

VAGUENESS IN QUANTITY

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The Study of Vagueness



□ Typical focus:

- ▣ Vague adjectives: *tall, expensive, thin, red, old, bald*
- ▣ Vague nouns: *heap*
 - Dimensions: size, cost, age, hue, etc.

□ Today's focus:

- ▣ Vagueness in the expression of quantity and amount
 - Dimensions: cardinality (number); volume, mass
 - additive dimensions

Game Plan



1. Inherently vague and context-dependent quantity expressions:
 - ▣ Adjectives of quantity: *many, few, much, little*
2. Case study:
 - ▣ *Most* (vague) vs. *more than half* (not vague)

Not in the Game Plan (today)



- Approximate or vague use of (potentially) precise quantity expressions (Krifka 2009):
 - (1) a. There are **100** people in the room **approximate**
b. There are **99** people in the room **precise**
- ▣ Instead, focus on quantity expressions whose meaning is inherently vague – with the goal of exploring what they can tell us about vagueness more generally

1. Adjectives of Quantity

Adjectives of Quantity



- (2)
 - a. **Many** people I know like jazz
 - b. **Few** students came to the lecture
 - c. I don't have **much** money
 - d. There is **little** water in the bucket

- (3) Fred is **tall**

Parallels to Gradable Adjectives



□ Gradability

- (4)
 - a. Fred read **fewer** books than Barney
 - b. Barney drank **the most** wine
(cf. **taller** than Barney/the **tallest** man here)

- (5)
 - a. Barney drank **very little** wine
 - b. Betty read **as many** books **as** Wilma
 - c. Wilma read **too few** books
(cf. Fred is **very tall/too tall/etc.**)

Parallels to Gradable Adjectives

□ Context sensitivity

(6) *Many students came to the lecture*

- Situation 1: In-class lecture in advanced Semantics class
- Situation 2: University-wide lecture by Bill Clinton

□ Borderline cases

- 1000 students coming to Clinton's lecture is many
- 3 is not many
- But what about 50? 100?

Parallels to Gradable Adjectives



□ Sorities Paradox

- a.** If 1000 students attend Clinton's lecture, that is many
- b.** If n students attending Clinton's lecture is many, then $n - 1$ students attending Clinton's lecture is many
- c.** 3 students attending Clinton's lecture is many

Parallels to Gradable Adjectives



- Compositional regulation of vagueness
 - ▣ *For* phrases
 - (7) a. Barney owns **few** books for a professor
 - b. Barney is **tall** for a jockey
 - ▣ *Compared to* phrases
 - (8) a. Fred owns **few** books compared to Barney
 - b. Fred is **tall** compared to Barney

Distinctions vs. 'Ordinary' Adjectives

□ Predicative use

(9) a. Fred is **tall**

b. The fans were **many**

(10) a. I consider Fred **tall**

b. *I consider the fans **many**

(11) a. Every boy is **tall**

b. *Every fan is **few**

□ Differential use

(12) a. Fred drank **much/little more** than Barney

b. *Fred is **tall taller** than Barney

Framework



- Degree-based approach (Cresswell 1977; Heim 2000; Kennedy 2007; a.o.)
- Gradability modeled via...
 - ▣ scales S consisting of...
 - ▣ set of degrees $d...$
 - ▣ ordered by ordering relationship $>$
- Gradable adjectives relate individuals to degrees

Semantics of Gradable Predicates

- ‘Ordinary’ gradable adjectives: gradable predicates over **individuals**

(13) a. $[[\text{tall}]] = \lambda d \lambda x. \text{HEIGHT}(x) \geq d$

b. $[[\text{short}]] = \lambda d \lambda x. \text{HEIGHT}(x) \leq d$

- Adjectives of quantity: gradable predicates over **scalar intervals**

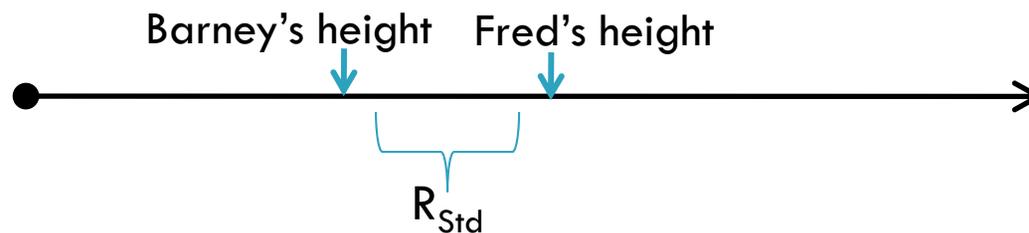
(14) a. $[[\text{many}]] = \lambda d \lambda I. \text{MAX}(I) \geq d$

