Non-literal interpretation of number words

Hyperbole and round interpretations in RSA: Kao et al. (2014)

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Computational Pragmatics 2018

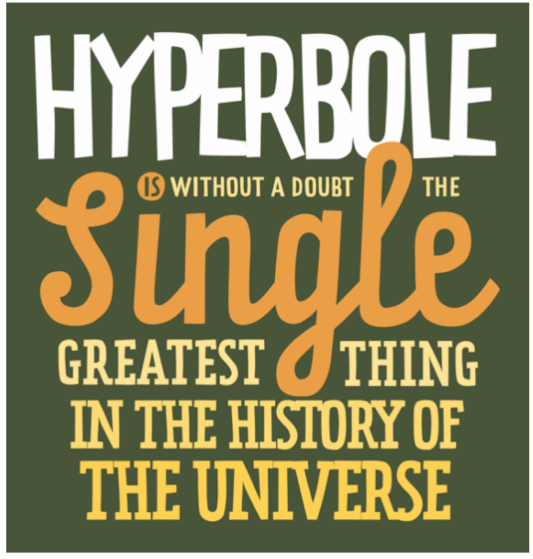
Phenomena to be dealt with

Hyperbole

the use of exaggeration to create emphasis or convey strong emotional feeling

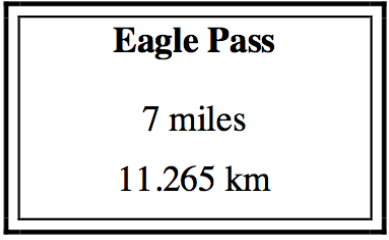
Pragmatic halo: loose talk

allowable imprecision in the use of precise expressions (Lasersohn, 1999)


HYPERBOLE
IS WITHOUT A DOUBT THE
single
GREATEST THING
IN THE HISTORY OF
THE UNIVERSE

Failure of the metric system

Why did the metric system not catch on [in the US]? There are many reasons. But one that cannot be taken lightly is that certain well-intended public relation attempts intended to familiarize the American people with the metric system just did not work. Since the Metric Conversion Act, road distances in National Parks are often given in miles and kilometers. And since then, travelers encounter signs like the following one:



It is not hard to see why road signs like [this] suggest that the metric system is something for intellectuals, or "rocket scientists", far too unwieldy for everyday purposes.

from Krifka (2002)

Non-literal interpretation

Problem

- RSA speaker will never use a message that is literally false
- RSA listener will never assign positive probability to false interpretation

Solution

listener makes a joint inference over:

- world state
  - e.g., prize of a watch
- speaker affect
  - e.g., whether the speaker is aroused or not
- speaker's goal
  - whether to convey information about prize precisely or loosely
  - whether to convey information about prize and/or speaker's affect

Model preliminaries

Composite states

$$S = \{x \pm k \mid x \in \{50, 500, 1000, 5000, 10000\}, k \in \{0, 1\}\}$$ worlds

$$A = \{0, 1\}$$ affect

$$T = S \times A$$ states

$$U = S$$

Speaker goals

$$g : S \times A \to S \cup A \cup S \times A$$

value $g(s, a)$	speaker wants to convey
s	precise info about world
Round(s)	loose info about world
a	info about affect state
s, a	info about world (precise) and affect
Round(s), a	info about world (loose) and affect

Joint-inference of speaker-goal (QUD)

"Filtering speaker" version

$$P_{LL}(s, a \mid u) = P_A(a \mid s) P(s \mid [\![u]\!])$$

$$P_{S_1}(u, \mid s, a, g; \alpha, C) \propto \exp\left(\alpha \left(\log\left(\sum_{s', a' \,:\, g(s', a') = g(s, a)} P_{LL}(s', a' \mid u)\right) - C(u)\right)\right)$$

$$P_{L_1}(s, a, g \mid u; \alpha, C) \propto P_S(s) \cdot P_A(a \mid s) \cdot P_G(g) \cdot P_{S_1}(u, \mid s, a, g; \alpha, C)$$

assume $P(g) = P(g)$ for all g, g'

Joint-inference of speaker-goal (QUD)

