



## 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.
    - ~ **Not all** students got an A.
  - 2) The soup was **warm**.
    - ~ 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
    - <cool, cold> and <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 = 0ms, Exp 2 SOA = 750ms
  
- Activation for both alternatives and associates at 0ms
- Only alternatives activated at 750ms

# Priming scalar alternatives



- 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?



# Ronai & Xiang (2023)

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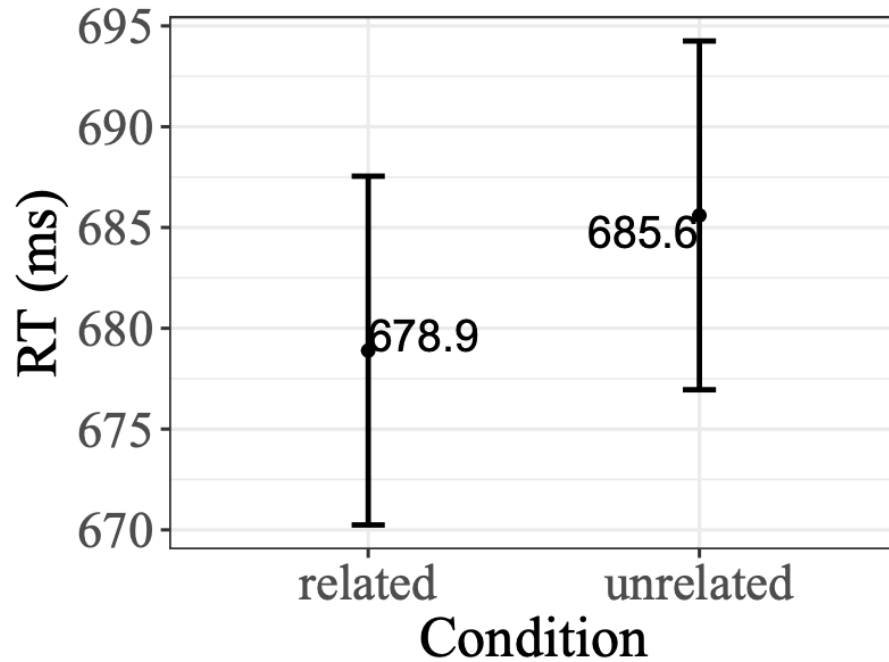
- Do weak scalars (*warm*) activate their stronger scale-mates (*hot*) during comprehension?
- Is this activation specific to sentential contexts?
- Does the inclusion of the particle *only* influence priming?

