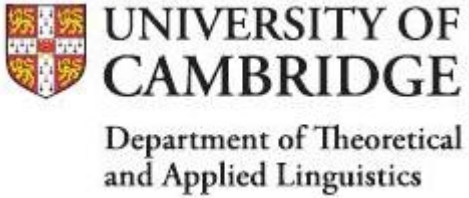
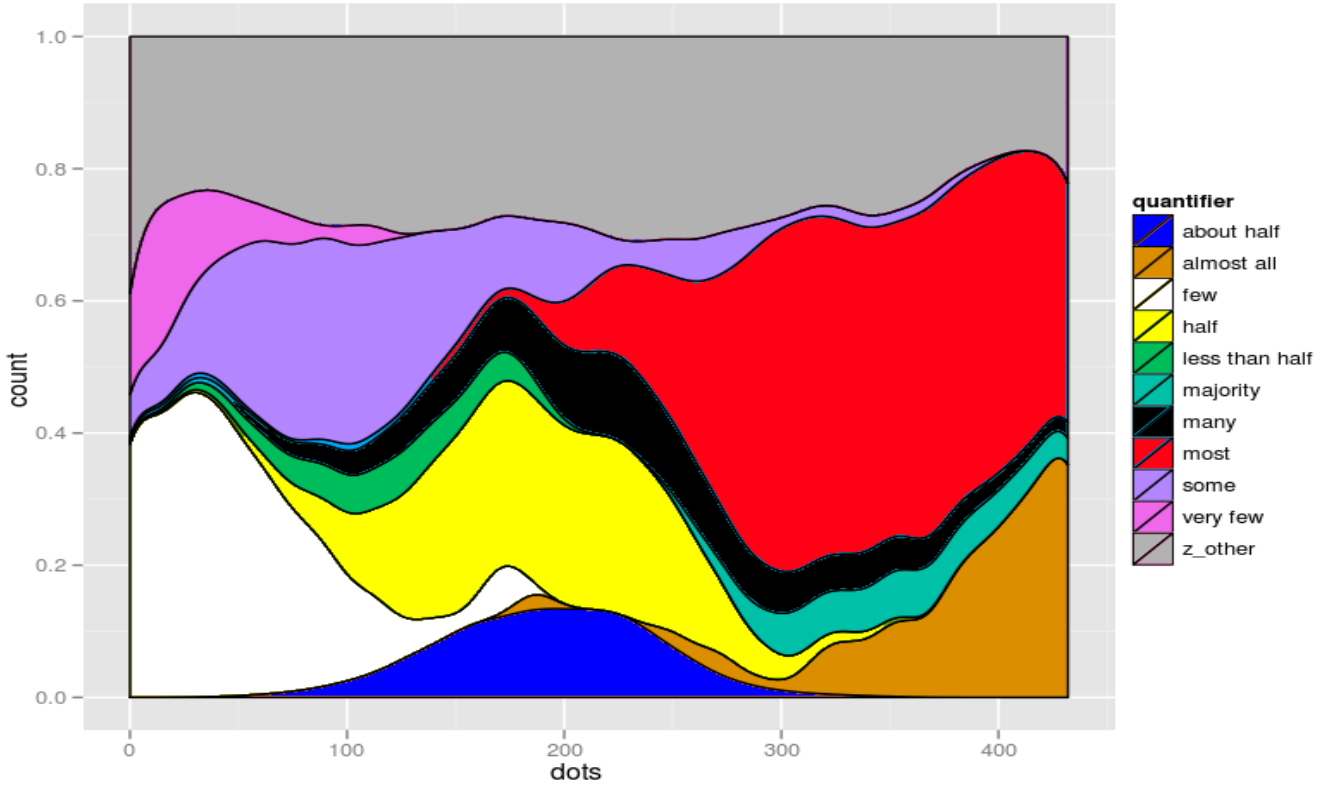



