Hitting playfully and kissing angrily: A self-paced reading study on force inferences

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1 Introduction

2 Self-Paced Reading Experiment
   - Experimental Design and Stimuli
   - Analysis
   - Discussion

3 Theoretical Embedding

4 Summary and Conclusion
Modification and Inferences

Adverbs have a lexical meaning that they can combine with a verb’s meaning in modification (e.g. *walk fast*). But some of the adverbs also trigger an inference and give rise to additional meanings.

(1)  
   a. Nancy hit Oliver playfully. → lightly  
   b. Nancy hit Oliver angrily. → hard

This additional meaning is testable in denial-of-expectation construction (cf. Lakoff, 1971).

(2)  
   a. Nancy hit Oliver playfully, but still rather √hard/?lightly.  
   b. Nancy hit Oliver angrily, but still rather √lightly/?hard.

We can therefore speak of two classes of adverbs:  
- **multi-attribute adverb adverbs** (e.g. playfully, angrily), which give rise to a force inference in addition to their lexical meaning and  
- **single-attribute adverbs** (e.g. lightly, hard), which specify the amount of force directly in their lexical entries.
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Design

- self-paced reading experiment (moving window)
- latin square design
- 15 stimuli, 15 controls, 60 fillers (per list)
- 15 verbs of contact (e.g. hit, kiss, push, throw, pinch, grab)
- adverbs:
  - multi attribute: e.g. playfully, friendly, angrily, painfully
  - single attribute: e.g. lightly, gently, hard, forcefully
- fillers: similar sentences for speed, contradictions, force → sound inference
- sentences followed by rating task:
  1: clearly bad; 2: maybe bad; 3: maybe good; 4: clearly good
- rating task followed by a control question relating to verb, participants, PP or adverb
- 7 sentences trial round
- 3 experimental rounds of 30 sentences and ratings (plus 25% chance of control question)
Materials

Stimuli:

(3) Jet sloeg Harry speels, en tegelijk vrij hard, op zijn schouder.
Jet hit Harry playfully, and simultaneously rather hard, on his shoulder.

Control:

(4) Jet sloeg Harry boos, en tegelijk vrij hard, op zijn schouder.
Jet hit Harry angrily, and simultaneously rather hard, on his shoulder.

→ sufficient word material following first adverb to compute inference
→ contrast established through “vrij” (rather)
→ simultaneity through “tegelijk” (simultaneously)
→ predictions: slow-down at critical adverb and spill-over area in stimuli
Data Clean-Up

- 91 participants: 45 for list 1 & 46 for list 2
- Excluded participants: 11 from list 1 & 8 from list 2
- Basis for exclusions: control questions (less than 70% correct), contradictions (score calculated from ratings)
- 1 item excluded: particle verb (aandrukken)
  → recomputation (particle at the end of sentence)
  → 4 words in spillover instead of 3
- observations excluded (cf. Wehlan, 2008):
  < 100 ms
  > 5000 ms (rt 1), > 2000 ms (rt 2 & 3), > 6500 ms (rt 4)
Overview Reading Times

[Graph showing reading times for different words and conditions]

Dekker, Goldschmidt  Hitting playfully and kissing angrily
Force Increase Reading Times Only

The graph shows the reading times for different words with and without force increase. The x-axis represents the words in Dutch: ‘zacht’ (lightly), ‘op’ (on), ‘zijn’ (his), and ‘schouder’ (shoulder). The y-axis represents the reading times. Two lines are depicted: one for ‘INCREASE’ and one for ‘CINCR’.
Force Decrease Reading Times Only
Statistics

linear mixed effects model in R (on log-transformed data):
→ random effects: participants, items
→ fixed effects: condition

<table>
<thead>
<tr>
<th></th>
<th>RT1 (hard/zacht)</th>
<th>RT2 (op)</th>
<th>RT3 (zijn)</th>
<th>RT4 (schouder)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase</td>
<td>p=.005**</td>
<td>p=.235</td>
<td>p=.005**</td>
<td>p=.005 **</td>
</tr>
<tr>
<td>Decrease</td>
<td>n.a.</td>
<td>p=.012*</td>
<td>p=.082</td>
<td>p=.45</td>
</tr>
</tbody>
</table>

Table: In all instances except one (rt 1, decrease), the stimuli condition was read slower than the control condition. The table gives the p-values, significant differences are marked * or **.
the trend we observed provides evidence that there is a reading time delay when an inference is cancelled
this trend was significant in the majority of the cases
However: force increase stimuli (angrily, and at the same time rather lightly) are problematic; ratings are very diverse (evenly divided over whole scale), sentences might be contradictory
decrease stimuli (friendly, and at the same time rather hard) are unproblematic, ratings were very good

In the following, we will focus on the analysis of the force decrease examples.
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Lexical Entries

For the force verbs:
\[
\text{hit} = \lambda e. \exists f [\text{FORCE}(e,f) \land \text{magnitude}(f,v)]
\]

For single attribute adverbs:
\[
\text{hard} = \lambda e. \exists f [\text{FORCE}(e,f) \land \text{magnitude}(f,\text{high})]
\]
\[
\text{lightly} = \lambda e. \exists f [\text{FORCE}(e,f) \land \text{magnitude}(f,\text{low})]
\]

For the multi attribute adverbs:
\[
\text{playfully} = \lambda e [\text{playfully}(e)]
\]
\[
\text{friendly} = \lambda e [\text{friendly}(e)]
\]
a) *Nancy hit Oliver hard.*  
\[\exists e[\text{hit}(e) \land \text{agent}(e, nancy) \land \text{patient}(e, oliver) \land \exists f[\text{FORCE}(e, f) \land \text{magnitude}(f, \text{high})]]\]

b) *Nancy hit Oliver friendly.*  
\[\exists e[\text{hit}(e) \land \text{agent}(e, nancy) \land \text{patient}(e, oliver) \land \text{friendly}(e) \land \exists f[\text{FORCE}(e, f) \land \text{magnitude}(f, \text{v})]]\]
Creating the Inference

- perception-based mechanism to determine value of force magnitude:
  language ↔ concepts ↔ perception
  hit friendly ↔ “be kind”, “no risk” ↔ low force

- An example of the mechanism:
  $$\forall e [\text{friendly}(e) \land \exists f [\text{force}(e,f)]]_{def} \rightarrow \text{magnitude}(f,\text{low})$$

- This is at the moment not very satisfying and rather preliminary. The mechanism needs to be based on carefully worked out lexical semantics.
• non-lexical world knowledge plays a role in meaning composition

• e.g. people can readily compute a force-inference when reading non-force related adverbs
References


Thank you for listening!