1. **BACKGROUND**

In many languages, including English, subject-extracted relative clauses (SRs) have been shown to be processed faster than object-extracted relative clauses (ORs).

### Competing Explanations
- **Frequency-based accounts** (Jurafsky, 1996; Hale, 2001; Levy, 2008): The higher structural frequency of SRs might explain the relative processing ease of SRs compared to ORs.
- **Retrieval-based accounts** (Gibson 2000; Lewis & Vasishth, 2005): The distance between the gap and the head noun is a predictor for processing difficulty when building the head-gap dependency.

2. **WHY CHINESE?**

Teasing apart frequency- from retrieval-based explanations:
- As in English, SRs are more frequent than ORs in Chinese (Hsiao & Gibson, 2003).
- In contrast to English, in Chinese the distance between the head and the gap is longer in SRs.

Mixed results on whether the SR advantage also holds in Chinese.
(e.g., Gibson & Wu, 2013; Lin & Bever, 2006; Chen et al., 2012)

One problem: local ambiguities in the stimuli potentially confound the results. Although context sentences have been used to disambiguate the items (Gibson & Wu, 2013), the materials remain syntactically ambiguous.

3. **DESIGN AND PREDICTIONS**

We considered both the **Extraction Type** (SR or OR) and the **Modification Type** (Subject- or Object-modifying).

We disambiguated stimuli across all regions as follows: (c.f. Chen et al., 2012, SPR)
- The **DET-CL** combination predicts a nominal head (e.g. the RC-head **g**u**ke**).
- The **ADVP** predicts a directly upcoming VP between the **DET-CL** and the expected nominal head. } It can only be an RC.
- The **NUM-CL** sequence at the end of the RC ensures that the relativizer **DE** cannot be interpreted as a genitive marker.

1. *Na-ge [k] GAP zuowan zou-le fuwusheng yi-dun de [g]uke jian-guo laoban...* (Subject-modifying SR)
   \[
   \begin{array}{ll}
   \text{DET-CL} & \text{GAP ADVP hit-ASP waiter} \\
   \text{NUM-CL} & \text{REL customer see-ASP boss}
   \end{array}
   \]
   That customer who hit the waiter once last night had seen the boss ...

2. *Na-ge [k] zuowan fuwusheng zou-le GAP yi-dun de [g]uke jian-guo laoban...* (Subject-modifying OR)
   \[
   \begin{array}{ll}
   \text{DET-CL} & \text{ADVP waiter hit-ASP GAP NUM-CL REL customer see-ASP boss}
   \end{array}
   \]
   That customer who the waiter hit once last night had seen the boss ...

3. *Laoban jian-guo na-ge [k] GAP zuowan zou-le fuwusheng yi-dun de [g]uke...* (Object-modifying SR)
   \[
   \begin{array}{ll}
   \text{boss see-ASP} & \text{DET-CL GAP ADVP hit-ASP waiter} \\
   \text{NUM-CL} & \text{REL customer...}
   \end{array}
   \]
   The boss had seen that customer who hit the waiter once last night ...

4. *Laoban jian-guo na-ge [k] zuowan fuwusheng zou-le GAP yi-dun de [g]uke...* (Object-modifying OR)
   \[
   \begin{array}{ll}
   \text{boss see-ASP} & \text{DET-CL ADVP waiter hit-ASP GAP NUM-CL REL customer...}
   \end{array}
   \]
   The boss had seen that customer who the waiter hit once last night ...

### Predictions:
- Frequency-based accounts: SR advantage at the RC region and at the head noun.
- Retrieval-based accounts: OR advantage at the head noun.

4. **A POTENTIAL CONFOUNDED**

In Chinese, adverbs can be preverbal or clause-initial.
- SR-conditions (1) & (3): the ADVP is at a preverbal position.
- OR-conditions (2) & (4): the ADVP is clause-initial.
- The processing cost associated with the ADVP at different positions might confound the SR advantage found in Chen et al. (2012).

We employed two additional conditions containing an ADVP at either preverbal or clause initial positions to find out whether adverb position affects processing ease. This allows us to test whether the position of the adverb might indeed confound our RC stimuli.

5. **PROCEDURE AND RESULTS**

Total fixation time at the RC region (V-N/N-V)

<table>
<thead>
<tr>
<th>Extraction Type</th>
<th>Modification type</th>
</tr>
</thead>
<tbody>
<tr>
<td>subject-extracted</td>
<td>object-extracted</td>
</tr>
<tr>
<td>subject-modifying</td>
<td>object-modifying</td>
</tr>
</tbody>
</table>

Total fixation time at the head noun

<table>
<thead>
<tr>
<th>Extraction Type</th>
<th>Modification type</th>
</tr>
</thead>
<tbody>
<tr>
<td>subject-extracted</td>
<td>object-extracted</td>
</tr>
<tr>
<td>subject-modifying</td>
<td>object-modifying</td>
</tr>
</tbody>
</table>

### Procedure
- 32 items (16 were taken from Chen et al. 2012); 88 fillers.
- Each trial was followed by a comprehension question.
- 40 subjects from National Taiwan Normal University, Taipei.

### Data analysis
- Log-transformed reading times at the relative clause region (RC-verb=RC-object in SRs; RC-object=RC-verb in ORs) and at the head noun were analyzed using Linear Mixed Effects Models with random effects for subjects and items.
- For each subject, the processing cost associated with the clause-initial ADVP was calculated (total fixation time on the verb) using a Linear Model. We then included each subject’s coefficient as a predictor in the models of RC processing.
- RC-region:
  - SR advantage in total fixation time (t=2.06), regression path duration (t=3.37), right-bounded reading time (t=2.34), first-pass regression probability (z=5.07) and re-reading probability (z=2.5).
- Head noun:
  - SR advantage in total fixation duration (t=2.04) and re-reading time (t=2.5).
- Spillover-region:
  - The SR advantage remained significant in the materials following on the head noun.

6. **DISCUSSION**

- We found a processing advantage of SRs compared to ORs at the RC region and at the head noun.
- The processing cost associated with the adverbial at different positions cannot explain the SR advantage we observe in the data.
- The SR advantage is predicted by frequency-based accounts but is inconsistent with retrieval-based accounts.

This study, along with Chen et al. (2012), forms the first set of experiments investigating Chinese RCs using materials without any syntactic ambiguities.

### ACKNOWLEDGEMENTS

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### SELECTED REFERENCES