Which alternatives are relevant in scalar implicature processing? A priming study with antonyms and negation

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Scalar implicatures

- Pragmatic inferences arising from the Gricean principle of Quantity (Grice, 1975)

1) *Some* students got an A.
   \[ \sim \text{Not all students got an A.} \]

2) The soup was *warm*.
   \[ \sim \text{The soup was not hot.} \]
Theoretical treatments

• Most accounts see the **negation of the stronger alternative** as necessary for scalar implicatures (see Sauerland, 2012)

• Horn (1972) proposed ordered **lexical scales**
  • The split-scale assumption
    • \(<\text{cool, cold}>\) and \(<\text{warm, hot}>\) are separate scales

• However, some research suggests even **antonyms** play a role in scalar implicature (Peloquin & Frank, 2016)
Scalar diversity

• van Tiel et al. (2016) found that there are large differences between different scales in the degree to which comprehenders endorse scalar implicature meanings

3) John is **intelligent**.
   \[\sim\] John is **not brilliant**.

• (3) is an example of a rarely endorsed implicature
Focus alternatives

• Alternatives are a crucial concept both in implicatures and in focus (Gotzner & Romoli, 2022)

• According to Roothian (1992) semantics, alternatives are necessary for the derivation of the meaning of sentences such as this:

4) Mary saw only the lion at the zoo.

• The set of alternatives consists of plausible replacements for the focused element, i.e. {zebra, giraffe, penguin}
Alternatives in focus comprehension

- Research suggests that focus alternatives are present in the real-time comprehension of language
  - See Gotzner & Spalek (2019) for an overview

- Studies have used **lexical decision** and **probe recognition** to tap into the immediate activation and eventual representation of alternatives respectively
Alternatives in focus comprehension

- Husband & Ferreira (2016) exposed their participants to sentences such as the following:

5) The museum thrilled the **sculptor** when they called about his work

- Contrastive focus (L+H*) or non-contrastive (H*) prosody
- Alternatives (painter), associates (statue), unrelated (register)
- Exp 1 SOA = Oms, Exp 2 SOA = 750ms

- Activation for both alternatives and associates at 0ms
- Only alternatives activated at 750ms
Recently, researchers have attempted to transfer the methods used in the investigation of focus alternatives to the domain of scalar implicatures (De Carvalho et al., 2016; Ronai & Xiang, 2023).

Do comprehenders activate and represent stronger scalar alternatives in order to negate them and derive scalar implicatures?
• Do weak scalars (*warm*) activate their stronger scale-mates (*hot*) during comprehension?

• Is this activation specific to sentential contexts?

• Does the inclusion of the particle *only* influence priming?
• Experiment 2: Lexical priming
  • Isolated weak scalar primes (warm) with lexical decision on the strong scalar target (hot)

• Experiment 3: Sentential context
  6) The soup is warm/vegetarian. (target: hot)

• Experiment 4: Only
  7) The soup is only warm/vegetarian. (target: hot)
Ronai & Xiang (2023)

Experiment 2: Lexical priming

Experiment 3: Sentential context
Ronai & Xiang (2023)

• Significant effect of relatedness found in the sentential context Experiment 3
  • Strong scalars were primed by their weaker scale-mates

• This priming was **not observed** when primes were presented as isolated words
  • The researchers argued that this was evidence that the priming observed was due to scalar implicature derivation processes
Outstanding issues

• The lexical-sentential contrast might not be enough
  • We need a sentential context that cannot give rise to an implicature of the negation of the stronger term

• Ronai & Xiang (2023) analysed raw RTs as opposed to log-transformed data
The current project

• Are the priming effects truly indicative of online scalar implicature derivation?

• Do only stronger alternatives play a role in online implicature derivation?
The current project

• Main RQ:
  • What alternatives constitute the basis of scalar implicature derivation?

