Contextual predictability facilitates processing of negation... or, does it facilitate a strategy for making anti-predictions?

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Are negating elements processed incrementally?
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• NO – the embedded proposition must be computed first

A robin is a bird / tree

A robin is not a bird / tree

Fischler et al (1983)
Are negating elements processed incrementally?

• YES – if the context is pragmatically supportive

With proper equipment, scuba-diving is very safe / dangerous

With proper equipment, scuba-diving is not very safe / dangerous

Nieuwland & Kuperberg (2008)
Does predictability matter as well as pragmatic felicity?

Federmeier & Kutas (1999)
Does predictability matter as well as pragmatic felicity?

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• Cloze probability can vary in highly felicitous sentences
  • “He caught the pass and scored another touchdown. There was nothing he enjoyed more than a good game of ...”
  • Eleanor offered to fix her visitor some coffee. Then she realized she didn't have a clean ...”

Federmeier & Kutas (1999)
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Federmeier & Kutas (1999)

• BUT hard to control and reliant on world knowledge
• Solution: episodic contexts providing ad-hoc relations between entities not already associated in LTM
Methodology: Mouse-tracking

• Mouse trajectories can tap into multi-stage decision processes
• Compared to SAT techniques
• Advantages: no extra cognitive load, natural for participants, fewer trials required
• Now used in many domains
• Software: MouseTracker (Jon Freeman)

Review: Freeman, Dale & Farmer (2011)
Methodology: Mouse-tracking

Image from mousetracker.jbfreeman.net
Methodology: Mouse-tracking

Image from Freeman, Dale & Farmer (2011)
Mouse-tracking in negation processing

Table 1
Experiment 1: Means and effect estimates

<table>
<thead>
<tr>
<th>Condition</th>
<th>x-flips (#)</th>
<th>AC (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/no negation</td>
<td>1.13</td>
<td>1.56</td>
</tr>
<tr>
<td>T/negation</td>
<td>1.71</td>
<td>2.86</td>
</tr>
<tr>
<td>F/no negation</td>
<td>1.24</td>
<td>2.16</td>
</tr>
<tr>
<td>F/negation</td>
<td>1.34</td>
<td>2.27</td>
</tr>
<tr>
<td>Estimate_negation</td>
<td>0.35***</td>
<td>0.70***</td>
</tr>
<tr>
<td>Estimate_T/F</td>
<td>0.13</td>
<td>0.31</td>
</tr>
<tr>
<td>Estimate_N × T/F</td>
<td>0.47**</td>
<td>1.16***</td>
</tr>
</tbody>
</table>

Dale & Duran (2011)
Design

Visual contexts precede sentences to manipulate predictability of critical word
Visual contexts precede sentences to manipulate predictability of critical word.
Design

Affirmative:
The left side contains the feather / burger

Negation:
The right side doesn’t contain the feather / burger
Design

3000 ms

The left side doesn’t contain the feather
Results
Results
Results

Distribution of Maximum Deviations

- Affirmative Predictable
- Affirmative Unpredictable
- Negation Predictable
- Negation Unpredictable
Results

Proportion of responses with large deviation

- Predictable
- Unpredictable

Sentence type:
- Affirmative
- Negation
Discussion

• Predictability of important words in a sentence seems to be a critical factor for how easily negating elements can be incorporated incrementally.

• This is an effect beyond the correlation between predictability and pragmatic felicity (all sentences are felicitous in the context).

• Why is this? Two possible interpretations:
  ● Predictability facilitates processing in a similar way to pragmatic felicity.
  ● The apparent ease of processing is an illusion produced by people employing an anti-prediction strategy where available.
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Anti-prediction strategy masks lack of incrementality?

Predictable

The right side doesn't contain...

Right side...
Anything but the feather!
Anti-predictions in ERPs?

-5

Conditions naming “unique” object
Conditions naming “non-unique” object

μV

0 250 500

0 10

μV
Other evidence for anti-predictions

Orenes et al (2014)
Next experiment: direct effect of predictability, or anti-predictions?

Anti-prediction 1

Anti-prediction 2

Anti-prediction 3
Thank you
References


ERPs to affirmatives / negations with varying predictability

- **Affirmatives**
  - True, strong prediction
  - True, weak prediction
  - False, strong prediction
  - False, weak prediction

- **Negations**

![Graphs showing ERPs for affirmatives and negations with varying predictability.](image-url)