# Constraints on quantifiers

Chris Cummins
DTAL, University of Cambridge

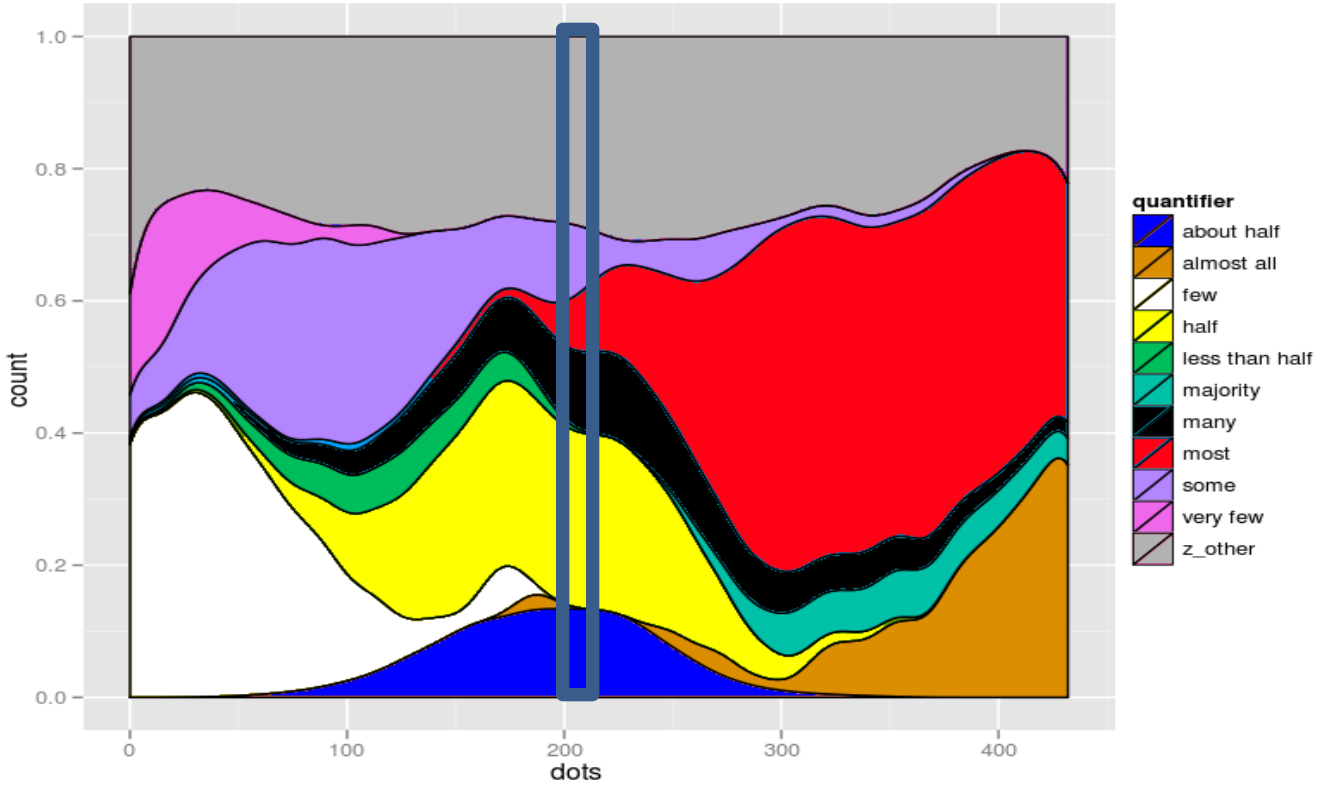
PUQOL workshop at ESSLLI, 8-12 August 2011