b. $[[\text{few}]] = \lambda d \lambda I. \text{MAX}(I) \leq d$

The Positive Form

- Gradable expressions do not encode a standard of comparison
- In positive (unmodified) form, degree slot (d) filled by standard value R_{Std}

(15) $\llbracket \text{Fred is tall} \rrbracket = 1$ iff $\text{HEIGHT}(\text{fred}) \geq R_{Std}$
 $\llbracket \text{Barney is short} \rrbracket = 1$ iff $\text{HEIGHT}(\text{barney}) \leq R_{Std}$



- Where does R_{Std} come from?

Comparison Classes

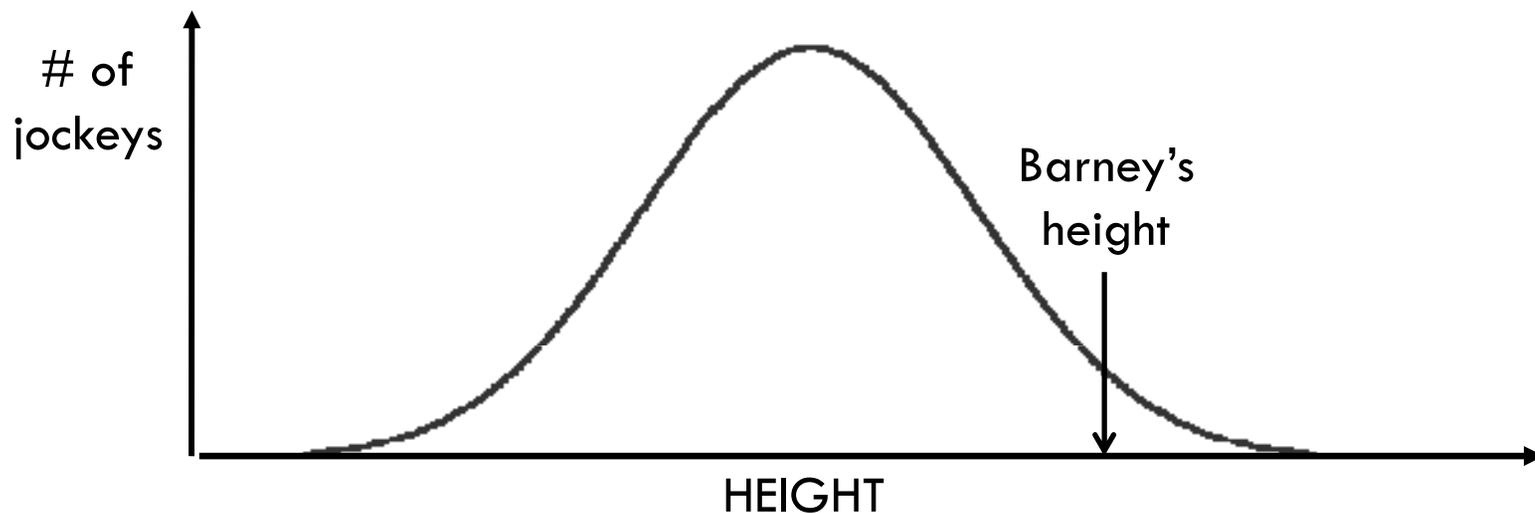
- Vague expressions interpreted with reference to a **comparison class** (Klein 1980)

(16) Barney is tall for a jockey

‘Barney’s height exceeds the standard for jockeys’

‘Barney is (considerably) taller than the average jockey’

‘Barney is taller than most jockeys’



Example



- (17) a. Sue's apartment is expensive for an apartment on this street
- b. Paul's apartment is inexpensive for an apartment on this street

