Scalar diversity and negative strengthening

Anton Benz, Carla Bombi Ferrer & Nicole Gotzner

Leibniz Centre General Linguistics (ZAS)
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Scalar Implicature

Example (Often studied)
Mary ate some of the apples.
Scalar implicature: Mary didn’t eat all of the apples
Scale: $\langle \text{all}, \text{some} \rangle$

Example (Rarely studied)
Mary is content.
Scalar implicature: Mary is not happy.
Scale: $\langle \text{happy, content} \rangle$
A variety of scales

From v. Tiel et al (2016)

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjectives</td>
<td>⟨free, cheap⟩</td>
</tr>
<tr>
<td></td>
<td>⟨intelligent, brilliant⟩</td>
</tr>
<tr>
<td>Adverbs</td>
<td>⟨always, sometimes⟩</td>
</tr>
<tr>
<td></td>
<td>⟨necessarily, possibly⟩</td>
</tr>
<tr>
<td>Connectives</td>
<td>⟨and, or⟩</td>
</tr>
<tr>
<td>Determiners</td>
<td>⟨all, some⟩</td>
</tr>
<tr>
<td></td>
<td>⟨few, none⟩</td>
</tr>
<tr>
<td>Nouns</td>
<td>⟨dog, mammal⟩</td>
</tr>
<tr>
<td></td>
<td>⟨car, vehicle⟩</td>
</tr>
<tr>
<td>Verbs</td>
<td>⟨must, might⟩</td>
</tr>
<tr>
<td></td>
<td>⟨finish, start⟩</td>
</tr>
</tbody>
</table>
Uniformity assumption

Uniformity assumption:

▶ scale $\langle all, some \rangle$ representative for all scales. (p. 139)
▶ behaviour of one scale generalises to the whole family of scales (p. 140)
▶ all scales yield the same rate of scalar implicatures (p. 144)


▶ experimental study on a larger number of scales (43).
▶ results show great variability in rates of implicatures.
▶ conclusion: disproves uniformity hypothesis.
This talk

▶ experimental study on **negative strengthening** using the same set of scales.
▶ evaluate **correlation** between negative strengthening and scalar implicatures.
▶ show that a version of the uniformity hypothesis is **consistent** with data.
Section 1

An Experiment on Scalar Diversity

Van Tiel et al. 2016
John says:

She is content.

Would you conclude from this that, according to John, she is not happy?

☐ Yes  ☐ No

- MTurk Questionnaire for 25 participants
- 32 adjectives, 6 main verbs, 2 auxiliary verbs, 2 quantifiers, 1 adverb
Results

- High variance of proportion of YES answers
  ⇒ inconsistent with Uniformity hypothesis
Some examples

SI for various scales:

- $\langle \text{free, cheap} \rangle$: 100%
- $\langle \text{all, some} \rangle$: 96%
- $\langle \text{love, like} \rangle$: 50%
- $\langle \text{finish, start} \rangle$: 21%
- $\langle \text{happy, content} \rangle$: 4%
Section 2

Negative Strengthening
**R/I principle** (Horn, 1989; Levinson, 2000): Produce minimal linguistic expression sufficient to achieve your communicative ends

**Example (Negation of gradable adjectives)**

Mary is not happy
Semantics: Mary is less than happy
R/I implicature: Mary is unhappy

- Negative strengthening excludes middle ground, i.e. stronger interpretation than semantic negation
Measurement of Happiness

A scale reaching from happy to unhappy:

- content
  - happy
- not content
  - not happy

- Semantics of happy and not happy.
Measurement of Happiness

A scale reaching from happy to unhappy:

- semantic meaning of *not happy*: not happy
- quantity–implicature of *content*: *content
- R/I–implicature of *not happy*: not happy (negative strengthening)
Negative Strengthening and Scalar Implicature

- Participants interpret semantically.

---

John says:

*She is* content.

Would you conclude from this that, according to John, she is not happy?

- [ ] Yes
- [x] No
Negative Strengthening and Scalar Implicature

- Participants interpret **semantically**.
- Participants draw **scalar implicature**.

---

John says:

*She is* content.

Would you conclude from this that, according to John, she is **not happy**?

☑ Yes  □ No
Negative Strengthening and Scalar Implicature

- Participants interpret **semantically**.
- Participants draw **scalar implicature**.
- Participants apply **negative strengthening**.

John says:

_She is content._

Would you conclude from this that, according to John, she is **not happy**?

☐ Yes  ☑ No
v. Tiel et al.:

- \langle happy, content \rangle: 4% SI
- Control: unfounded inferences: 6% SI
- Lack of SI could be due to negative strengthening of not happy!
Arguments against explanation by negative strengthening  
(v. Tiel et al. 2016, p. 149):

1. Negative strengthening particularly robust for negated expressions. However, negated expressions generate scalar implicatures:
   - \langle impossible, difficult \rangle: 79%
   - \langle none, few \rangle: 75%
   - \langle unsolvable, hard \rangle: 71%
   - \langle unavailable, scarce \rangle: 62%
   - \langle unforgettable, memorable \rangle: 50%

2. Experiments by Doran et al. (2009, 2012) come to same conclusion:
   - Use picture verification task.
   - Should not be affected by negative strengthening.
Section 3

Testing for Negative Strengthening
A Sample Item

John says:

She is not happy.

Would you conclude from this that, according to John, she is not content?

☐ Yes    ☐ No

- MTurk Questionnaire with 40 participants
- Exactly the same conditions and fillers as v. Tiel et al. 2016, Exp. 1.
- 32 adjectives, 6 main verbs, 2 auxiliary verbs, 2 quantifiers, 1 adverb
Effect of Negative Strengthening

- Participants interpret **semantically**.