# Ronai & Xiang (2023)

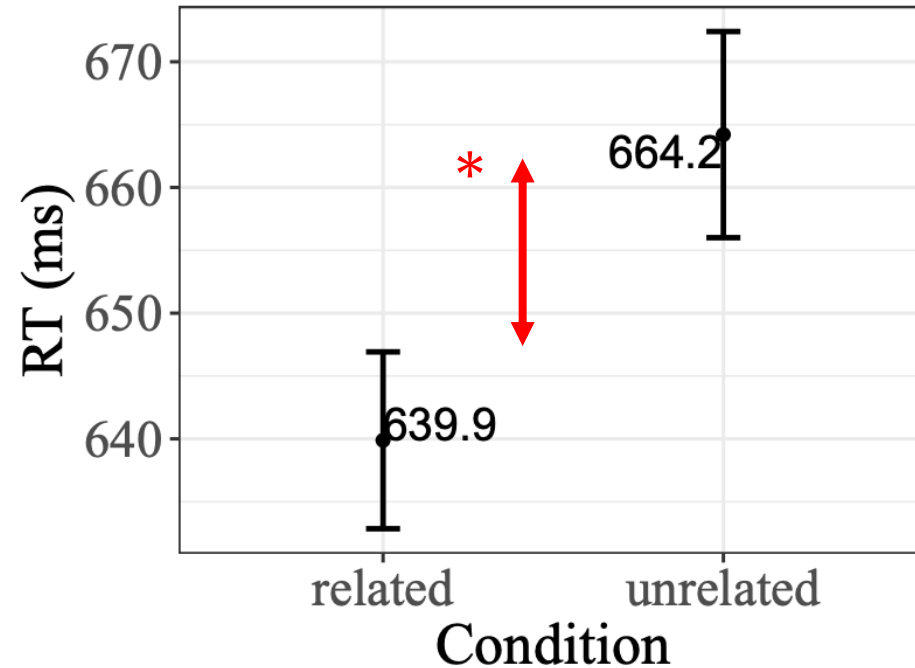


- Experiment 2: Lexical priming
  - Isolated weak scalar primes (*warm*) with lexical decision on the strong scalar target (*hot*)
- Experiment 3: Sentential context
  - 6) The soup is warm/vegetarian. (target: *hot*)
- Experiment 4: *Only*
  - 7) The soup is only warm/vegetarian. (target: *hot*)

# 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

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- 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

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- Single factor sentential experiments
  - Negated scale mates (Experiment 1)
  - Antonyms (Experiment 2)
- Single factor lexical experiments
  - Antonyms (Experiment 3)



# Processing accounts



- **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

*time*



Gotzner (2017)

# Predictions



Account/ Prime type	Scalar Account	Semantic Network Account	Alternative Activation Account
Scalars	✓	✓	✓
Negated Scalars	✗	✓	✗
Antonyms	✗	✓	✓

# 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



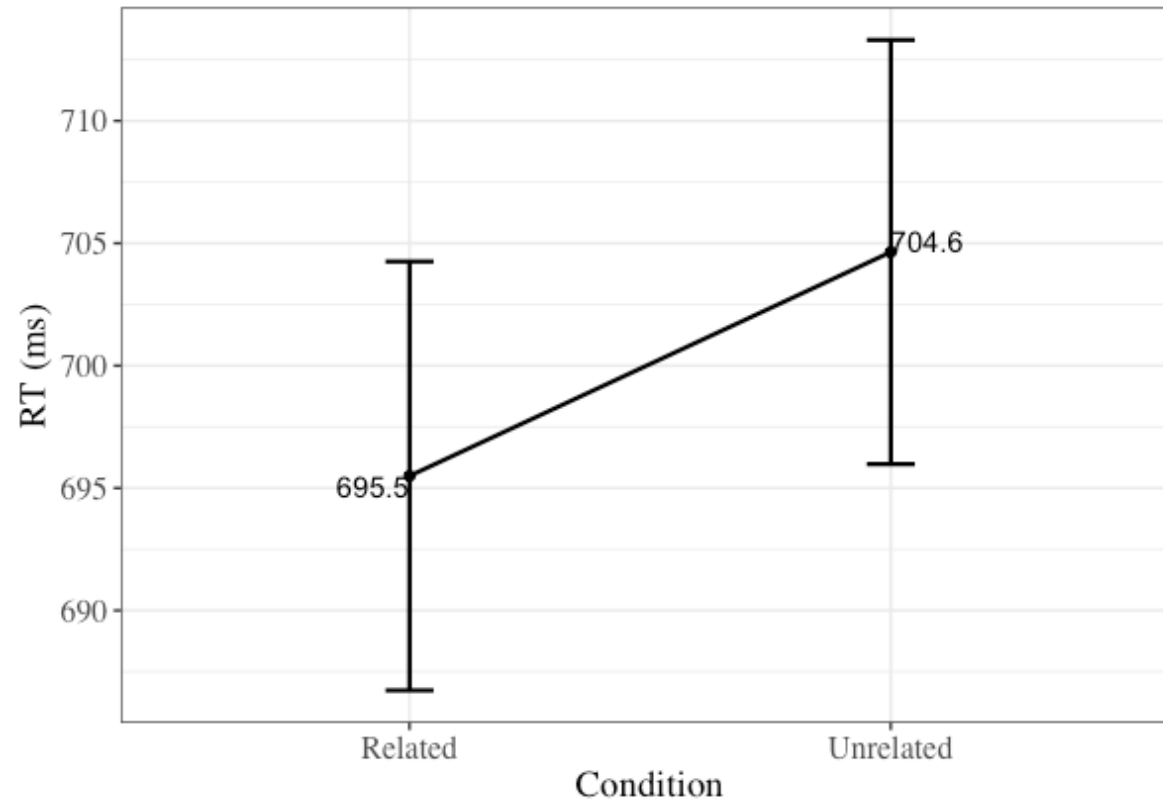
- Do scale-mates (*dirty*) still activate the target (*filthy*) when the latter is no longer informationally stronger?
- Scale reversal due to **constituent negation**