The facts

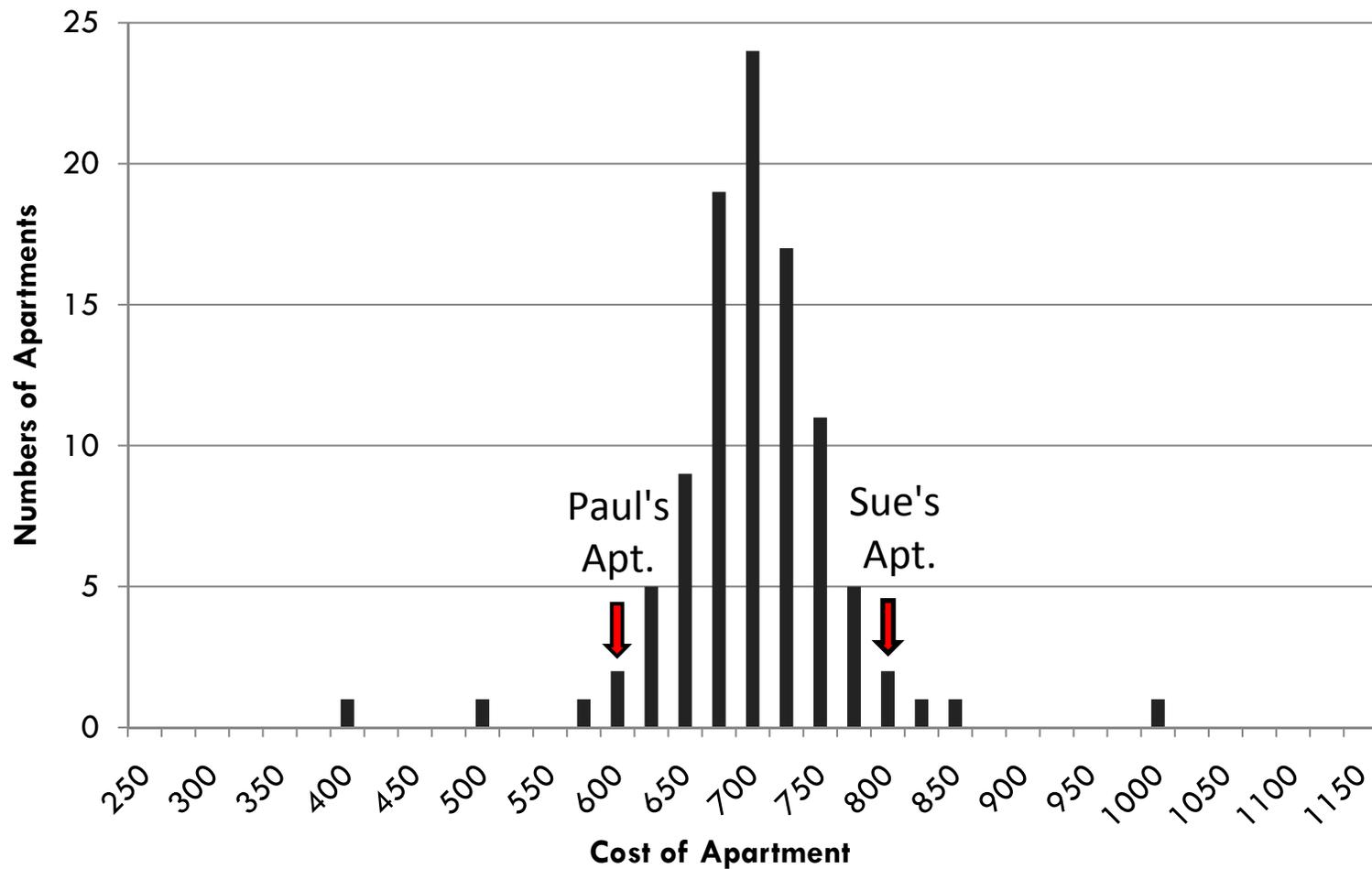
Sue's apartment: €800

Paul's apartment €600

Median on this street: €700

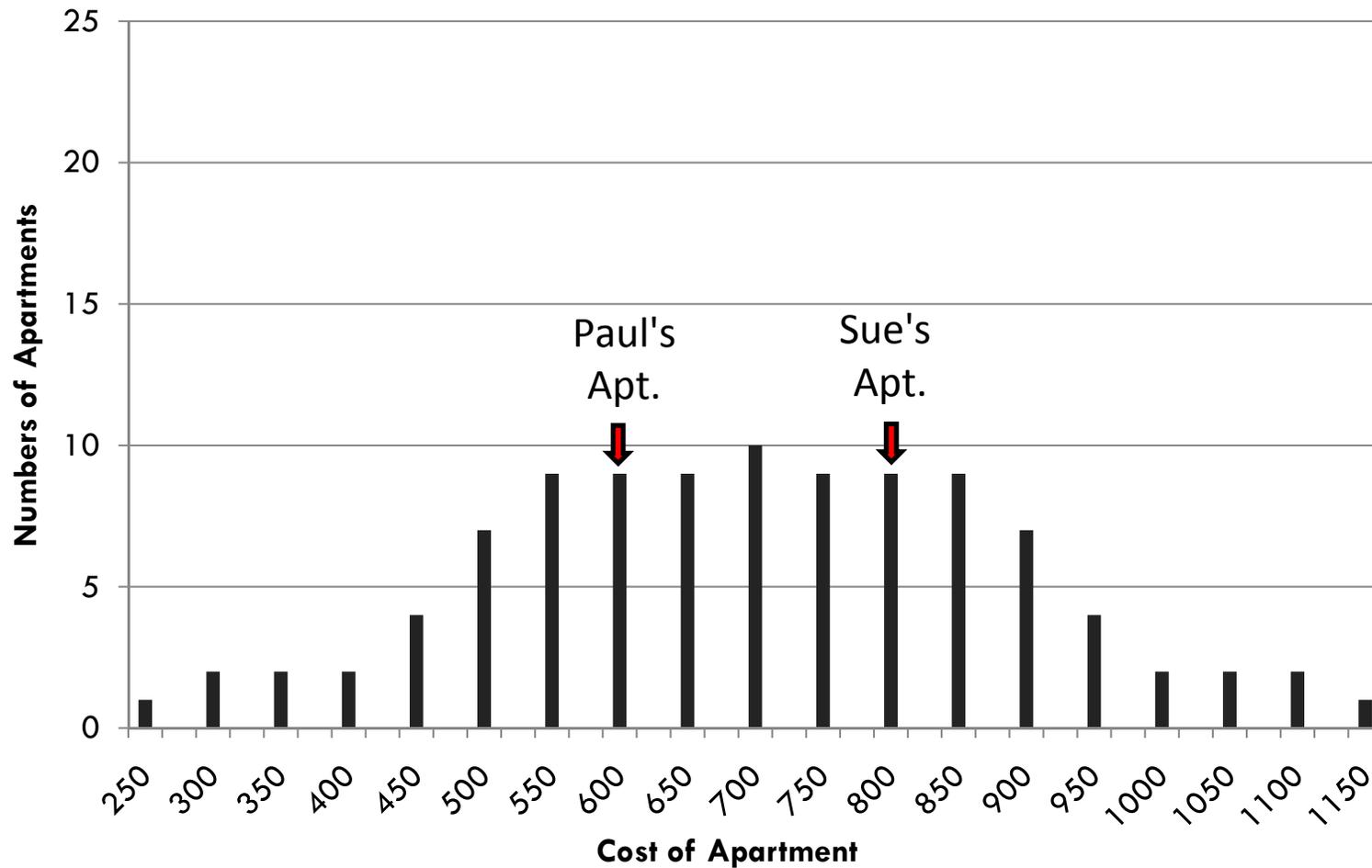
Example

- (17a,b) true in this situation



Example

- But false in this situation



Comparison Classes

- Can be captured with a statistical analogy

(18) $\llbracket \text{Barney is tall for a jockey} \rrbracket = 1$

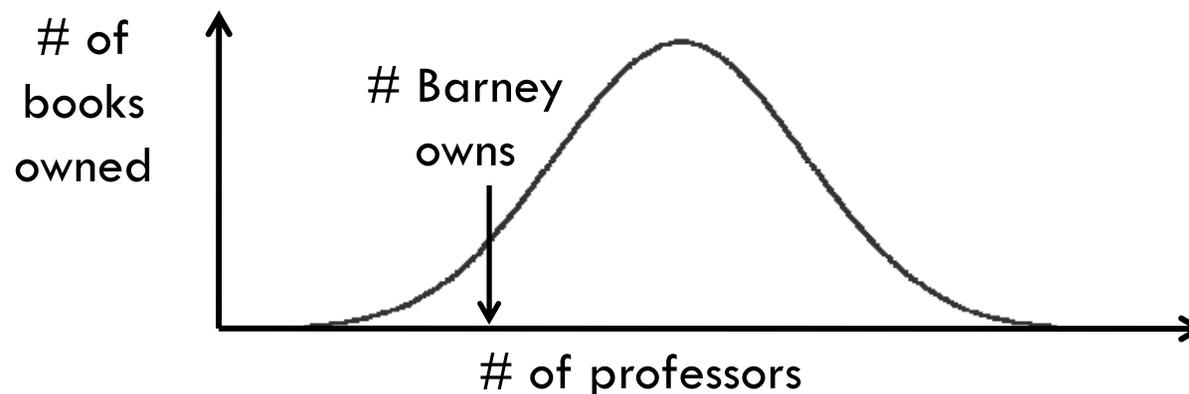
iff $\text{HEIGHT}(\text{barney}) \geq R_{\text{Std}}$,

where $R_{\text{Std}} = \text{median}_{x:\text{jockey}(x)}(d:\text{HEIGHT}(x)=d) \pm n \bullet \text{MAD}_{x:\text{jockey}(x)}(d:\text{HEIGHT}(x)=d)$

MAD = mean absolute deviation

Extended to Adjectives of Quantity