# The luxury of choice…



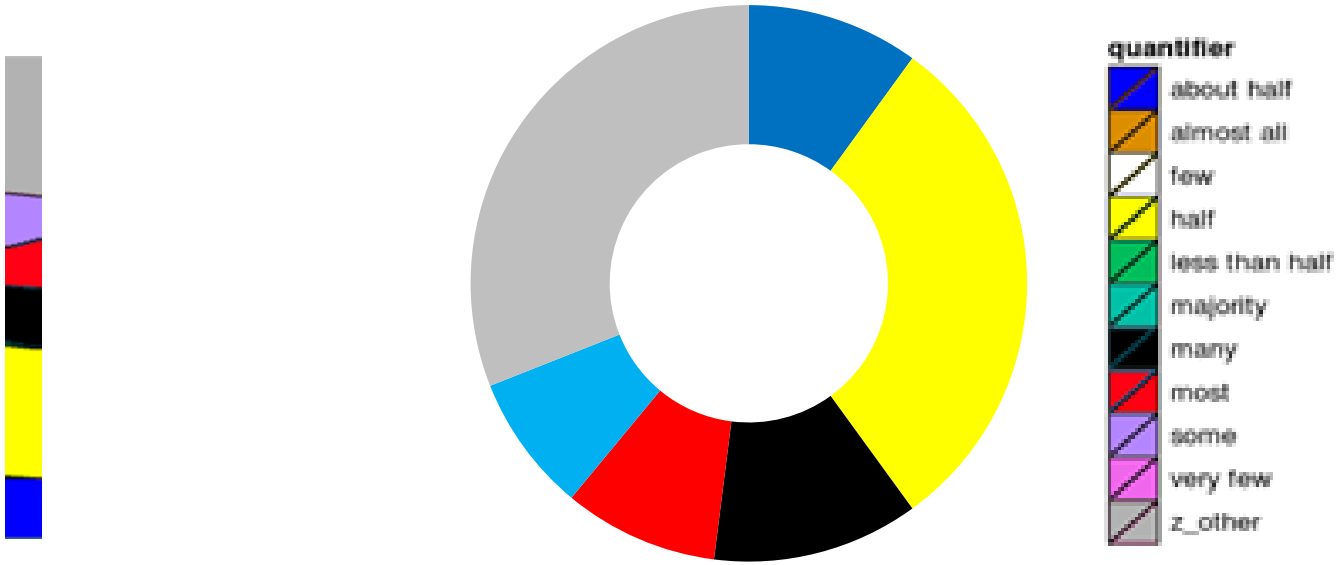

Bååth, Sauerland, and Sikstrøm (in preparation)

# Speaker's perspective

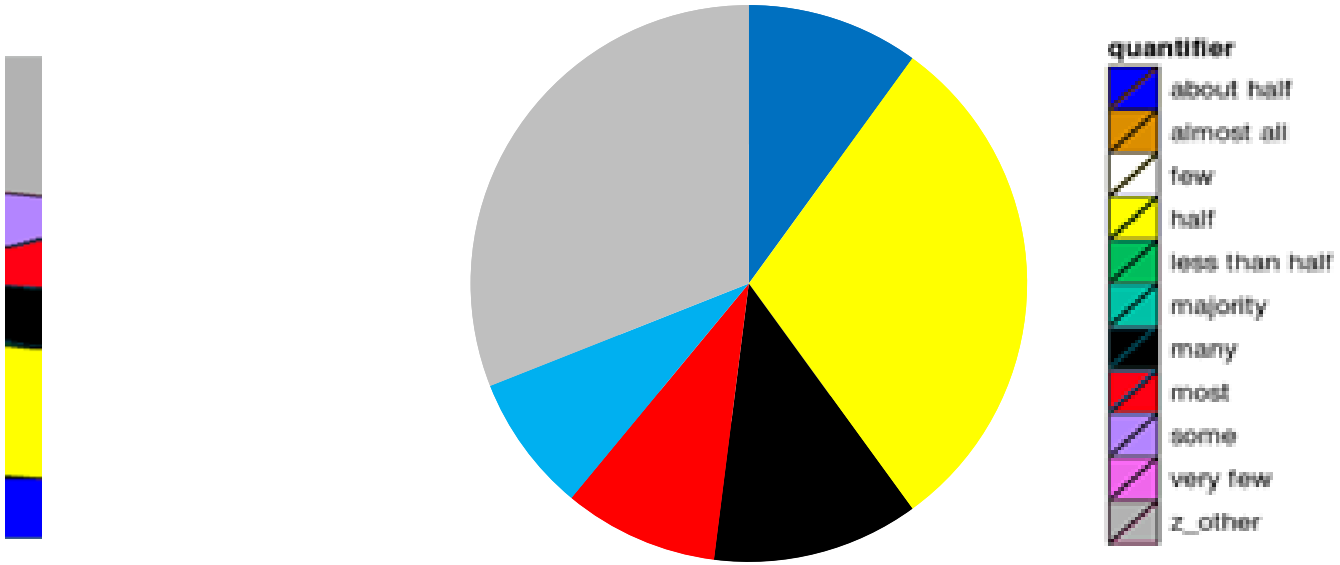



Bååth, Sauerland, and Sikstrøm (in preparation)