"Variable pass" version

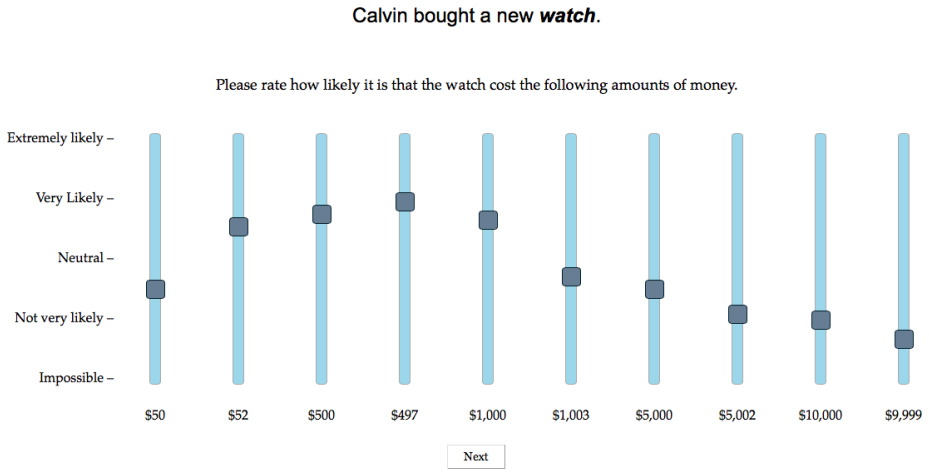
$$P_{LL}(x \mid u, g) = \sum_{s,a \,:\, g(s,a)=x} P_A(a \mid s) P(s \mid [\![u]\!])$$

$$P_{S_1}(u, \mid s, a, g; \alpha, C) \propto \exp\left(\alpha \left(\log P_{LL}(g(s,a) \mid u) - C(u)\right)\right)$$

$$P_{L_1}(s, a, g \mid u; \alpha, C) \propto P_S(s) \cdot P_A(a \mid s) \cdot P_G(g) \cdot P_{S_1}(u, \mid s, a, g; \alpha, C)$$

assume $P(g) = P(g)$ for all g, g'

State prior $P_S(s)$



Affect prior $P_A(a \mid s)$

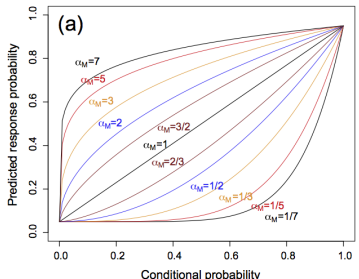
Linking function

Problem

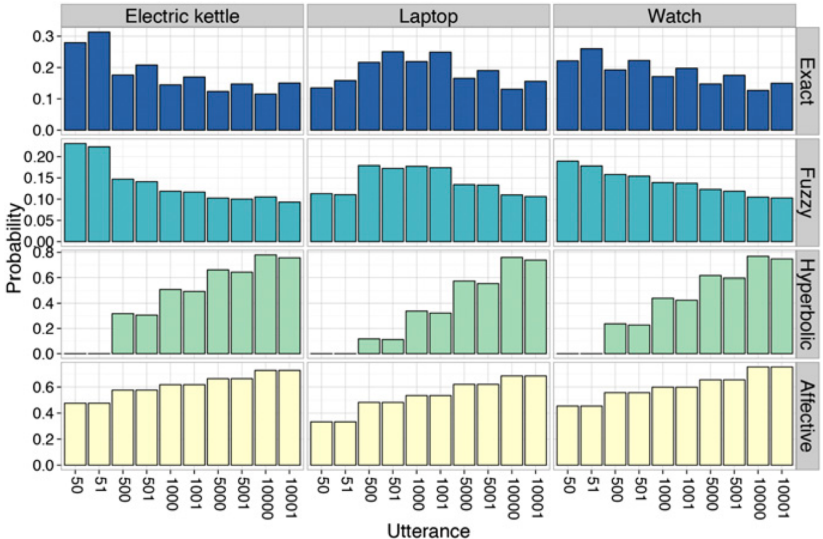
- model's R_2 predicts probabilities for s and a
- data are slider ratings
- map need not be identity: subjects may like or eschew extreme ratings

Solution: power-law link function

Prediction(slider rating x | parameters, α) $\propto R_2(x \mid \text{parameters})^{\alpha}$



Model predictions



$d = 2.4$, $\alpha = .25$

Experiment 1

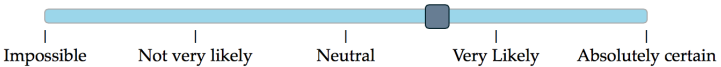
Step 1: affect

Nathan bought a new ***watch***.

A friend asked him, "Was it expensive?"

Nathan said, "It cost 5,000 dollars."

