Scalar diversity and negative strengthening

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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: ⟨*all, some*⟩

Example (Rarely studied)

Mary is content.
Scalar implicature: Mary is not happy.
Scale: ⟨*happy, content*⟩

A variety of scales

From v. Tiel et al (2016)

Category	Examples	
Adjectives	⟨*free, cheap*⟩	⟨*intelligent, brilliant*⟩
Adverbs	⟨*always, sometimes*⟩	⟨*necessarily, possibly*⟩
Connectives	⟨*and, or*⟩	
Determiners	⟨*all, some*⟩	⟨*few, none*⟩
Nouns	⟨*dog, mammal*⟩	⟨*car, vehicle*⟩
Verbs	⟨*must, might*⟩	⟨*finish, start*⟩

Uniformity assumption

v. Tiel et al (2016)

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)

B. van Tiel, E. van Miltenburg, N. Zevakhina, & B. Geurts (2016):

- 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

A Sample Item

John says:

She is content.

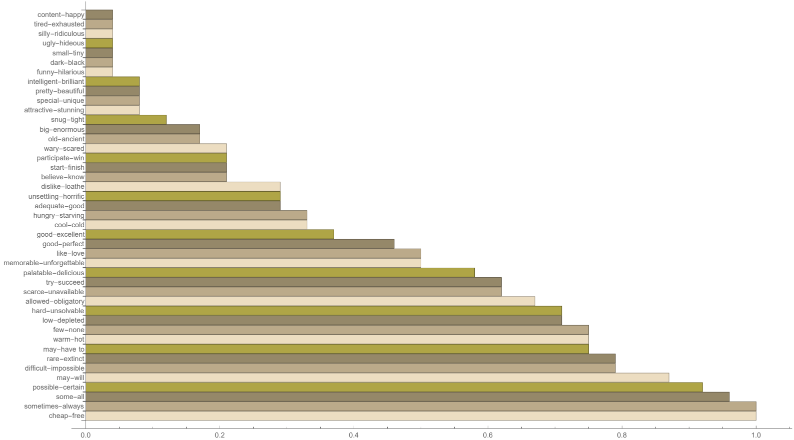
Would you conclude from this that, according to John, she is not happy?

☐ Yes ☐ No

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

Results

Out[53]=



- High variance of proportion of YES answers

⇒ inconsistent with Uniformity hypothesis

Some examples

SI for various scales:

- $\langle$*free, cheap*$\rangle$: 100%
- $\langle$*all, some*$\rangle$: 96%
- $\langle$*love, like*$\rangle$: 50%
- $\langle$*finish, start*$\rangle$: 21%
- $\langle$*happy, content*$\rangle$: 4%

Section 2

Negative Strengthening

Negative Strenghtening

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

Example (Negation of gradable adjectives)

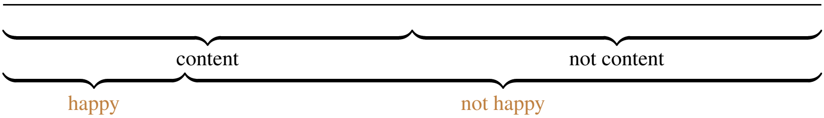
Mary is not happy
Semantics: Mary is less than happy
R/I implicature: Mary is unhappy

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

Measurement of Happiness

Horn 1989, Levinson 2000, Blutner 2004, Krifka 2007

A scale reaching from happy to unhappy:

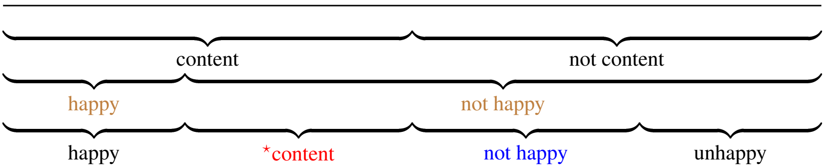


- Semantics of **happy** and **not happy**.

Measurement of Happiness

Horn 1989, Levinson 2000, Blutner 2004, Krifka 2007

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 ☑ 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

Scalar Implicature and Negative Strengthening

v. Tiel et al.:

- ⟨*happy, content*⟩: 4% SI
- Control: unfounded inferences: 6% SI
- Lack of SI could be due to negative strengthening of *not happy*!