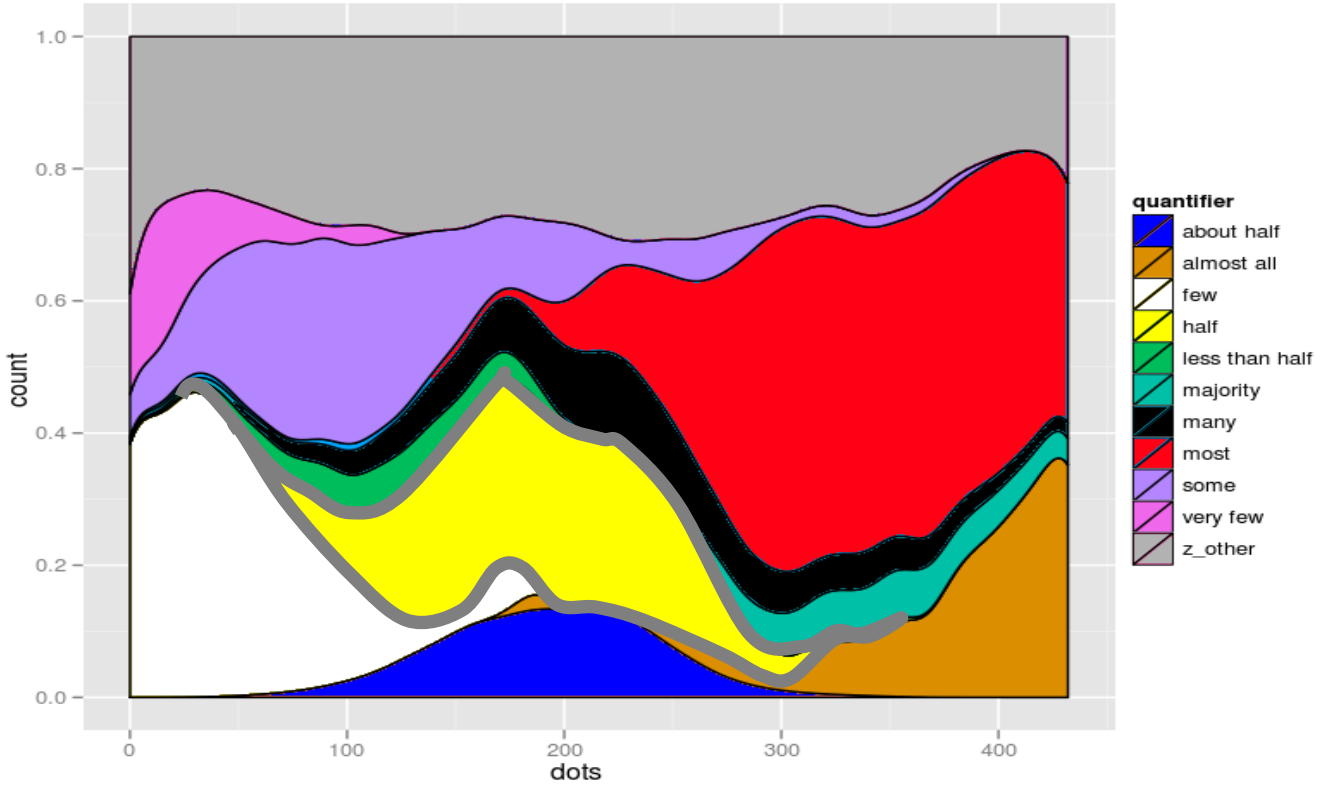
# Speaker’s perspective (200 dots)



# Speaker’s perspective (200 dots)



# Hearer's perspective




Bååth, Sauerland, and Sikstrøm (in preparation)