How likely is it that Nathan thinks the watch was expensive?



http://stanford.edu/~justinek/hyperbole-paper/materials/experiment1.html

Experiment 1

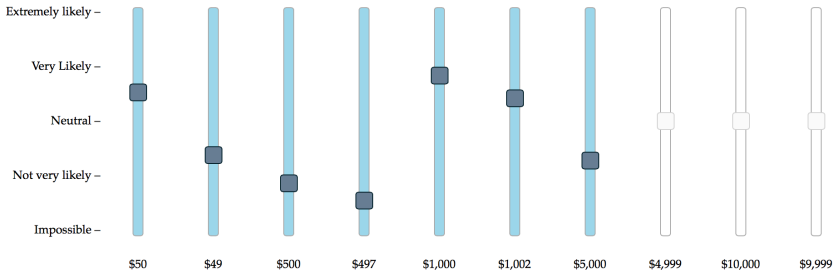
Step 2: prize

Nathan bought a new ***watch***.

A friend asked him, "Was it expensive?"

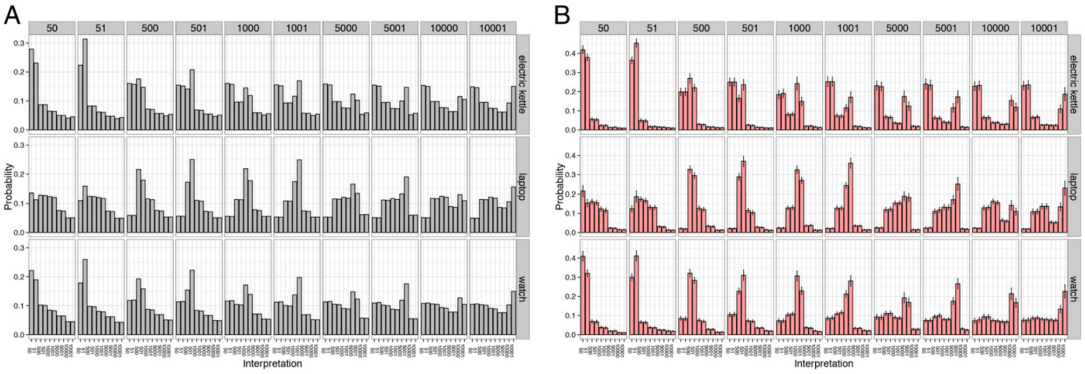
Nathan said, "It cost 5,000 dollars."

Please rate how likely it is that the watch cost the following amounts of money.



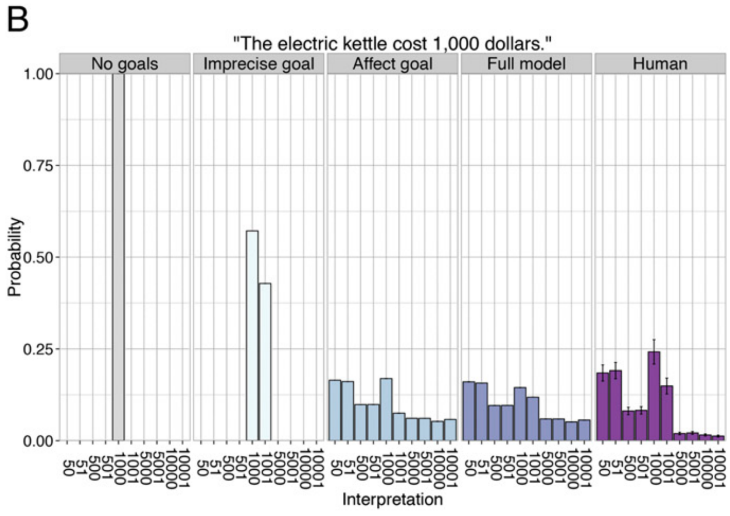
http://stanford.edu/~justinek/hyperbole-paper/materials/experiment1.html

