VAGUENESS, IMPRECISION AND SCALES

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Vagueness and Imprecision

(1)	John is tall	Vague
(2)	John arrived at 4 o’clock	Imprecise

Vagueness and Imprecision

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- Different:
  - Underlying precise concept (*4 o'clock*) vs. no underlying precise concept (*tall*)

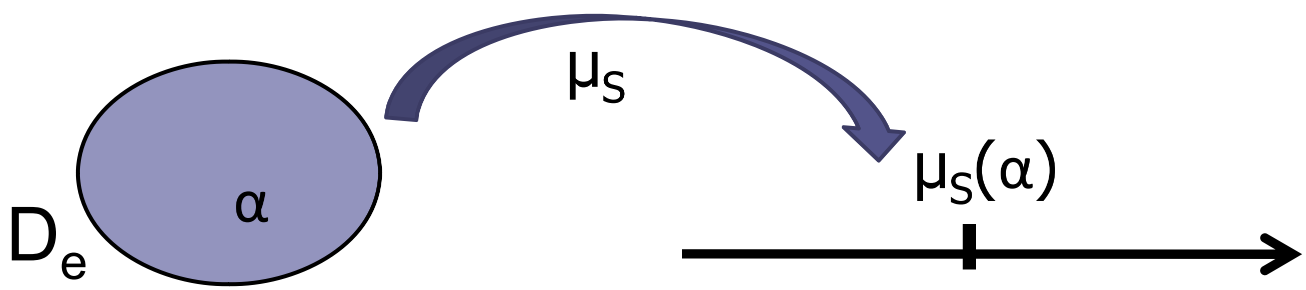
Vagueness and Imprecision

(1)	John is tall	Vague
(2)	John arrived at 4 o'clock	Imprecise

- Different:
  - Underlying precise concept (*4 o'clock*) vs. no underlying precise concept (*tall*)
- Similar:
  - Lack of sharp boundaries
  - Borderline cases
  - Sorities paradox