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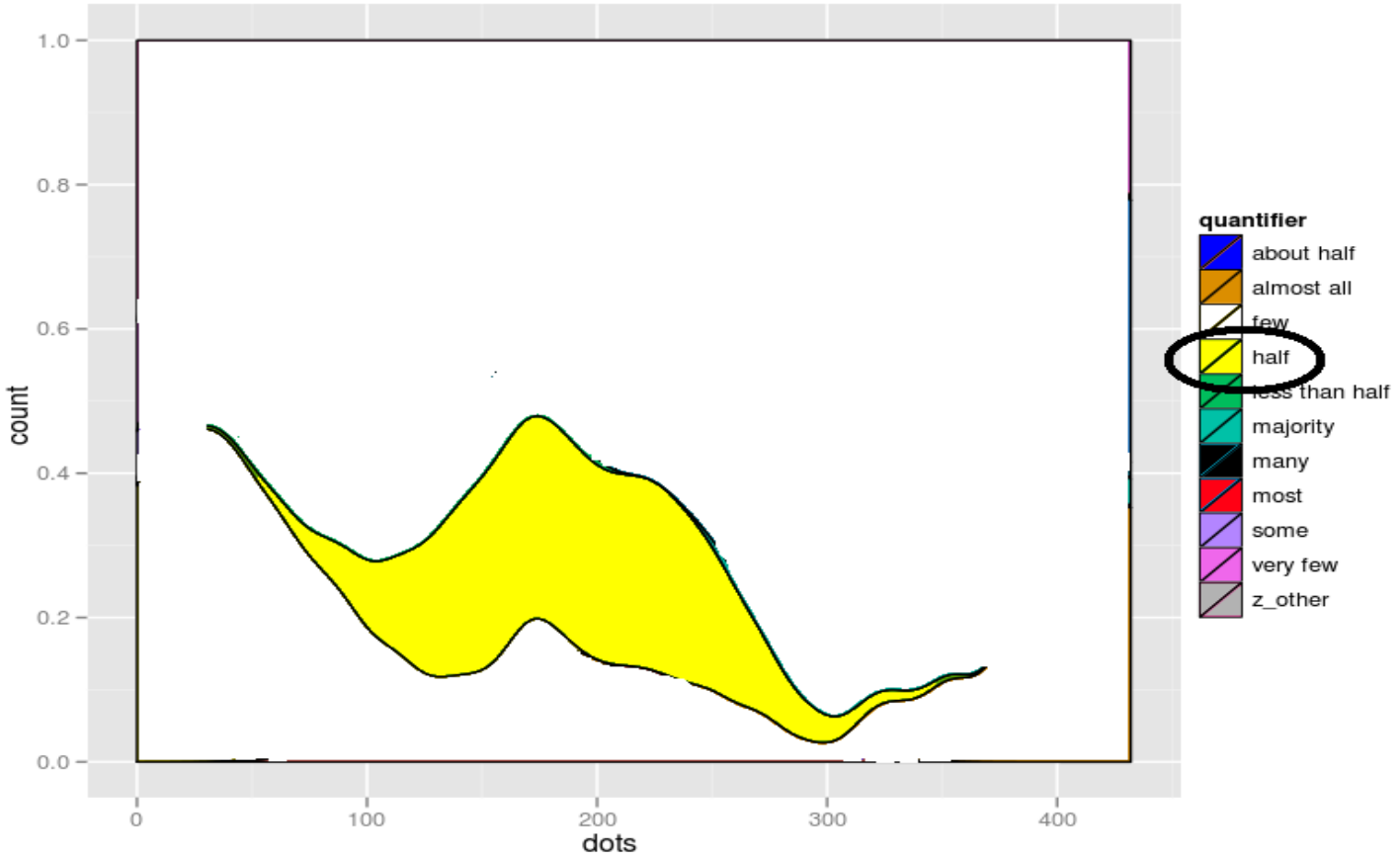

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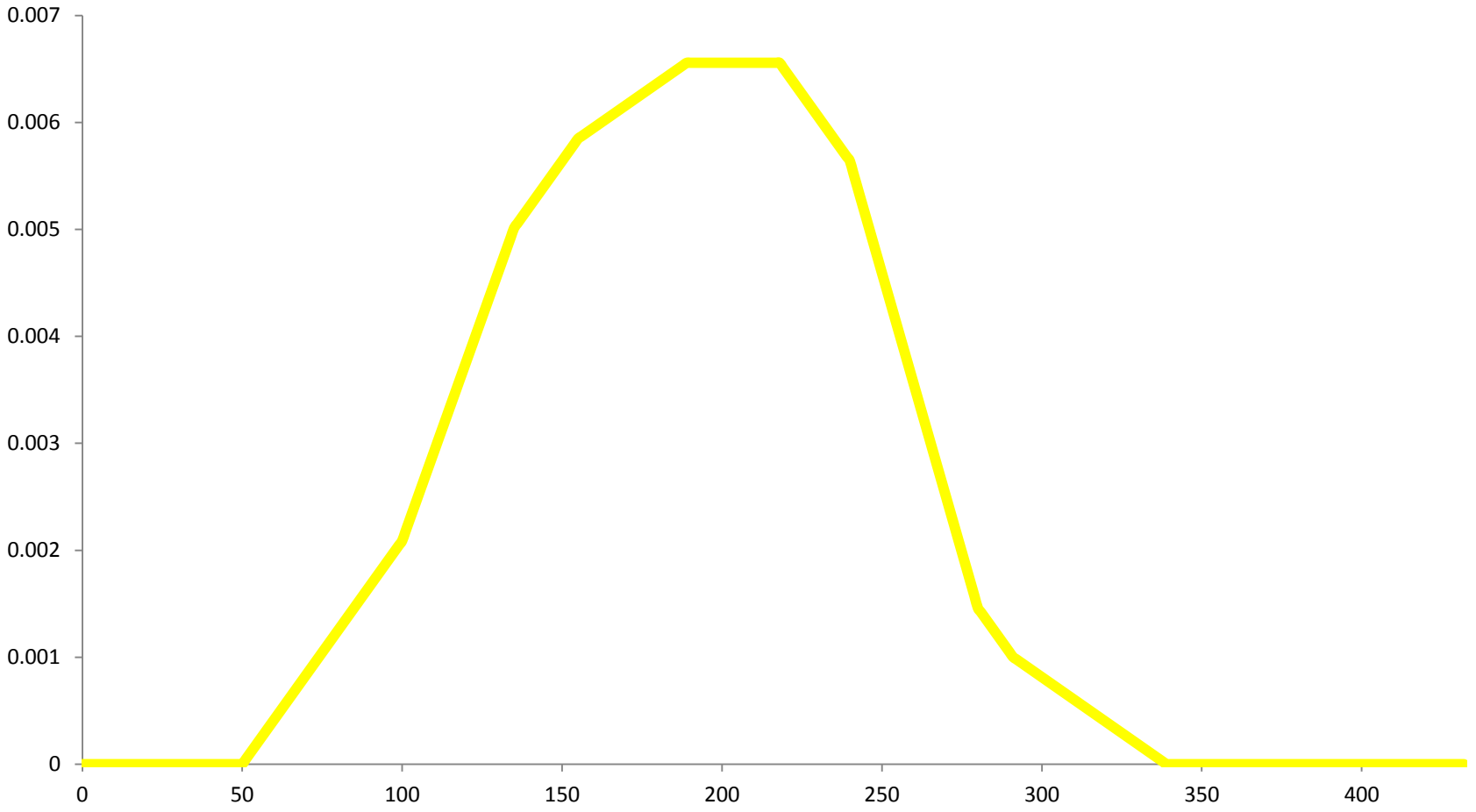


