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Pragmatic enrichments of modified fractions

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Motivation

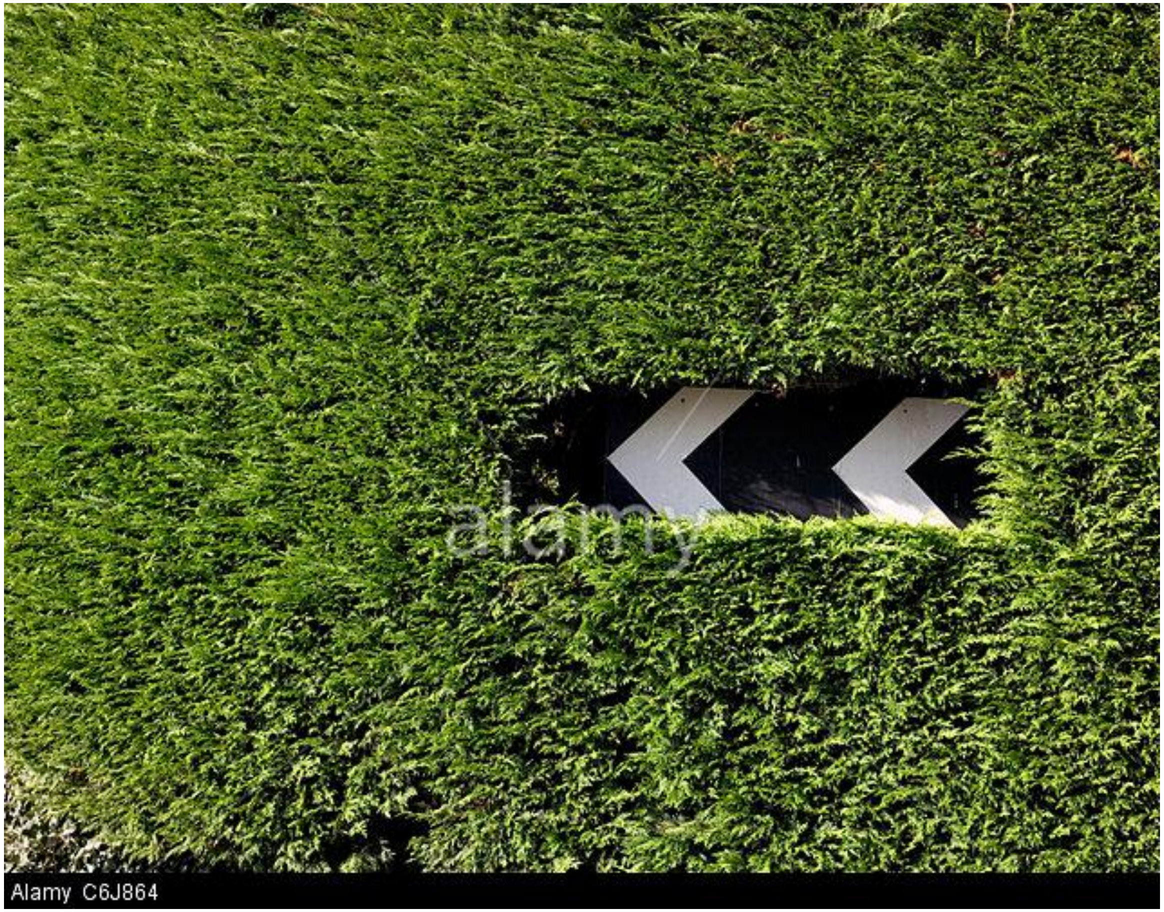
- Why study (modified) fractions?
  - Indication of how we **cognize about number**
- Why be interested in their pragmatics?
  - Indication of how we **reason about alternatives**

- **Granularity** as a concept that covers those aspects
  - But perhaps a little more to it than that

Modified fractions

- Fractions (2/3, 1/2, 4/5, etc.) modified by expressions such as “more/less than”, “about”, “almost”, etc.
  - Williams and Power call these *hedges*, but I think that’s potentially misleading
  - Focusing here on “directional hedges”, which might almost be a contradiction in terms

A directional hedge



Use

- Modified fractions used quite widely
  - Including in “high-stakes” contexts
  - Long-running debate in the medical literature about how to convey quantity information effectively
  - e.g. 32%, or “about a third”, or “almost one in three”, or “more than three in ten”, or “some”?
- Relatively little semantic and pragmatic research on this, with the notable exception of “more than half”

“More than half” vs. “most”

- Semantic similarity motivates a closer look (Solt, in press)
  - Some distributional differences:

    *More than half of / *most coin tosses land heads.*

    *More than half / *most of the US population is female.*

    *Federer has won most / *more than half of the Slams since 2003.*
- Evidence for a more complex, or polysemous, meaning for *most*
- Also raises the question of whether pragmatic enrichments are in play, based on the existence of alternatives

- But what about the pragmatic enrichments that could arise due to the existence of other modified fractions?