- (19) Barney owns few books for a professor
'Barney owns fewer books than most professors'



- (20) $\llbracket(19)\rrbracket = 1$ iff # of books owned by Barney $< N_S$,
where $N_S = \text{median}_{x:\text{professor}(x)}(d:x \text{ owns } d\text{-many books}) \pm$
 $\text{MAD}_{x:\text{professor}(x)}(d:x \text{ owns } d\text{-many books})$

Consequence 1: Comparison Classes

- We need a broader view of comparison classes:
 - (21) a. Barney is tall for a jockey
 - CC = jockeys (subject of gradable expression \in CC)
 - b. Barney owns few books for a professor
 - CC = professors (subject of gradable expression \notin CC)
 - c. For a Sunday, there aren't many cars in the lot
 - CC = Sundays (times t)
 - d. Few students came to the lecture
 - Compared to what I expected
 - CC = situations consistent with my expectations (worlds w) (cf. Fernando & Kamp 1996)

A Complication

- Cardinal vs. proportional readings (Partee 1989):

(22) Few Linguistics students are registered for the class

- **Cardinal:** a small number of Linguistics students

- **Proportional:** a small proportion of the Ling. students

- Distinct:

...because there **are** few Linguistics students Cardinal

- Grammatically determined:

(23) a. There are few Linguistics students Cardinal

b. Few of the Linguistics students are here Proportional

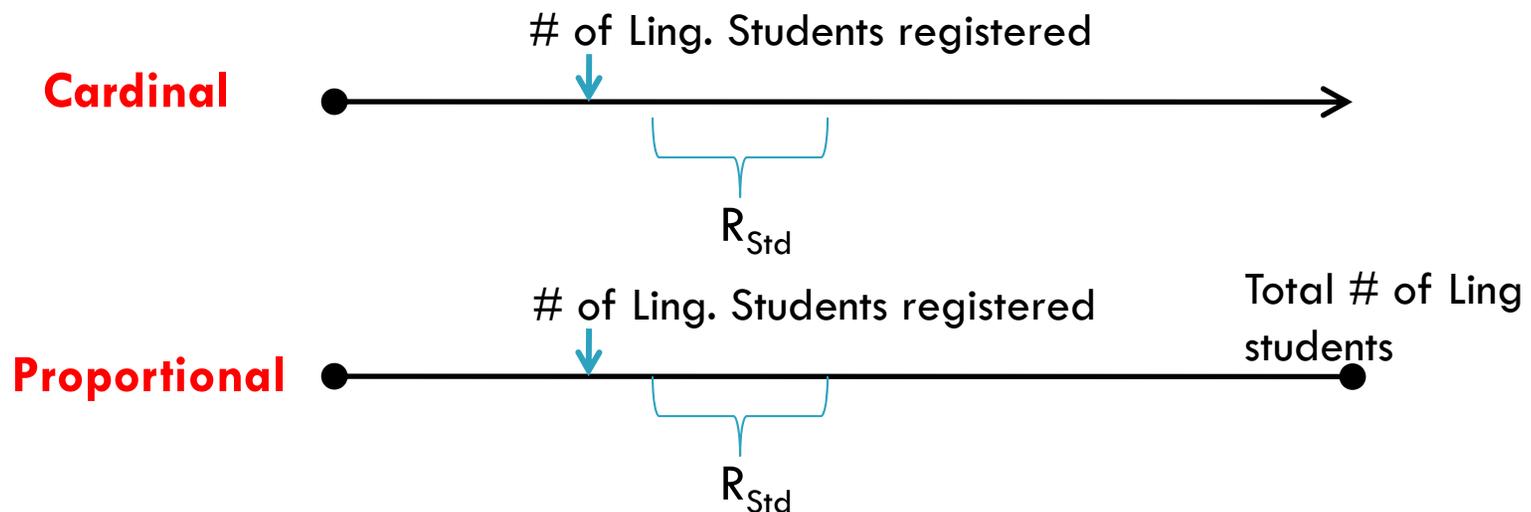
c. Few students I know have blue eyes Proportional