# Usage and interpretation…

- Speakers are not choosing arbitrarily among possible semantically correct utterances
  - Why?
  - What are they doing?
- This information could enable hearers to adjust their interpretation of utterances
  - How?
  - Are they doing this?

# Numerical quantification

- (Perhaps infinitely) many semantically truthful options are available for the speaker's use in a given situation

*More than 20/19/18…*

*Fewer than 25/26/27…* …boats are in the harbour

*Between 20 and 25/19 and 26…*

# Determining the optimal utterance

- Considering the 'competitor' utterances

  "more than 22"
  "more than 20"
  "between 20 and 30"…
- Arguments for and against each
- No intuitively clear winner
- Relevance appears only to offer post hoc explanation

# Soft constraints?

- Idea: model speaker's decision procedure as a problem of multiple constraint satisfaction

- Advantages:
  - Theoretical frameworks exist to do this
  - Can yield quantifiable, testable predictions
  - Constraints have (accidentally) been studied…

# Example: time reporting

- Van der Henst and colleagues
  - Precise vs. imprecise elicitation contexts
  - Analogue vs. digital watches
- Predictable trends analysed in RT terms
- However, individual factors touched upon:
  - Informativeness
  - Communicative preference for roundness
  - *(implicitly)* Numeral priming from watch-face
  - *(implicitly)* Granularity requirement

# Proposed constraints

- Informativeness (e.g. Van der Henst, Carles and Sperber 2002)
- Numeral salience (e.g. Jansen and Pollmann 2001)
- Quantifier simplicity (e.g. Cummins and Katsos 2010)
- Granularity (e.g. Krifka 2009)
- Numeral / quantifier priming

- Functionally motivated/empirically validated
- Cross-disciplinary (cf. Musolino 2004)

# Constraint-based model of speaker's choice

- Two main components:
  - (Individually) ranked list of relevant constraints
  - Selection procedure to determine optimal utterance
- Classical Optimality Theory account
  - Speaker-referring
  - Unidirectional
- Constraints are:
  - Preferably observed
  - Non-obligatory
  - Defined such that their violations can be quantified

# Example 1: ‘more than *n*’

- Problem:
  - ‘more than *n*’ seems to resist implicature
  - yet ‘more than 100’ seems to convey two bounds
- Constraint-based account
  - Consider ‘more than *n*’ vs. ‘more than *m*’
  - If *m* > *n*, and speaker knows ‘more than *m*’ holds, *m* preferred unless (potentially)
    - *m* is less **salient** numeral than *n*
    - *m* is not a scale point at relevant **granularity** level
    - *n* is **primed** and *m* is not

# Prediction

- ‘more than *n*’ +> ‘not more than *m*’…
  - strongly if ‘more than *m*’ is a good candidate with respect to the relevant constraints
    - More specifically, if ‘more than *m*’ **harmonically bounds** ‘more than *n*’
  - weakly if not

# Experimental verification

***Information:*** A newspaper reported the following.

"[Numerical expression] people attended the public meeting about the new highway construction project."