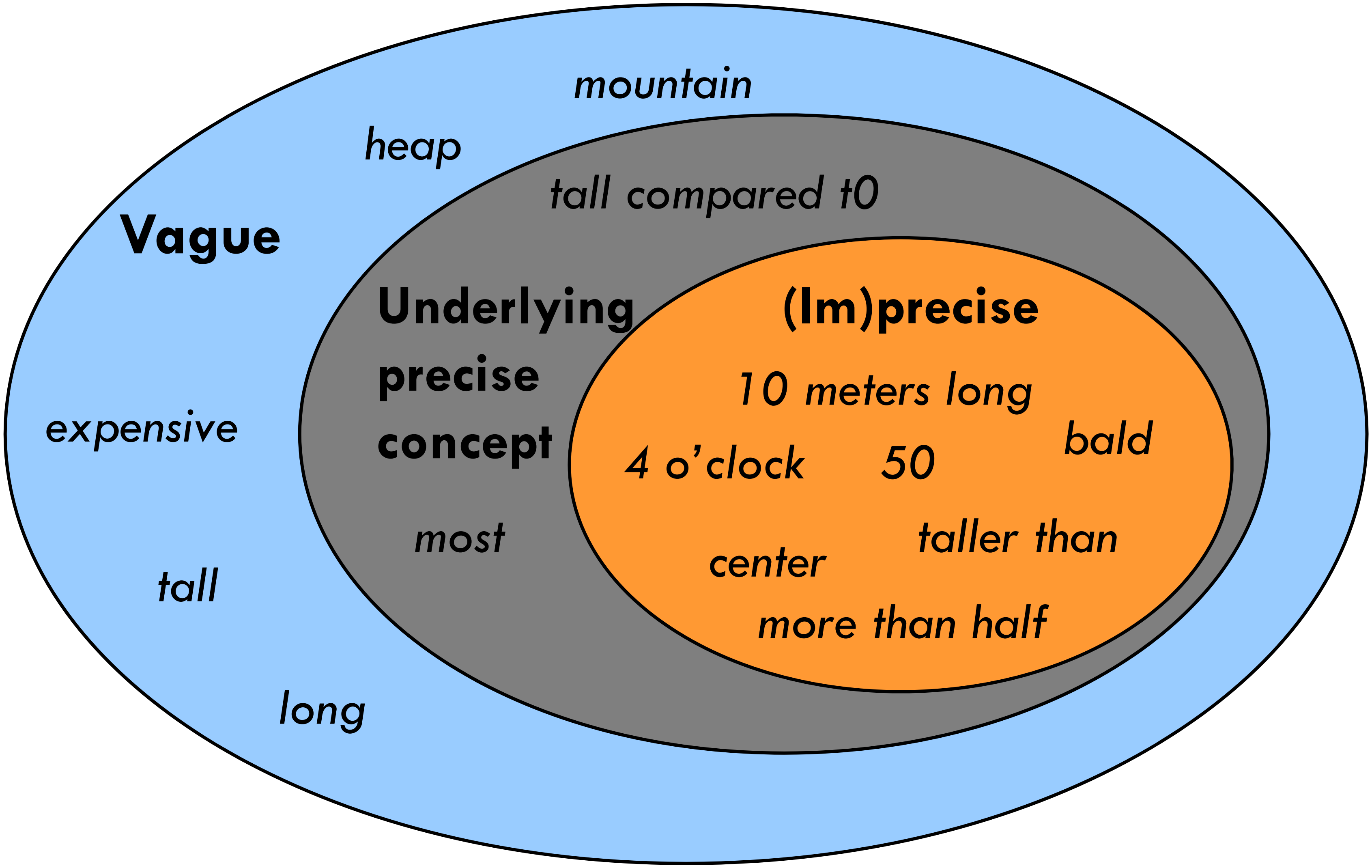
Central claim

- Linguistic facts relating to both vagueness and imprecision can be analyzed in terms of the structure of **measurement scales**
  - A scale $S = \langle D, >, DIM \rangle$
    - D a set of degrees
    - $>$ an ordering on D
    - DIM a dimension of measurement
  - Measure functions μ_S map entities to degrees

