constructions in order to avoid the long distance covert wh-dependency.
Evidence for locality?

\[ V_{\text{wonder}}[\text{CP1 +Q} \ldots V_{\text{announce}}[\text{CP2} \ldots \text{wh}]] \quad \text{more costly} \]

\[ V_{\text{wonder}}[\text{CP1 +Q} \ldots V_{\text{lead}}[\text{FP} \ldots \text{wh}]] \]
Evidence for locality?

\[ V_{\text{wonder}}[\text{CP1} + Q \ldots V_{\text{announce}}[\text{CP2} \ldots \text{wh}]] \quad \text{more costly} \]

\[ V_{\text{wonder}}[\text{CP1} + Q \ldots V_{\text{lead}}[\text{FP} \ldots \text{wh}]] \]

Not necessarily
scope taking in processing can be modeled under the general cue-based memory retrieval framework (e.g. Lewis & Vasishth 2005; Van Dyke & McElree 2006)

\[ V_{\text{wonder}}[CP_1,+Q] \ldots V_{\text{announce}}[CP_2 \ldots WH]\]

Parallel access

Similarity based interference
English presents the opposite pattern

**CP intervener**
The journalist who the union member believed that the tax policy had intensely agitated was planning a series of articles.

**TP intervener**
The journalist who the union member believed the tax policy to have intensely agitated was planning a series of articles.

Keine, 2015; also see Gibson and Warren, 2004
Experiment 3&4:
when do we see locality, when we don’t

... V[CP1 ... V[CP2 ... WH]

Does the parser access the local CP2 faster?
...find out [CP1... know [CP2, +Q ... WH]]

Success

...find out [CP1... believe [CP2, -Q ... WH]]

Failure
小王打听到了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-CL dam

“Mr. W. found out which dam the construction team knew the villagers rebuilt.”

“Mr. W. found out the construction team knew which dam 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-CL dam

“Mr. W. found out which dam the team believe the villagers rebuilt.”

Multiclausal, CP2-Q
Acceptability Judgment

Regression Path Reading Time at the in-situ WH phrase

Acceptability

V2-know

V2-believe

Ungrammatical fillers

Reading Time (Log)

V2-know

V2-believe
...know [CP1...find out[CP2 ... WH]]

...believe [CP1, -Q...find out[CP2 ... WH]]

Success
Acceptability Judgment

V2-know

Regression Path Reading Time at the in-situ WH phrase

V2-know

V1-know
Evidence for locality

...find out[CP1... know[CP2 ... WH]]  easy

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

...know [CP1...find out[CP2 ... WH]]  easy

...believe [CP1, -Q...find out[CP2 ... WH]]  easy
Removing the locality effect

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

A predictive +Q feature is incrementally encoded
…wonder[\textcolor{red}{\textsc{CP1}, +Q} \ldots \textcolor{blue}{\textsc{know}}[\textcolor{red}{\textsc{CP2}} \ldots \textcolor{red}{\textsc{WH}}]]

Multiclausal, CP2+Q

…wonder[\textcolor{red}{\textsc{CP1}, +Q} \ldots \textcolor{blue}{\textsc{believe}}[\textcolor{red}{\textsc{CP2}, -Q} \ldots \textcolor{red}{\textsc{WH}}]]

Multiclausal, CP2-Q
小王 想弄明白 工程队 知道 村民们 扩建了 哪座水坝。

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

Multiclausal, CP2+Q
Acceptability Judgment

Interaction

***

know

believe

know

believe

“find out”

“wonder”
Reading time at the wh-in-situ phrase

Log RT-Regression Path Time

**Believe**

![Bar chart showing reading time for "find out" and "wonder" with error bars.](image)
...wonder[CP1, +Q...V[CP2....WH]

retrieval cues

...find out [CP1...V[CP2...WH]

Reanalysis needed!

The most recent CP site is more activated (less memory decay) in memory; available for reanalysis earlier
Expt 3-4 Summary

Constructing a covert dependency in Chinese is constrained by the language specific word order, which modulates information encoding and retrieval.

If a distant scope position is incrementally encoded with a very salient [+Q] feature, e.g. a predictive feature, no locality is observed.

otherwise, local scope sites are accessed first, leading to a locality effect.
Experiment 5

Truth value judgment task (subj n=57)

Context:

At a recent archaeology conference, Emily said that her research team found evidence to prove that a famous ancient city was actually built by aliens. But she didn’t release the name of the city.
Target sentence (ambiguous)

a. Emily **announced** her team **discovered** aliens built **which city**.

○ **True**  
  Indicate *low* scope reading
  “Emily announced her team discovered **which city** was built by aliens.”

○ **False**  
  Indicate *high* scope reading
  “Emily announced **which city** her team discovered was built by aliens.”
b. Emily hid her team discovered aliens built which city.

- **True** Indicate **high** scope reading
  
  “Emily hid (the fact that) which city her team discovered was built by aliens.”

- **False** Indicate **low** scope reading
  
  “Emily hid (the fact that) her team discovered which city was built by aliens.”
Target sentence (unambiguous)

c. Emily announced her team believed aliens built which city.

- True

- False

“Emily announced which city her team believed was built by aliens.”
Target sentence (unambiguous)

d. Emily **hid** her team **believed** aliens built **which city**.

- **True**  
  Indicate **high** scope reading
  “Emily hid (the fact that) **which city** her team believed was built by aliens.”

- **False**  
  Parsing failure
Experiment 6

Acceptability in context

![Bar chart showing acceptability judgments for ambiguous and unambiguous contexts. The chart indicates a higher acceptability for ambiguous contexts.](chart.png)
Experiment 6  
Acceptability in context

![Bar chart showing acceptability judgments for ambiguous and unambiguous contexts, comparing 'Announce' and 'Hide' conditions.](chart)
The puzzle

- Ambiguity is resolved towards a marked interpretation
- High scope readings are preferred for ambiguous sentences, despite their enhanced parsing complexity

Mismatch between parsing complexity and comprehension bias
Sketching two possible directions

Ambiguity resolution is influenced by cost-based implicature

“The blue thing”

Rohde et al. 2012
Ambiguity resolution is influenced by cost-based implicature

“The blue thing”

Rohde et al. 2012
Is the unambiguous form for the high scope interpretation more costly?

Emily announced *which city* her team discovered aliens built __.

Emily announced her team discovered *which city* aliens built __.

In principle, Mandarin allows wh-phrases to be fronted via topicalization.
Sketching two possible directions (II)

The high scope reading is more relevant given the implicit QUD raised by the context
Context:

At a recent archaeology conference, Emily said that her research team found evidence to prove that a famous ancient city was actually built by aliens. **But she didn’t release the name of the city.**

The concessive “but” expresses a denial to an implicit QUD ("Did Emily release the name of the city?")

Umbach, 2005
Emily **announced** her team **discovered** aliens built **which city**.

**High scope:** Emily announced **which city** her team discovered was built by aliens.

Emily announced the answer to the question “**which city did her team discover was built by aliens?**”

Lahiri, 2002; Uegaki, 2015; Groenendijk and Stokhof, 1984
Conclusions

To comprehend (and produce) a wh-in-situ construction in Chinese:

- Grammatical representations
- Mechanisms that build the structure
- Mechanisms that decide the ultimate interpretation
Thank you!