• Operationalisation:
  • Do informational strength relations between the prime and target words modulate alternative activation?
The current project

- Single factor sentential experiments
  - Negated scale mates (Experiment 1)
  - Antonyms (Experiment 2)
- Single factor lexical experiments
  - Antonyms (Experiment 3)
• **Scalar Account**
  - Based on the theoretical work by Horn (1972)
  - Only stronger terms play a role in scalar implicature derivation
  - No role of antonyms predicted

• **Semantic Network Account**
  - Words related to scalar items are stored in the mental lexicon (antonyms and scale-mates)
  - Priming effects are epiphenomenal

• **Alternative Activation Account** (Gotzner, 2017)
  - Initially a broad set of alternatives is activated via domain-general mechanisms
  - Subsequently this set is constrained to relevant alternatives by contextual and grammatical factors
Alternative Activation Account

1. Domain general mechanisms generate broad set of alternatives including all semantic associates (words/concepts)
   
   John is intelligent  
   strong scale-mate: BRILLIANT  
   antonym: STUPID

2. Grammatical and pragmatic mechanisms single out relevant alternatives
   
   strong scale-mate: BRILLIANT

Gotzner (2017)
## Predictions

<table>
<thead>
<tr>
<th>Account/Prime type</th>
<th>Scalar Account</th>
<th>Semantic Network Account</th>
<th>Alternative Activation Account</th>
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<td>Antonyms</td>
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Method

• Rapid serial visual presentation, PCIbex
• Single factor experiments
  • related vs. unrelated primes

8) Zack’s carpet was dirty/clean/patterned.

Target: FILTHY

scale-mate

antonym

unrelated
Experiment 1: Negated scale-mates

• Do scale-mates (dirty) still activate the target (filthy) when the latter is no longer informationally stronger?
• Scale reversal due to **constituent negation**

9) Zack’s carpet was **not dirty**/patterned.

Target: **FILTHY**

• N = 50
• Items = 52
• RSVP, words presented for 350ms each
• SOA = 650ms
Experiment 1: Results

![Graph showing mean reaction times (RT in ms) for related and unrelated conditions. The graph indicates that participants responded faster in the related condition (695.3 ms) than in the unrelated condition (704.6 ms).]
Experiment 1: Results

• Experiment 1 (negated weak scale-mates):
  • Relatedness: $\beta = 0.0081$, SE = 0.011, df = 32.25, $t = 0.71$, $p = 0.483$
Experiments 2 & 3: Antonyms

- Do antonyms (clean) prime the strong terms of opposite polarity (filthy)?
- Is this specific to sentential contexts or can it be seen with isolated lexical items too?

- Experiment 2: Sentential antonyms
- Experiment 3: Lexical antonyms
Experiments 2 & 3: Antonyms

• Experiment 2:
  • N = 50, Items = 60
  • RSVP, words presented for 350ms each
  • SOA = 650ms

• Experiment 3:
  • N = 50, Items = 60
  • Prime presented for 150ms on the screen
  • SOA = 650ms
Experiments 2 & 3: Results
Experiment 2 & 3: Results

• Experiment 2 (sentential antonyms):
  • Relatedness: $\beta = 0.0238$, SE = 0.008, df = 2846, $t = 2.93$, $p = 0.0034^*$

• Experiment 3 (lexical antonyms):
  • Relatedness: $\beta = 0.0248$, SE = 0.009, df = 2665, $t = 2.75$, $p = 0.0061^{**}$
Discussion

• Antonyms primed target words **both** when presented within sentences and when isolated
  • This could mean that antonyms cause priming that is unrelated to scalar implicature derivation

• The antonyms priming targets show that domain-general mechanisms operate in scalar implicature derivation

• No priming for scalars under negation

• The results are most compatible with the Alternative Activation Account
Negation processing

• One potential explanation for our results is that it is not informational strength relation reversal caused by negation that is at play, but *negation itself*

• Negated sentences have long been found to be harder to process when no context is given
  • see Kaup & Dudschig (2020) for an overview

• Lexical decision studies indicate that negation primes related terms at 100 ms and cancels priming at 1000 ms
  • Giora et al (2005); Hasson and Glucksberg (2006)
Conclusion

• We conducted experiments aimed at understanding activation when informational strength relations between the prime and target change.
• Negation seems to have cancelled priming for weak scalars.
• The results are overall consistent with the idea that comprehenders activate a slew of associated words and then narrow them down to function as alternatives based on contextual and grammatical constraints.


Gotzner, N., & Spalek, K. (2019). The life and times of focus alternatives: Tracing the activation of alternatives to a focused constituent in language comprehension. Language and Linguistics Compass, 13(2), e12310.