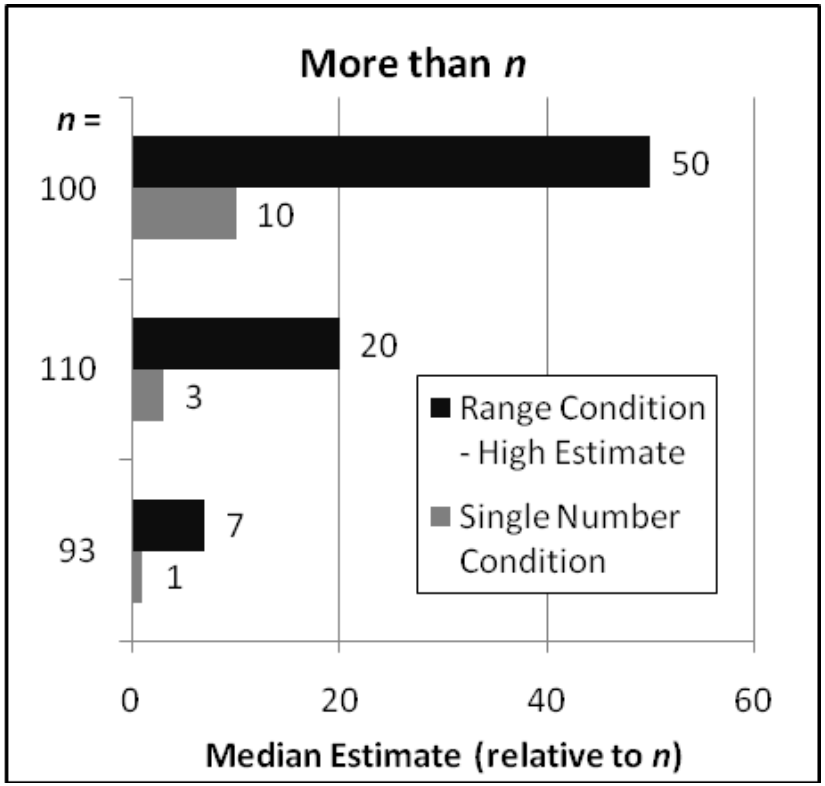
***Question:*** Based on reading this, how many people do you think attended the meeting?

Between _____ and _____ people attended [range condition]

_____ people attended [single number condition].

Cummins, Sauerland and Solt (submitted)

# Experimental verification




Fielded on MTurk: 100 participants per condition

ANOVAs show significant effects in both conditions ($p < 0.05$)

Comments reflect explicit awareness of this reasoning

# Effect of priming

- Less obvious prediction:
  - **Prior mention of numeral attenuates implicature**

A: We need to sell (*n*) tickets to break even.
B: We've already sold more than *n* tickets.

- No prior mention
  - Hearer reasons as before
- Prior mention
  - Speaker could have said 'more than *m*' for some *m* > *n*…
  - …but maybe chose 'more than *n*' to satisfy numeral priming…
  - …so implicature not available.