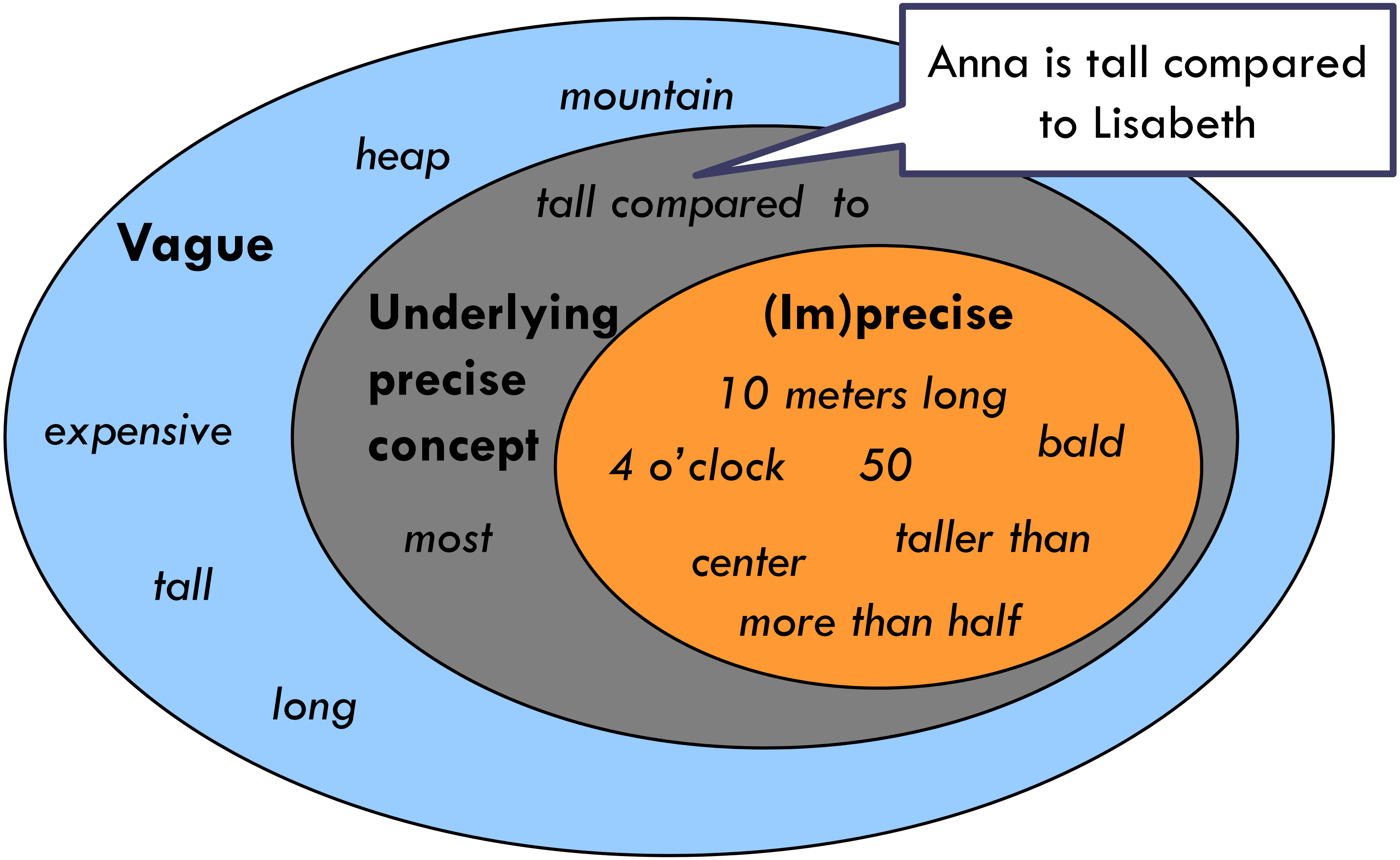


Bartsch & Vennemann 1973; Cresswell 1976; von Stechow 1984; Heim1985, 2000; Kennedy 1999; a.o.