Cardinal vs. Proportional

- **Proposal:** Proportional reading of Q-adjectives arises when domain of quantification is a topic/presupposed

- Consequence for scale structure: upper bound

Few Linguistics students are registered for Psychology of Language



Vagueness and the Proportional Reading

- Borderline cases remain:

- (24) Many of the people in this room have blue eyes

- How many out of 50?

- But context sensitivity reduced:

- (25) Few of the teachers I know are female $< \sim 1/3$

- (26) Few of the people in this room are right handed

- In the case where 50% are right handed??

- Suggests ‘default’ location for R_{Std} in proportional case

Consequence 2: Constraining Vagueness



- Proportional case points to alternative possibility for constraining the interpretation of vague predicate – via scale structure
 - ▣ Cf. Kennedy (2007): maximize the contribution of conventional elements

2. *Most vs. More than Half*

Case Study

3. *Most vs. More than Half*

- Two proportional quantifiers with (superficially) equivalent semantics

(27) a. **Most** Americans have broadband internet access

b. **More than half of** Americans have broadband internet access

(28) $\llbracket \text{most} \rrbracket = \llbracket \text{more than half} \rrbracket =$

$$= \lambda X \lambda Y. |X \cap Y| > \frac{1}{2} |X|$$

- (27a,b) true iff # of Americans who have broadband > $\frac{1}{2}$ total # Americans

However...

- Speakers' intuition: *most* > *more than half*
- *More than half* has sharp lower bound; *most* does not

(29) a. **More than half** of the U.S. population is female ✓

b. **Most** of the U.S. population is female ??

- The facts: female 50.7% vs. male 49.3%
(U.S. Census Bureau 2008)

Most vs. More than Half

□ *Most > more than half*

(30) a. The survey showed that **most students (81.5%)** do not use websites for math-related assignments