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



# 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

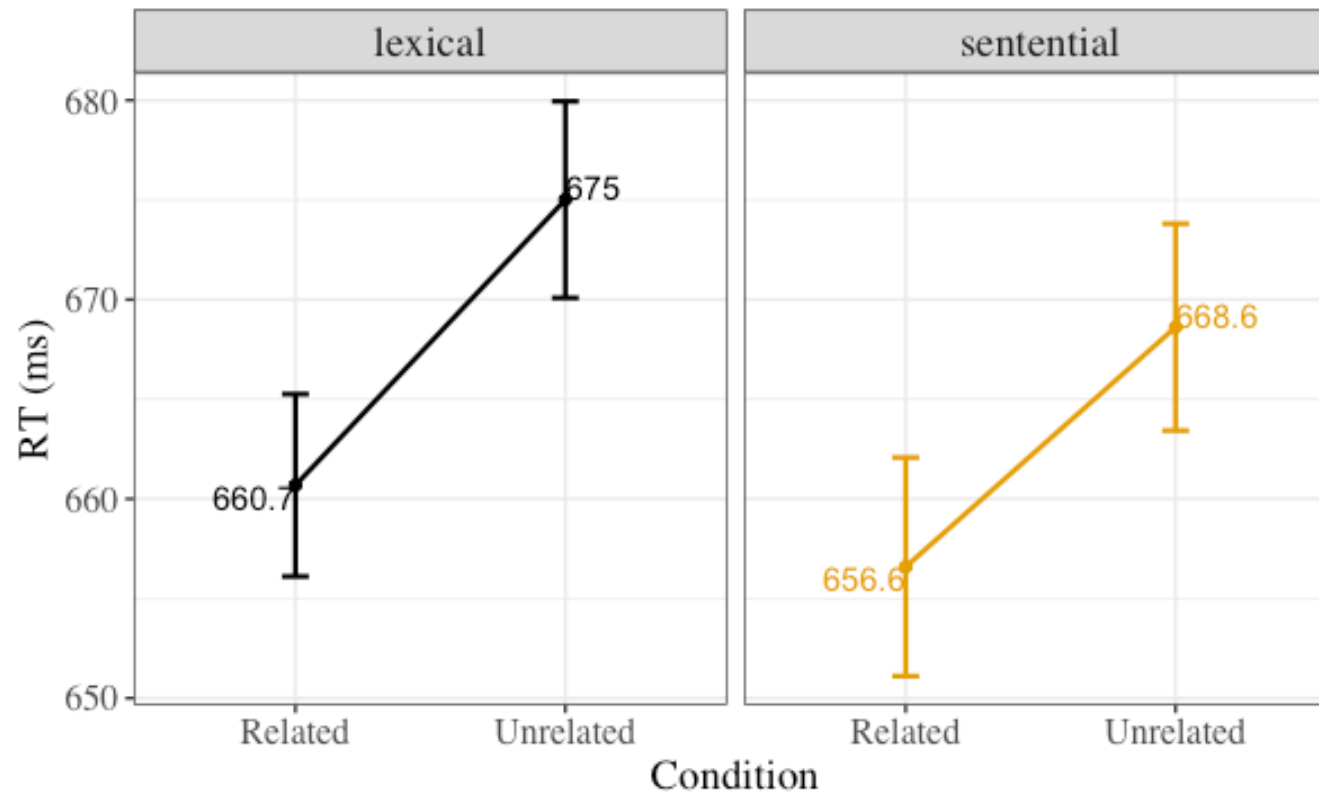


# Experiments 2 & 3: Antonyms



- 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

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- 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

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