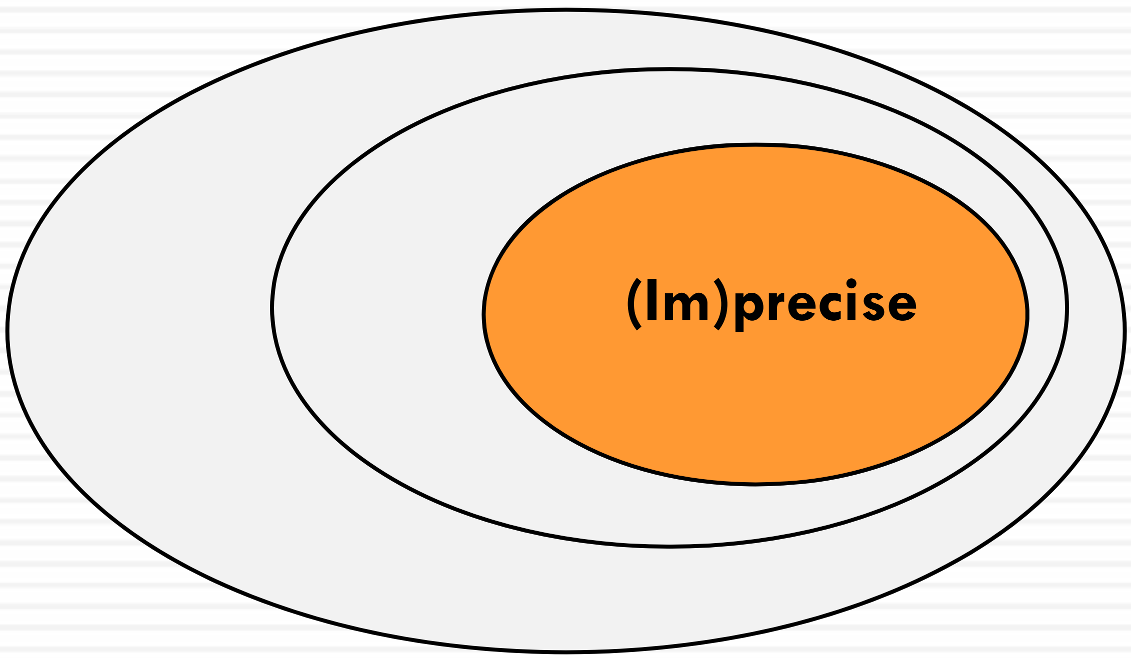
Vagueness vs. imprecision



Vagueness vs. imprecision



Imprecision



Imprecision and roundness

- Round numbers interpreted approximately; non-round numbers interpreted imprecisely

a. There were 100 people at the meeting	approximate
b. There were 99 people at the meeting	precise

- Extends beyond round / non-round

a. I wrote this article in twenty-four hours	approximate
b. I wrote this article in twenty-three hours	precise
a. Mary waited for forty-five minutes	approximate
b. Mary waited for forty minutes	precise

Scale Granularity

- Krifka 2007: Results of measurement an be reported with respect to scales differing in their granularity

Duration (minutes):

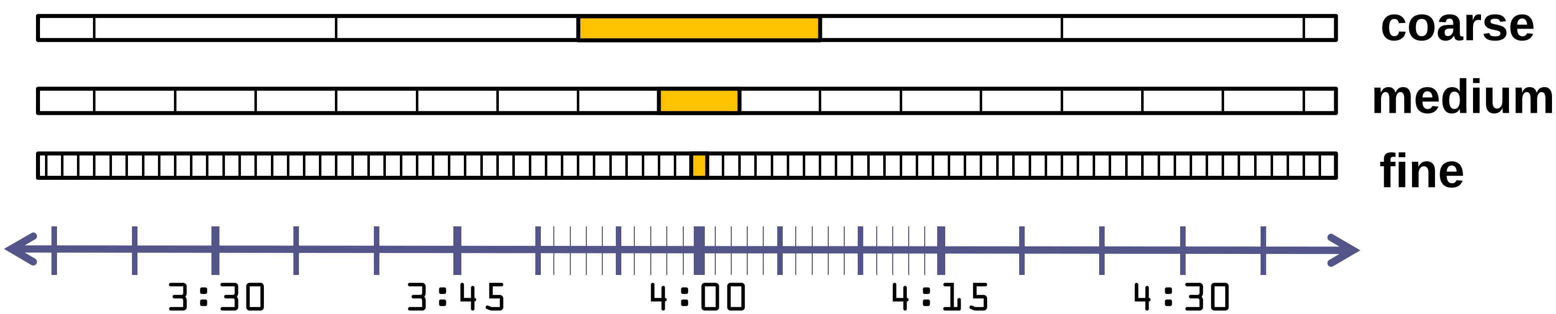
```
a. 0-------------------------------60---------------
b. 0---------------30--------------60---------------
c. 0------15-------30------45------60------75-------
d. 0-5-10-15-20-25-30-35-40-45-50-55-60-65-70-75-80-85-
```

- Pragmatic principle: numerical expression interpreted relative to coarsest-grained scale on which it occurs
  - *Forty-five minutes:* Scale (c) - interval [37.5 min, 52.5 min]
  - *Forty minutes:* Scale (d) – interval [38.5 min, 42.5 min]

Granularity and approximators

- Sauerland & Stateva 2010: scalar approximators such as *exactly* and *approximately* analyzed as setting granularity level

4 o'clock



$$[\![\textit{exactly 4 o'clock}]\!] = [\![\textit{4 o'clock}]\!]^{gran_{finest}}$$