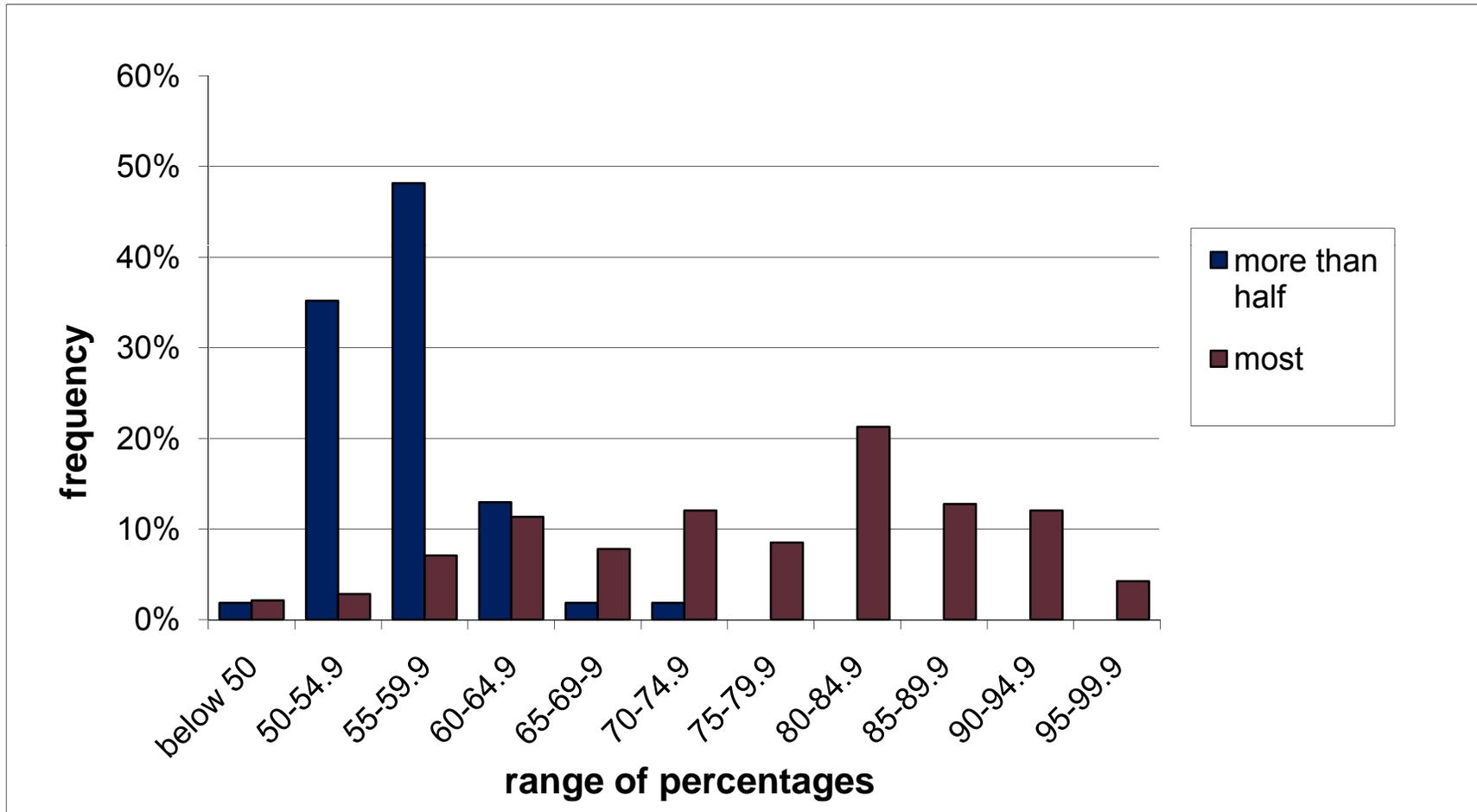
(*Education*, 129(1), pp. 56-79, 2008)

b. **More than half of respondents (55%)** say that making money is more important now than it was five years ago (*Money*, 21(3), p. 72, 1992)

Source: Corpus of Contemporary American English (COCA: Davies 2008-)

- 400+ million word corpus covering multiple genres (magazine, newspaper, fiction, academic, spoken) for the years 1990-2009

Most vs. More than Half



Source: COCA

Observation



- In the pair *most* and *more than half*, we have the case study of a contrast between an expression with a vague lower bound (*most*) and a parallel expression whose lower bound is precise (*more than half*)

Further Divergences

- *Most* is readily followed directly by a plural noun, yielding a generic-like interpretation

(31) a. **Most people** follow the moral judgments of those around them (*Writer*, 121(7), pp. 30-33, 2008)

b. Money is at least partly a control issue in **most families** (*Money*, 32(1), p. 106, 2003)

c. **Most teens** want to fit in with their peers (*CNN YourHealth*, 31/8/2002)

Further Divergences



- *More than half* is awkward in similar contexts, and (when acceptable) has a ‘survey results’ rather than generic flavor:

(32) a. ??**More than half of people** follow the moral judgments of those around them

b. ??Money is at least partly a control issue in **more than half of families**

c. ??**More than half of teens** want to fit in with their peers

Further Divergences

□ *Most* can occur with uncountable domains:

(33) a. But like **most things**, obesity is not spread equally across social classes (*Mens Health*, 23(7), p. 164, 2008)

b. But he had enough material on his truck to handle **most problems** (*Contractor*, 47(4), p. 30, 2000)

c. **Most beliefs, worries, and memories** also operate outside awareness (*Science News*, 142(16), 1992)

d. In **most situations** the closer the test approximates actual job tasks, the better (*Current Psychology*, 14(2), 1995)