---

John says:

*She is not happy.*

Would you conclude from this that, according to John, she is **not content**?

☐ Yes  ☑ No
Effect of Negative Strengthening

- Participants interpret semantically.
- Participants apply negative strengthening.

John says:

*She is not happy.*

Would you conclude from this that, according to John, she is not content?

- [ ] Yes
- [ ] No
Testing for Negative Strengthening

Results

- High variance of proportion of YES answers
  ⇒ Negative strengthening not uniformly distributed
Some examples

SI & NS for various scales:

<table>
<thead>
<tr>
<th>Scale</th>
<th>SI</th>
<th>NS</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨free, cheap⟩</td>
<td>100%</td>
<td>28%</td>
</tr>
<tr>
<td>⟨all, some⟩</td>
<td>96%</td>
<td>42%</td>
</tr>
<tr>
<td>⟨love, like⟩</td>
<td>50%</td>
<td>43%</td>
</tr>
<tr>
<td>⟨finish, start⟩</td>
<td>21%</td>
<td>14%</td>
</tr>
<tr>
<td>⟨exhausted, tired⟩</td>
<td>4%</td>
<td>69%</td>
</tr>
<tr>
<td>⟨happy, content⟩</td>
<td>4%</td>
<td>92%</td>
</tr>
</tbody>
</table>
## Negative Expressions

SI & NS for scales with negative expressions:

<table>
<thead>
<tr>
<th>Scale</th>
<th>SI</th>
<th>NS</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨impossible, difficult⟩</td>
<td>79%</td>
<td>25%</td>
</tr>
<tr>
<td>⟨none, few⟩</td>
<td>75%</td>
<td>31%</td>
</tr>
<tr>
<td>⟨unsolvable, hard⟩</td>
<td>71%</td>
<td>43%</td>
</tr>
<tr>
<td>⟨unavailable, scarce⟩</td>
<td>62%</td>
<td>58%</td>
</tr>
<tr>
<td>⟨unforgettable, memorable⟩</td>
<td>50%</td>
<td>56%</td>
</tr>
</tbody>
</table>

- Negative strengthening not particularly strong
- Contradicts claim by v. Tiel et al.
Correlation between SI and NS

- Axis: negative strengthening (NS)
- y-Axis: scalar implicature (SI)

Anti-correlation:
- Spearman rank correlation: -0.463, p-value < 0.002
Section 4

The Uniformity Hypothesis
Uniformity Hypothesis

Uniformity assumption:
- Scale \( \langle all, some \rangle \) representative for all scales. (p. 139)
- Behaviour of one scale generalises to the whole family of scales (p. 140)
- All scales yield the same rate of scalar implicatures (p. 144)

There exists \( S \) such that for all scales \( i \):

\[
S_o(i) = S \quad (S_o(i) = \text{observed rate of SIs})
\]

⇒ In this form incorrect as Doran et al. and v. Tiel et al showed.
- Has not been defended by anyone (to my knowledge).
Uniformity Hypothesis

Unmodified uniformity hypothesis:

There exists constant $S$ such that for all scales $i$:

$$S_0(i) = S$$
Uniformity Hypothesis

Special Uniformity hypothesis:

Uniformity hypothesis
There exists constant $S$ such that for all scales $i$:

$$S_o(i) = S \ast (1 - n_o(i))$$

- Scalar implicature can be cancelled by negative strengthening.
- $n_o(i)$: observed rate of negative strengthening for item $i$.
- SI is inferred with probability $S$ except negative strengthening occurs.
Fitted value of $S$ (43 items): 0.772206
Mean (predicted − observed): −0.0236088
Standard deviation: 0.297902
M and L Scales

L-Scale (all–some):
- Weak expression covers everything from lower end to strong expression.

M-Scale (happy–content):
- Weak expression starts somewhere in the middle and reaches up to strong expression.
Fitted Model (M scales)

- Fitted value of $S$ (32 items): 0.800808
- Mean (predicted − observed): 0.0203298
- Standard deviation: 0.215635
Fitted Model (L scales)

- Fitted value of $S$ (11 items): 0.733525
- Mean (predicted − observed): −0.139947
- Standard deviation: 0.454593
Conclusions

► Special uniformity hypothesis consistent with data.
► Found numerical correlation between two different types of implicature:
  — Scalar implicature (Q–implicature)
  — Negative strengthening (I/M–implicature)
► Outlook:
  — Correlation between SI and NS may be sensitive to general scale structure
  — Finer typology of scales can be motivated by numerical analysis
Thank you for your attention!
References I

Pragmatics and the lexicon.  


References II

*A Natural History of Negation.*  

Negated antonyms: Creating and filling the gap.  

*Presumptive Meanings: The Theory of Generalized Conversational Implicatures.*  
Appendix: Selection of Scales (v. Tiel et al.)

Search Internet / Corpora for:

- X if not Y
- X or even Y
- not just X but Y

With:

- X: weak scale mate
- Y: strong scale mate

Includes scales in which

- X is more frequent than Y
- other way round
Appendix: Possible explanations of variance

v. Tiel et al tested correlation of following parameters with % of SI:

- Boundedness: is scale open or bounded (has endpoint): significant correlation
- Semantic distinctness (distance between strength of scalemates)
- No other significant correlation.
  - availability of lexical scales (cloze task)
  - grammatical class (open/closed)
  - word frequency
  - semantic relatedness (latent semantic analysis)