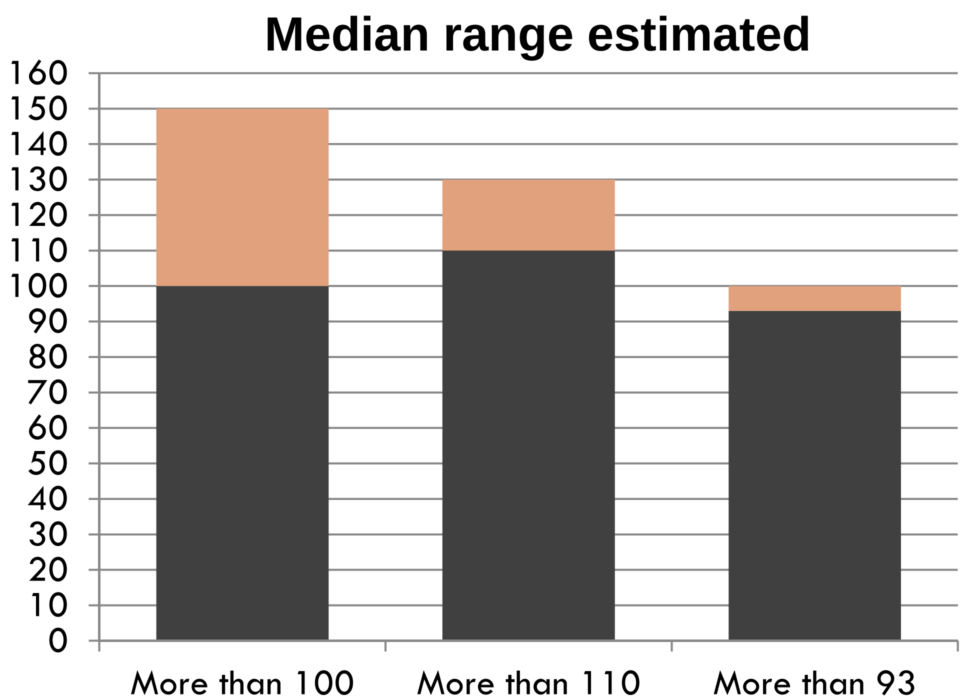
$$= [\text{4 o'clock} \pm \text{30 sec}]$$

Granularity and pragmatic reasoning

More than 100 people
More than 110 people
More than 93 people

attended the meeting about the new highway construction project

- How many attended?



- Amazon MTurk
- n= 100/condition

From Cummins, Sauerland & Solt (under revision)

Granularity and pragmatic reasoning

- Cummins, Sauerland & Solt (under rev.): modified numerals give rise to scalar implicatures based on granularity (Grice 1975; Horn 1989):
  - ***More than n*** implicates ***not more than m***, where m is the next-highest value on some scale on which n occurs

```
a. ----100-----------------150-----------------200-------------
b. ----100-------125-------150-------175-------200-------225---
c. -90-100-110-120-130-140-150-160-170-180-190-200-210-220-230-
```

Granularity and expression choice

- Speaker/hearer preference for approximation over precision
  - Rounding when telling the time (van der Henst et al. 2002)

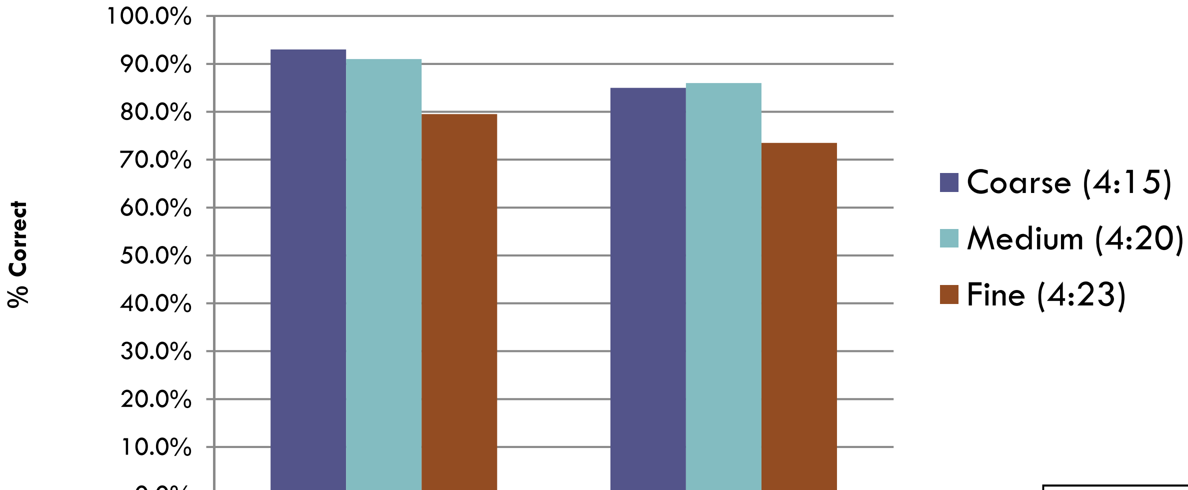
  - Reporting of survey data:

    A third of Americans (32%) read the bible daily

- **Hypothesis:** Expressions interpreted relative to coarse-grained scale easier to process

Granularity and expression choice

- Recall for clock times (Sternberg paradigm)
- 3 granularity levels: coarse (e.g. 4:15), medium (e.g. 4:20), fine (e.g. 4:23)



	3 Items	4 Items
Coarse (4:15)	93.0%	85.0%
Medium (4:20)	91.0%	86.0%
Fine (4:23)	79.5%	73.5%

•Granularity or roundness?

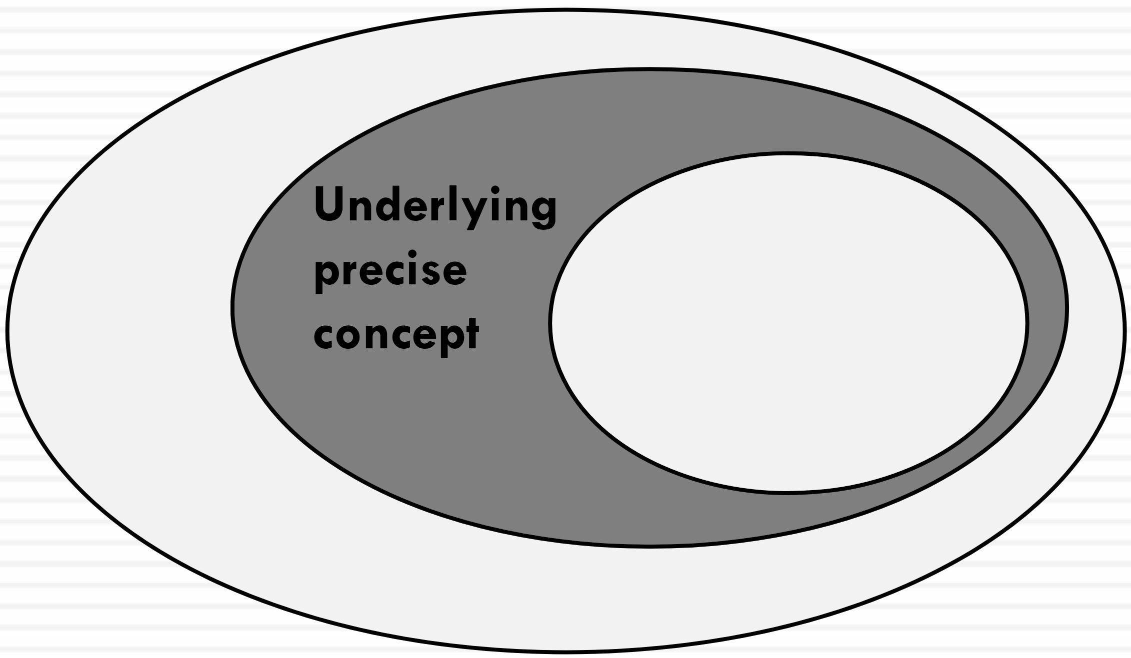
EURO-XPRAG project
Preference for Approximation;
Solt, Cummins & Palmovič
(in prep.)