Scalar Implicature and Negative Strengthening

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:
   - — ⟨*impossible, difficult*⟩: 79%
   - — ⟨*none, few*⟩: 75%
   - — ⟨*unsolvable, hard*⟩: 71%
   - — ⟨*unavailable, scarce*⟩: 62%
   - — ⟨*unforgettable, memorable*⟩: 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.

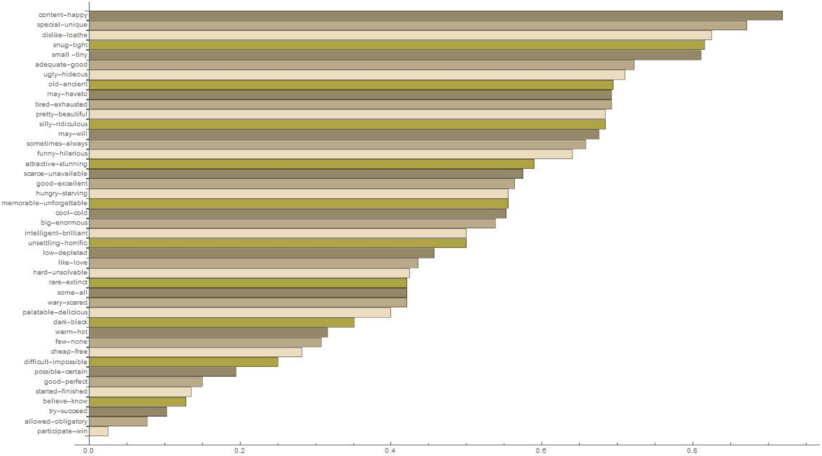
John says:

She is not happy.

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

☑ Yes ☐ No

Results



- High variance of proportion of YES answers

⇒ Negative strengthening not uniformly distributed

Some examples

SI & NS for various scales:

Scale	SI	NS
⟨*free, cheap*⟩:	100%	28%
⟨*all, some*⟩:	96%	42%
⟨*love, like*⟩:	50%	43%
⟨*finish, start*⟩:	21%	14%
⟨*exhausted, tired*⟩:	4%	69%
⟨*happy, content*⟩:	4%	92%

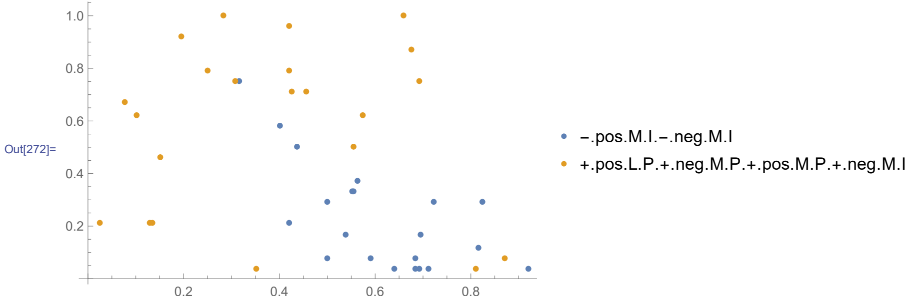
Negative Expressions

SI & NS for scales with negative expressions:

Scale	SI	NS
⟨*impossible, difficult*⟩:	79%	25%
⟨*none, few*⟩:	75%	31%
⟨*unsolvable, hard*⟩:	71%	43%
⟨*unavailable, scarce*⟩:	62%	58%
⟨*unforgettable, memorable*⟩:	50%	56%

- Negative strengthening not particularly strong
- Contradicts claim by v. Tiel et al.