Quantity implicatures from fractions

- Does “more than a quarter” implicate “less than half”?
- Does “more than ¾” implicate “less than nine-tenths”?

- Easy to explain on classic Gricean grounds, when these readings do happen to arise:
  - *more than F => not more than G,* where G > F
- However, not obvious which G we consider for a given F

Choosing alternatives

- It can't just be all stronger alternatives: the fractions are dense in the reals, so the implicature would be too strong
  - "more than F" !=> "not more than F"
- It doesn't seem to be all reasonably computable stronger alternatives
  - "more than a half" !=> "not more than five-ninths" (although the reverse might be true)
- It also doesn't seem to be all equally lexicalized alternatives, à la Horn

Idea: appeal to granularity

- Krifka (and others): scales can differ in their density of representation points
- Time domain a notable example
  - *I got home at 6:07pm* vs. *I got home at 6pm*
- Similar point can be made for number (Krifka 2009)
  - *103 people were there* vs. *100 people were there*
- Correspondingly, can obtain pragmatic bounds based on alternatives of the right granularity (Cummins et al. 2012)
  - *More than 80 people* => *Not more than 90/100 people*
  - *More than 80 people* !=> *Not more than 81 people*

Granularity of fractions

- Each denominator defines a granularity level
  - Therefore predict implicatures about the next term on the scale: *more than ¼* => *not more than ½* (=2/4)
- However, fractions not well-behaved
  - Krifka posits that scale points should divide up the space systematically (for obvious reasons) and that coarse-grained scale points should also be scale points on fine-grained scales
  - For fractions, this tends not to hold, at least not when we combine scales, e.g. fifths and halves, quarters and tenths, etc.
- Which is to be master?
  - Do we choose scales, implicitly, so as to respect granularity considerations, or do we care only about the numerical properties?

Implicatures as a guide to scales

- Idea: perhaps we can test for the psychological reality of the various scale levels by seeing which implicatures work
- Potentially interesting because
  - mapping the domain might help us address practical communicative problems that arise in it
  - understanding how this works could offer insights into how we deal with number, and with operations such as division
  - pragmatically, we might learn something about how people use informationally stronger options that may or may not be 'scalar'

First pilot studies

- Two questionnaires (15 and 14 items) fielded separately on Mechanical Turk (n=20 for each)
  - v1 aimed at “less than one quarter/fifth…” and counterparts
  - v2 aimed at quarters, fifths, tenths

A market research company has conducted a detailed survey on a large group of people, and has written up the results. For instance, “More than 50% of the participants are female”, “Less than 20% of the participants own two cars”, and so on.

You’re now going to read some expressions that have been used to summarise the results from the survey. For each one, please state the range of possible values, in percent, that you think the expression means.

For example, if the expression is “about half”, you might say that that means between 45% and 55%, or between 40% and 60%, etc.

There are no ‘correct’ answers: we’re interested in knowing what you think.

Outcome

- Three kinds of responses
  - Literal, no implicature – 0%/100% bound (about half the responses)
  - Apparent implicatures connected with stronger scale points
    - Sometimes of equally coarse or coarser granularity: *more than one tenth* = 10-20%, *more than a quarter* = 25-50%
    - Sometimes of finer granularity: *more than three quarters* = 75-90%
  - A few enrichments that don't seem to associate with scalar alternatives (but occur multiple times and don't look like errors)
    - *more than three quarters* = 75-85%, *more than four fifths* = 80-95%

Follow-up: order of presentation?

- Possible to get “ad hoc” scales for quantity too
- Test: two versions of a similar small experiment
  - v1: thirds and sixths, then tenths
  - v2: tenths, then thirds and sixths
- Little sign of any effect due to order:
  - Tenths are a salient alternative to thirds/sixths in some cases; the reverse is generally not true

(Necessarily tentative) conclusion

- Small samples, and eliciting percentages not ideal…
- However, appears that there is a clear distinction between what is coarse-grained and what is salient
  - Normal “rules” of granularity do not seem to apply here

And speculatively…

- Classic scalar implicatures involve clearly defined scales
  - Although theorists may have over-posited (van Tiel et al.)
- For fractions, we may have a different picture of which alternatives are in play than our interlocutor does
- Potentially risky to adopt a classically Gricean interpretative strategy
  - Could we be relying on something more like typical interpretations? Is that what's going on in the cases of unusual pragmatic bounds?
- Better explanations still, sincerely, welcomed