Summary

- Scale granularity can be productively applied to account for a range of linguist facts relating to (im)precision
- Other cases of imprecision/vagueness: a more radically different scale structure

Imprecision/vagueness borderline

borderline



Most and imprecise comparison

Most Americans have broadband internet access

More than half of Americans have broadband internet access

- Superficially equivalent in truth conditions

  |Americans with broadband internet access| >
  |Americans w/out broadband internet access|

- But felicitous use of ***most*** typically requires proportion 'significantly' greater than 50%

More than half of/??most Americans are female

  - Related precise concept; but resists precisification to this interpretation

Distribution of *Most* /*More than Half*

- *Most* is used for proportions considerably greater than half, while *more than half* is used for proportions close to 50%:

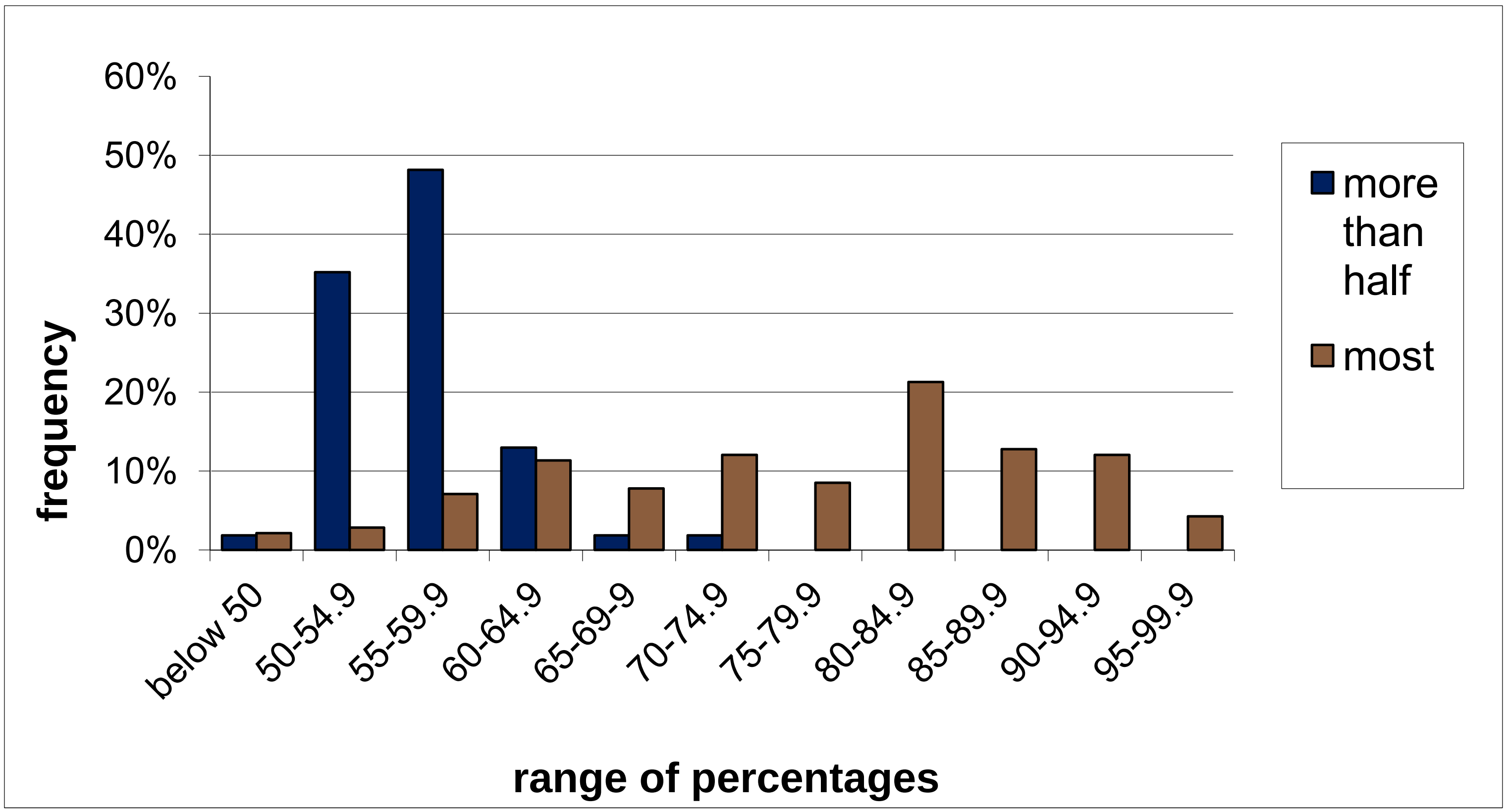
(1) a. The survey showed that **most students (81.5%)** do not use websites for math-related assignments (*Education*, 129(1), pp. 56-79, 2008)

b. And while **more than half of us** grill year-round **(57 percent)**, summertime is overwhelmingly charcoal time (*Denver Post*, 24/5/2000)

