Expectation and Memory in Processing of German Verb-final Clauses: Relativization Matters

Roger Levy  
University of California, San Diego  
rlevy@ucsd.edu

Frank Keller  
University of Edinburgh  
keller@inf.ed.ac.uk

Introduction

- Konieczny (2000) shows that the presence of additional preverbal material can facilitate the processing of clause-final verbs.
- This is an example of an anti-locality effect (e.g., Vaisish & Lewis, 2006); it contradicts standard results showing that pre-verbal dependents increase processing difficulty (e.g., Hale, 2001).
- Levy (2006) argued that this type of anti-locality result arises as a result of probabilistic expectations (Hale, 2001).
- To reconcile these results, we posit that the cost of memory retrieval varies across language and constructions.
- Hypothesis: relativization (unbounded dependency construction) involves more resources than clause-local constructions.

Experiment 1

- This experiment investigated processing difficulty at German clause-final verbs, controlling for the potential confounds present in Konieczny (2000).
- We varied the type and amount of preverbal material in the matrix clause.
- For our materials, a DATIVE argument serves as a strong indicator for the upcoming verb; an ADJUNCT is a weaker indicator.
- Lexicalization, immediately preverbal material, and sentence position at the critical verb (\(V^*\)) are completely controlled.

Method

- We used a 2 \(\times\) 2 design crossing the factors, as in (1):
  - a DATIVE phrase appears in the matrix clause (a & b) or the subordinate clause (c & d).
  - an ADJUNCT phrase appears in the matrix clause (a & c) or the subordinate clause (b & d).

<table>
<thead>
<tr>
<th>(1)</th>
<th>a. As NP</th>
<th>NP</th>
<th>V</th>
<th>has NP (who)</th>
<th>PP</th>
<th>NP</th>
<th>dat</th>
<th>NP</th>
<th>NP</th>
<th>acc</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>b.</td>
<td>As NP</td>
<td>PP</td>
<td>V</td>
<td>has NP (who)</td>
<td>PP</td>
<td>NP</td>
<td>dat</td>
<td>NP</td>
<td>NP</td>
<td>acc</td>
<td>V</td>
</tr>
<tr>
<td>c.</td>
<td>As NP</td>
<td>NP</td>
<td>V</td>
<td>has NP (who)</td>
<td>PP</td>
<td>NP</td>
<td>dat</td>
<td>NP</td>
<td>NP</td>
<td>acc</td>
<td>V</td>
</tr>
<tr>
<td>d.</td>
<td>As NP</td>
<td>NP</td>
<td>V</td>
<td>has NP (who)</td>
<td>PP</td>
<td>NP</td>
<td>dat</td>
<td>NP</td>
<td>NP</td>
<td>acc</td>
<td>V</td>
</tr>
</tbody>
</table>

- There were 24 items instantiating the template in (1).
- Each subject was assigned one of the lists; the items in the list were presented in random order together with 24 fillers.
- The eye-movements of 28 native speakers were recorded using an Eyelink-II video-based tracker.

Results and Discussion

- The total reading times for the four conditions are graphed in Figure 1.
- There was a significant main effect of DATIVE in total time (\(F_1(1, 27) = 7.287, p = 0.012; F_2(1, 23) = 4.532, p = 0.044\)). This effect was marginal for second pass time and absent in the other measures.
- There was no significant effect of ADJUNCT and no interaction.
- The mere presence of additional material does not have an effect. The constituent has to impose additional constraints on the verb (e.g., dative NP) to facilitate processing.
- Critical-verb reading time was uncorrelated with plausibility (pretest).

Experiment 2

Method

- This experiment tested if embedding the critical verb into a relative clause increases memory load.
- The matrix clause in (1)) was replaced by a relative clause (insertion of who).
- The anti-locality effects found by Konieczny and others are unlikely to be due to confounds of sentence position, lexicalization, plausibility.
- For our materials, a DATIVE argument serves as a strong indicator for the upcoming verb; an ADJUNCT is a weaker indicator.
- The matrix clause in (1)) was replaced by a relative clause (insertion of who).
- The critical verb reading time was uncorrelated with plausibility (pretest).

Results and Discussion

- The total reading times for the four conditions are graphed in Figure 2.
- Again significant main effect of DATIVE in total time (\(F_1(1, 27) = 5.688, p = 0.024; F_2(1, 23) = 4.282, p = 0.050\)). This effect was marginal for second pass time and absent in the other measures.
- No significant effect of ADJUNCT, but interaction DATIVE/ADJUNCT significant in second pass (\(F_1(1, 27) = 6.446, p = 0.017; F_2(1, 23) = 8.769, p = 0.007\)) and in total time (significant \(F_1\), marginal \(F_2\)).

Conclusions

- The anti-locality effects found by Konieczny and others are unlikely to be due to confounds of sentence position, lexicalization, plausibility.
- The facilitative effect of preverbal datives appears in late but not early measures; expectation effects may be similar to Cloze-type predictability effects.
- Preverbal adjuncts have an effect only under conditions of increased memory load, e.g., in relative clauses.
- Then they show a locality effect that modulates the anti-locality effects of preverbal datives.
- This indicates that memory-based theories of processing complexity (e.g., Gibson, 1998) need to posit differential retrieval costs for constructions.

References