Gradability, Scale Structure and Vagueness

# Modified fractions, granularity and scale structure

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# Aims

- an explicit and detailed account of the use, mental representation, online processing, neural correlates or acquisition of expressions of gradability, scalarity, and vagueness

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- an account of the use, mental representation, processing, of expressions of gradability, scalarity, and vagueness
- Specifically, the interpretation of modified fractions
  - “More than a half”
  - “Less than a quarter”
  - “About two fifths”

# “More than a half”

- See Solt (in press)
- Particularly of interest for its contrast with “most”, which naively we might think has the same truth-conditions
- Critical data include differences in distribution

  *More than half of Americans are female*

  *?With 36%, the Conservatives won most of the votes*
- Semantic difference, or pragmatic difference e.g. based on competition for selection?

# Today, a slightly different question…

- How do modified fractions “compete” with other modified fractions?
- And what can this tell us about granularity, scale structure, and numerical cognition in general?

# Before the data, some intuitions

- “More than a quarter of households are affected by fuel poverty”
  - +> “Less than a half of households…”
- “More than four-fifths of business executives in Europe want Britain to stay in the EU”
  - ?+> “Not more than nine-tenths…”

# If that's so, why?

- Something to do with the distribution of the representation points on the relevant scale
- Here, "fractions" and (let's say) the interval (0, 1)
- But they are all over this scale (by which I mean "everywhere dense on the unit interval")

- So, for these particular enrichments to go through, the space of alternatives must be tightly constrained
  - Otherwise, why not "more than a quarter" +> "less than two sevenths?"

# Idea: granularity

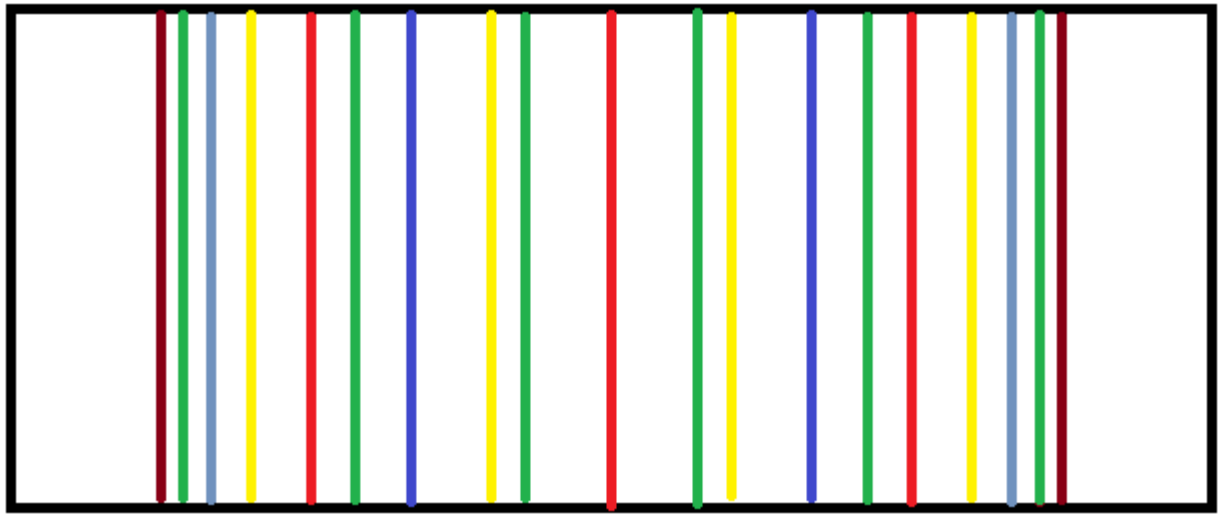
- Various plausible subsets of the fractions (halves, quarters, tenths, …)
- Krifka (and others): scales can differ in their density of representation points
- Different levels of precision called for under different circumstances
  - e.g. 103m to junction vs. Olympic 100m final

# Properties of granularity scales

- Scale points are systematic in how they divide up the available space
  - Sometimes uniform (10, 20, 30), sometimes logarithmic (million, billion, trillion)
- Different granularity levels coincide in their scale points
  - A coarse-grained scale point is also a scale point on finer-grained scales
  - Facilitates conversion between levels; perhaps crucial to meaning of coarse-grained scale points that there is a choice

# Fractions' potential scales

- Doesn't apply well to fractions…



# Properties of granularity scales

- Are these necessary properties of scales?
  - e.g. 25s scale vs. 10s scale?
- Fractions constitute a convenient testbed, because we could choose sets of fractions that obeyed these rules
  - e.g. <halves, quarters, eighths>, <halves, fifths, tenths>
- Do we do so?

- We can check by looking at the pragmatic interpretation of modified fractions

# Granularity and modified numerals

- Cummins, Sauerland and Solt (2012): pragmatic bounds from modified numerals (e.g. “more than 80”)
  - Upper-bound “not more than 100” inferred, in this case

- Different (opposite) theoretical motivation
  - Argued that “more than *n*” did not give rise to scalar implicature, on the basis of examples such as “John has more than 3 children”
  - No breakthrough in understanding the scale structure of numerals!
  - For fractions, the “more than” implicature doesn’t seem problematic, but the scale structure is little-studied

# Why study this?

- Because it's there…
- Because of the implications for how we cognise about number, particularly how we use divisors
  - Conjectured to be relevant for the use of number in general
- Because, practically, expressions of this type are very widely used to convey information, and we should care about how they do so…

# Introducing some pilot data…

- Many possible subquestions of the overarching issue: these include
  - Do we get range interpretations from modified fractions that take into account the location of the next scale point?
  - If so, do these interpretations get influenced by coarser-grained scale points on the way (*more than 7/10 -> not more than 3/4*)?
  - And do they get influenced by finer-grained scale points (*less than 1/4 -> not less than 1/10*)?

# 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.

# Summary of results

- We do get pragmatically restricted ranges
  - v1: 300 responses: 75 incorrect, 114 literal, 111 pragmatic
  - v2: 280 responses: 18 incorrect, 119 literal, 143 pragmatic
- Many of these reflect granularity
  - Examples: *more than one tenth* – 7 UBs at 19% or 20%; *less than nine tenths* – 7 LBs at 81%
- Some bounds based on "coarser" alternatives
  - Examples: *more than seven tenths* – 4 UBs at 74% or 75%; *more than two fifths* – 6 UBs at 49% or 50%
- Some bounds based on "finer" alternatives
  - 10% and 90% as bounds; 75% as UB for *more than a half* (but…)

# Potential implications

- Under these circumstances, participants are demonstrating interpretations based on finer-grained alternatives
- Perhaps not all that surprising
- Perhaps offering some kind of general moral about the somewhat flexible nature of quantity implicatures?

# Outlook

- Would like to gather some more data, to get a better map of the domain of fractions, as seen by users
  - Also to explore whether these readings are context-dependent, e.g. in high-stakes communication
- Question for discussion: is (any of) this interesting? And if so, which parts should be focused on?