Inhibition in the computation of scalar implicatures

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Introduction & Background

Scalar Implicature
- The meanings of scalar items are often pragmatically strengthened by scalar implicature.
  - Experimental turn in pragmatics has generated a lot of psycholinguistic research.
  - On time course (Beltrama & Xiang, 2012; Bott & Noveck, 2004; Bott, Bailey, & Grodner, 2014; Brekeny, Katsos, & Williams, 2006; Huang & Snedeker, 2009; Nieuwland, Ditman, & Kuperberg, 2010; Politzer-Ahles, et al, 2012).

The Question
- What mechanism does scalar implicature use to compute pragmatically strengthened meanings?
  - The idea: Calculation of scalar implicature triggers inhibition of stronger scalar alternatives as inappropriate meanings.

Scales, Implicature, & Mechanism

Scales
- Scalar adjectives denote degrees on a scale.
  - Informativity of alternatives forms scales. Stronger alternatives entail weaker alternatives (Horn 1984).
    Increasing Temperature Scale: <scalding, hot, warm>

Implicatures
- General computation: Choice of a weaker alternative on a scale by a speaker implicates the negation of stronger alternatives, as in (1).
  - Scalar implicatures are blocked in downward entailment, e.g. negation in (2) (Chierchia, 2004).

(1) The coffee is hot.
  a. ⊨ The coffee is at least hot.
  b. ⊨ The coffee is not scalding.

(2) The coffee is not hot.
  a. ⊨ The coffee is not at least hot.
  b. ⊨ The coffee is not scalding.

Mechanism
- Negation of stronger alternatives means that stronger alternatives are not appropriate for sentence meaning.
  - Reminiscent of contextually appropriate vs. inappropriate homonym meanings (Swinney 1979).
  - Contextually inappropriate meanings are inhibited, as reflected by the inhibition of their associates.

Initial representation

After scalar implicature calculation

Reactions Time Results
- One subject was removed due to excessively long reaction times (>2 sec).
  - Interaction (by model comparison): $\chi^2 = 2.888$, $p = .0939$

<table>
<thead>
<tr>
<th>Scalar Alternative</th>
<th>Est. (msec)</th>
<th>Coefficient Est. Sidev.</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stronger Implicature</td>
<td>660</td>
<td>Intercept 10.954 3.520 8.817 38.21 &lt;.001***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Implicature</td>
<td>660</td>
<td>Alternatives 13.497 16.975 0.80 .80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaker Implicature</td>
<td>652</td>
<td>Stronger 12.972 7.811 1.66 .097</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Implicature</td>
<td>657</td>
<td>Weaker -7.472 7.875 -0.95 .343</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Responses to Stronger scalar alternative targets were inhibited in Implicature contexts compared to No Implicature contexts by 26 msec.

Cross-modal Priming

<table>
<thead>
<tr>
<th>Context</th>
<th>Implicature</th>
<th>No Implicature</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (msec)</td>
<td>725</td>
<td>710</td>
</tr>
</tbody>
</table>

Accuracy Results
- Overall accuracy was high (>98%).

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Stronger</th>
<th>Weaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient Est. Sidev.</td>
<td>z</td>
<td>p</td>
</tr>
<tr>
<td>Stronger Implicature</td>
<td>99.1%</td>
<td>Intercept 11.209 2.247 4.998 &lt;.001***</td>
</tr>
<tr>
<td>No Implicature</td>
<td>98.9%</td>
<td>Alternatives 5.450 2.295 2.374 .018 *</td>
</tr>
<tr>
<td>Weaker Implicature</td>
<td>98.2%</td>
<td>Stronger 5.450 2.295 2.374 .018 *</td>
</tr>
<tr>
<td>No Implicature</td>
<td>98.4%</td>
<td>Weaker -5.287 7.288 -0.395 .693</td>
</tr>
</tbody>
</table>

Method

Design
- Cross-modal lexical decision task. 35 Subjects, 52 Items (26 adjective scales). 187 fillers.
  - 2 Alternative (Stronger vs. Weaker) x 2 Context (Implicature vs. No Implicature)
    - Stronger: scalding, Weaker: warm.
    - No implicature contexts derived by negation.

Analysis
- Mixed effects modeling (maximal random effects by subjects and items) to investigate three contrasts.

Summary
- Stronger alternatives are inhibited in Implicature contexts.
  - Lexical decisions to Stronger alternatives are slower in Implicature compared to No Implicature contexts.
  - Lexical decisions to Weaker alternatives are not affected by implicature context.

Conclusions
- The computation of scalar implicatures triggers inhibition mechanisms.
  - Stronger alternatives are inhibited as their meanings are inappropriate for the sentence.
  - Weaker alternatives are unaffected as their meanings are appropriate for the sentence.

Inhibition of stronger alternatives strengthens the meaning of the scalar item by making its contribution more precise.
- (at least) hot and it's too spicy for him to eat.

Selected References

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