Correlation between SI and NS



- *x*–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

v. Tiel et al (2016)

Uniformity assumption:

- Scale ⟨*all, some*⟩ 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:

Uniformity hypothesis

There exists constant S such that for all scales i:

$$S_o(i) = S$$

Uniformity Hypothesis

Special Uniformity hypothesis:

Uniformity hypothesis

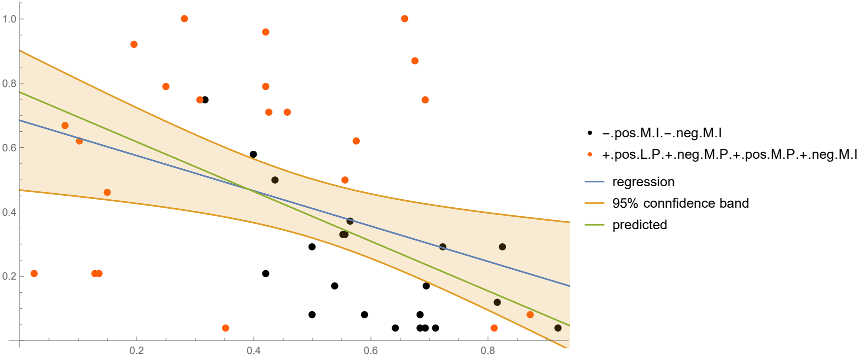
There exists constant S such that for all scales i:

$$S_o(i) = S * (1 - n_o(i))$$

- 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 Model (all Data)

Out[323]=



- Fitted value of S (43 items): 0.772206
- Mean (predicted − observed): −0.0236088
- Standard deviation: 0.297902

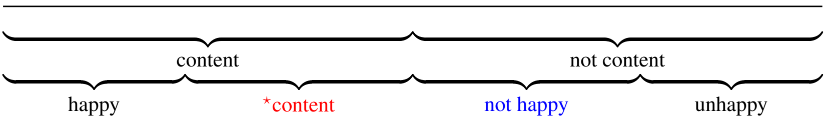
M and L Scales

L-Scale (all–some):

- Weak expression covers everything from lower end to strong expression.

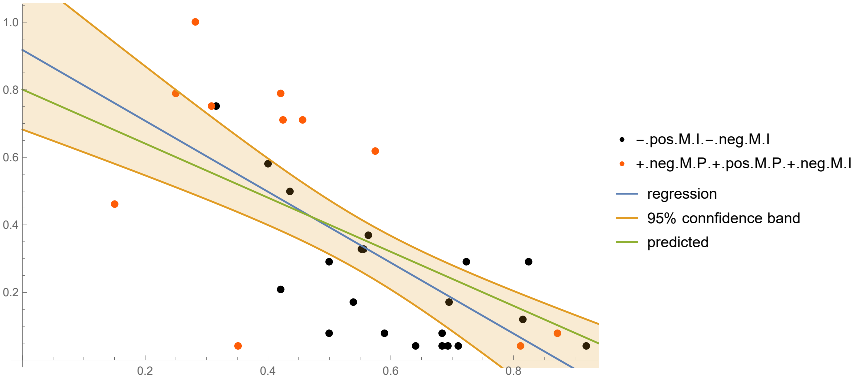
M-Scale (happy–content):

- Weak expression starts somewhere in the middle an reaches up to strong expression.



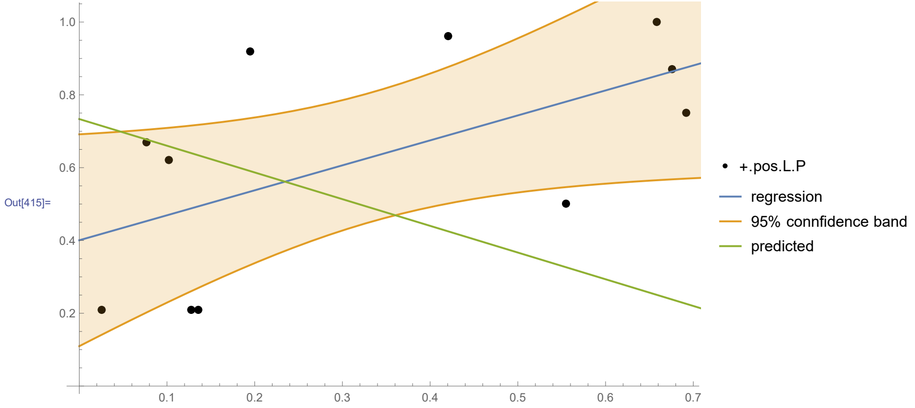
Fitted Model (M scales)

Out[369]=



- 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!

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[6] Stephen C. Levinson.
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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)