Model predictions: prize interpretation



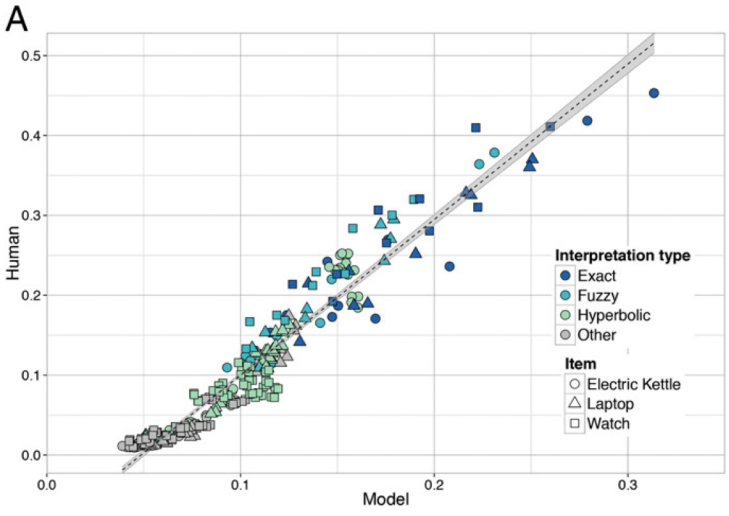
$d = 2.4$, $\alpha = .25$

Model predictions: prize interpretation component-wise



$d = 2.4$, $\alpha = .25$

Prediction-observation correlation



correlation: $r = 0.968$, $d = 2.4$, $\alpha = .25$

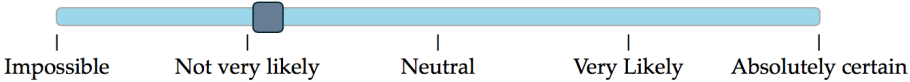
Experiment 2: affect interpretation

Gary had to buy a new ***watch*** that cost him 53 dollars.

A friend asked him, "Was it expensive?"

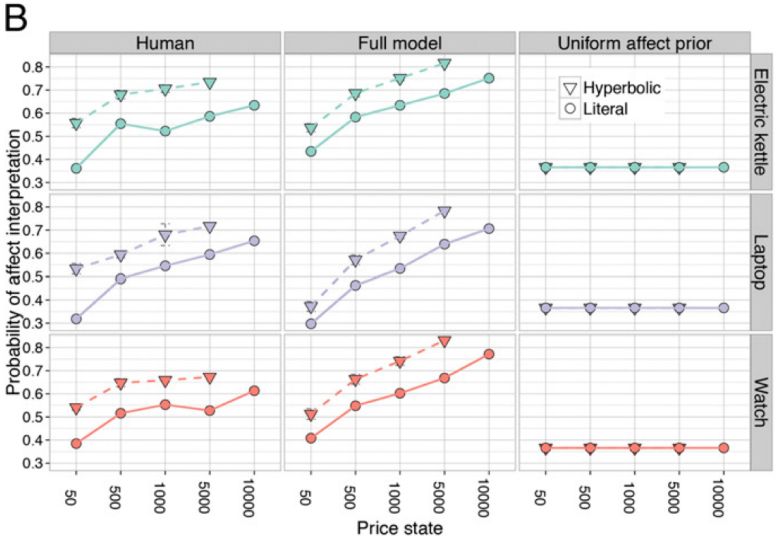
Gary said, "It cost 5,003 dollars."

How likely is it that Gary thinks the watch was expensive?



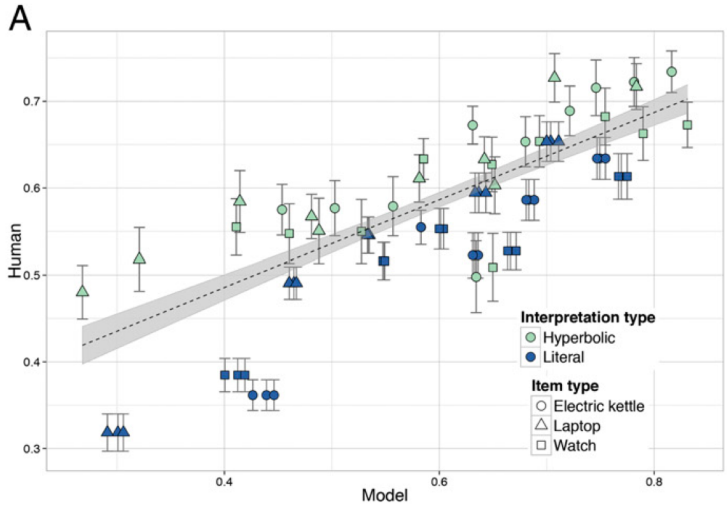
http://stanford.edu/~justinek/hyperbole-paper/materials/experiment2.html

Model predictions: affect interpretation component-wise



$d = 2.4$, $\alpha = .25$

Prediction-observation correlation



correlation: $r = 0.775$, $d = 2.4$, $\alpha = .25$

References

Kao, Justine T. et al. (2014). "Nonliteral Understanding of Number Words". In: *PNAS* 111.33, pp. 12002–12007.

Krifka, Manfred (2002). "Be Brief and Vague! And How Bidirectional Optimality Theory Allows for Verbosity and Precision". In: *Sounds and Systems. Studies in Structure and Change. A Festschrift for Theo Vennemann*. Ed. by D. Restle and D. Zaefferer. Berlin: Mouton de Gruyter, pp. 439–458.

Lasersohn, Peter (1999). "Pragmatic Halos". In: *Language* 75.3, pp. 522–551.