Further Divergences

- *More than half* requires a domain that can be individuated and counted (or otherwise measured):

(34) a. ??But like **more than half of things**, obesity is not spread equally across social classes

b. ?? But he had enough material on his truck to handle **more than half of problems**

c. ??**More than half of beliefs, worries, and memories** also operate outside awareness

d. ??In **more than half of situations** the closer the test approximates actual job tasks, the better

Corpus analysis

- Use of *more than half* typically co-occurs with mention of a source of supporting data; this is not the case with *most*

	Source of Data Mentioned (Data from COCA)	
	<u>More than Half</u>	<u>Most</u>
Americans	9 / 12	13 / 100
Men	4 / 6	5 / 100
Women	4 / 5	7 / 100
Students	5 / 5	36 / 100
Patients	5 / 5	39 / 100
Families	1 / 2	11 / 100
TOTAL	28 / 35 80%	111 / 600 19%

Source: COCA

Proposal



The observed differences in distribution and interpretation for *most* and *more than half* derive from a fundamental difference in logical form, which corresponds to a difference in possible verification strategies (cf. Hackl 2009)

Proposal

<i>Most</i>	<i>More than half</i>
<p><i>'Most F are G'</i></p> <p>is true iff</p> $ F \cap G > F - G $	<p><i>'More than half of F are G'</i></p> <p>is true iff</p> $ F \cap G > F /2$
<p><i>'Most Americans have broadband'</i></p> <p>is true iff</p> $\begin{aligned} & \{\text{Americans who have BB}\} \\ &> \\ & \{\text{Americans who do not have BB}\} \end{aligned}$	<p><i>'More than half of Americans have broadband'</i></p> <p>is true iff</p> $\begin{aligned} & \{\text{Americans who have BB}\} \\ &> \\ & \{\text{Americans}\} / 2 \end{aligned}$
A comparison of sets	A comparison of numbers

Analogy

- Suppose we have two rocks, A and B

	Does A weigh more than B?	Does A weigh more than $\frac{1}{2}$ as much as B?
	<ul style="list-style-type: none">• Weigh A• Weigh B• Compare the #s	<ul style="list-style-type: none">• Weigh A• Weigh B• Divide by 2• Compare the #s
	<ul style="list-style-type: none">• Put A and B on 2 pans of a balance scale• Determine which side hangs lower	

- Some comparisons are inherently comparisons of #s
- Some are comparisons of the 'stuff' itself

More than Half



- Expresses a comparison between **numbers**
 - Requires countable/measurable sets
 - **more than half of beliefs, worries and memories...*
 - Consistent with precise comparison
 - Allows use of *more than half* for proportions near 50%
 - Favored in cases where numerical data reported; yields 'survey results'

Most

- Expresses a comparison between **sets** (only secondarily realized as a comparison between numbers/measures)
 - ▣ May occur with sets whose members cannot be individuated and counted
 - *Most beliefs, worries and memories...*
 - ▣ May be verified through approximate strategies (e.g. visually, induction/generalization, lack of exceptions)
 - Imprecise; fail for two sets close in size (cf. infelicity of *most* for proportions near 50%)

Most

- Parallel in findings from the psychology of number cognition: humans possess two cognitive systems for the representation and processing of number: 1) precise; 2) approximate (Dehaene 1997)
- The approximate number system is...
 - ▣ Independent of knowledge of precise numbers (present in children, animals, etc.)
 - ▣ Involved in quantity comparison and approximate arithmetic
 - ▣ Ratio dependent: size and distance effects (cf. ratio effects with *most*)
 - Verification of *more than half* necessarily invokes precise system; verification of *most* favors approximate system

Conclusions: *Most/More than Half*



- Distinction between non-vague expression (*more than half*) and its vague counterpart (*most*) corresponds to distinction between counting/precise numerosity and approximate/non-numeric comparison
- Distributional and interpretative effects arise from possible verification strategies rather than directly from truth condition

Vagueness and Quantity

Final Observations



- Role of comparison classes (broadly considered)
- Interpretive effect of scale structure
- Vagueness and the approximate number system
- Vagueness and verification strategy



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