# Experimental verification (2)

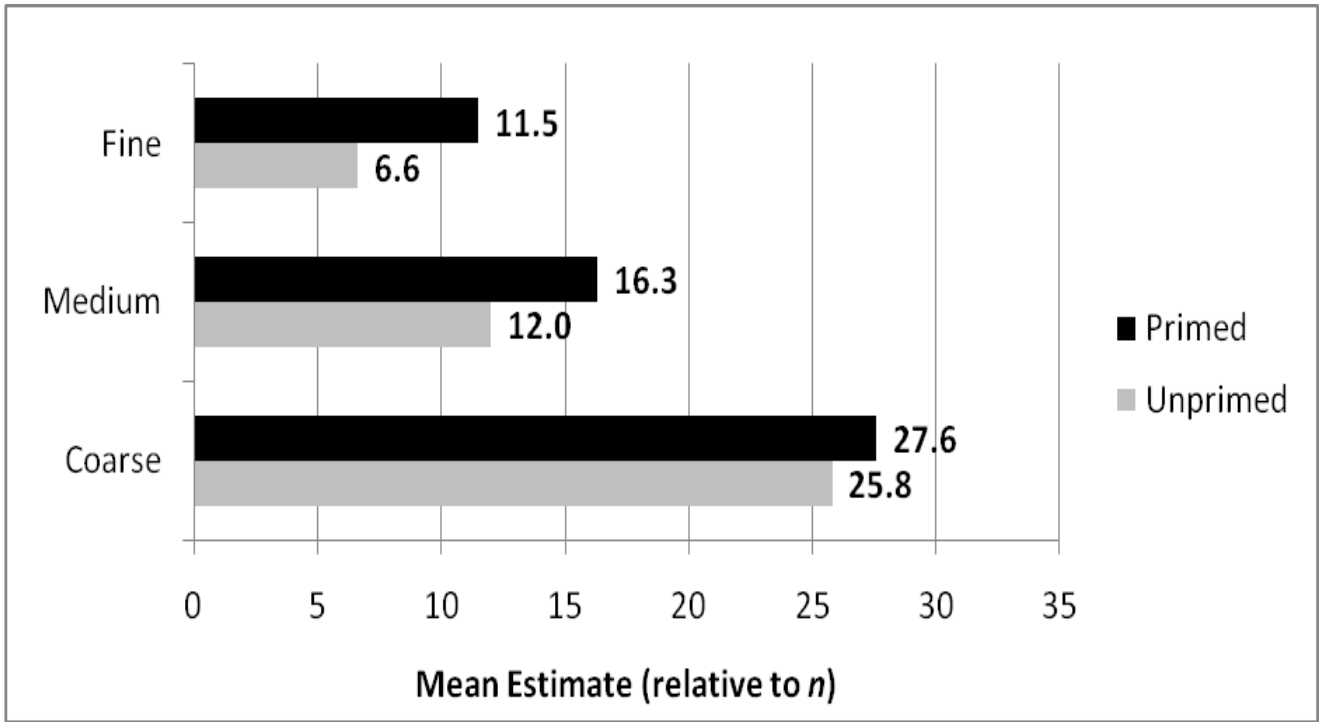
Please read the following short dialogues, and answer the questions by filling in a value for each blank space, according to your opinion. Consider each dialogue separately. Assume that participant B is well-informed, telling the truth, and being co-operative in each case.

A: We need to sell (60) tickets to cover our costs. How are the ticket sales going?

B: So far, we've sold fewer than 60 tickets.

How many tickets have been sold? From …… to ……, most likely …….

# Experimental verification (2)




40 participants: “more than” and “fewer than” conditions.

3x2x2 ANOVA shows main effects of

quantifier ($F(1,41)= 8.66$, $p<0.01$)

roundness ($F(2,80)=44.83$, $p<0.001$)

priming ($F(1,40)=10.78$, $p<0.01$).

# Example 2: ‘more than’ vs. ‘at least’

- Problem:
  - ‘at least *n*’ seems to convey sense of modality that ‘more than *n*-1’ lacks (Geurts and Nouwen 2007)
  - Expressions such as ‘up to’, ‘maximally’, etc. do likewise (Nouwen 2010)
  - This disappears in antecedent of conditional and certain other contexts (Cummins and Katsos 2010)

# Example 2: ‘more than’ vs. ‘at least’

Constraint-based account:

- Comparing ‘more than *n*’ with ‘at least *n*’:
  - Former harmonically bounds latter unless possible that ‘exactly *n*’ holds, so ‘at least *n*’ should convey this
- Reason to believe that ‘at least’ is more complex than ‘more than’, so violates **quantifier simplicity**
- Comparing ‘more than *n*-1’ with ‘at least *n*’:
  - Former harmonically bounds latter unless *n* is a more salient number than *n*-1
  - This appears to predict major usage trends

# Example 3: bare numeral approximations

- Problem:
  - Round numbers have (preferentially?) round interpretations (Krifka 2002, 2009 i.a.)
- Constraint-based model:
  - If all numbers approximative on semantics…
  - …then e.g. '49', '50' compete as expressions…
  - …but '50' **harmonically bounds** '49'
    - Similar in spirit to Krifka (2009)'s bidirectional model
    - Might predict differentiation over time between round/non-round numeral semantics

# Summary

- Constraint-based account is
  - Constituted of functionally motivated components
  - Useful as a source of (sometimes non-obvious) predictions
  - Applicable to some open questions on the semantics/pragmatics interface
  - Potentially psychologically plausible

# Possible future directions

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- Constraint-based account is
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  - Amenable to testing as a performance model for individual speakers