Source: COCA; Davies 2008-

Distribution of *Most* /*More than Half*

- *More than half* is used for proportions close to 50%, while *most* used for higher percentages:



Distribution of *Most* /*More than Half*

- *More than half* – but not *most* – requires a domain that can be individuated and counted (or otherwise quantitatively measured)

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

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

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

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

Source: COCA; Davies 2008-

Distribution of *Most* /*More than Half*

- *More than half* – but not *most* – requires a domain that can be individuated and counted (or otherwise quantitatively measured)

(4) a. But black activists acknowledge that **most racism** is not so blatant. (Associated Press, 16/9/1991)

b. ??But black activists acknowledge that **more than half of racism** is not so blatant.

- But…

(5) In 1997, non-OPEC producers accounted for **more than half of** world oil production. (Futurist, 33(3), p. 51, 1999)

Source: COCA; Davies 2008-

Two correlated differences

More than half	Most
Precise lower bound	Fuzzy lower bound
Restricted to contexts where numerical measurement is possible	Felicitous in contexts where counting/measurement not possible

Proposal

- Distinct logical forms (per Hackl 2009):

More than half of A are B	$\mu_S(A \cap B) > \mu_S(A)/2$
Most A are B	$\mu_S(A \cap B) > \mu_S(A - B)$

Proposal

- Distinct logical forms (per Hackl 2009):

  More than half of A are B $\mu_S(A \cap B) > \mu_S(A)/2$

  Most A are B $\mu_S(A \cap B) > \mu_S(A - B)$

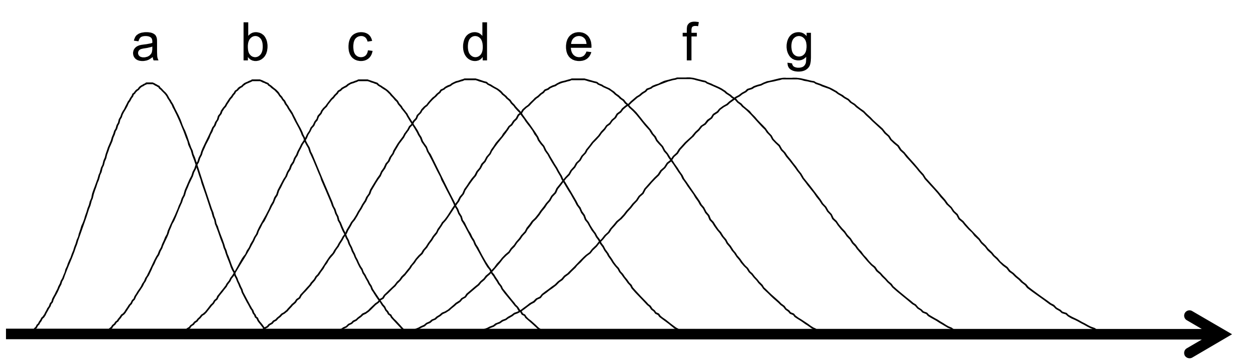
- Place different requirements on scale structure
  - ***More than half:*** support division by 2
    - **Ratio level:** volume in liters; area in hectares; set cardinality via counting numbers; etc.
  - ***Most:*** support comparison of degrees via >
    - **Ordinal level (rank ordering) or weaker**

  ➢ Account for distributional differences

Semi-ordered scale

- Consider a scale where:
  - Degrees are Gaussian curves with linearly increasing standard deviations
  - Greater than relationship based on degree of overlap

    a > b iff midpoint (a) exceeds midpoint(b)+1 std dev



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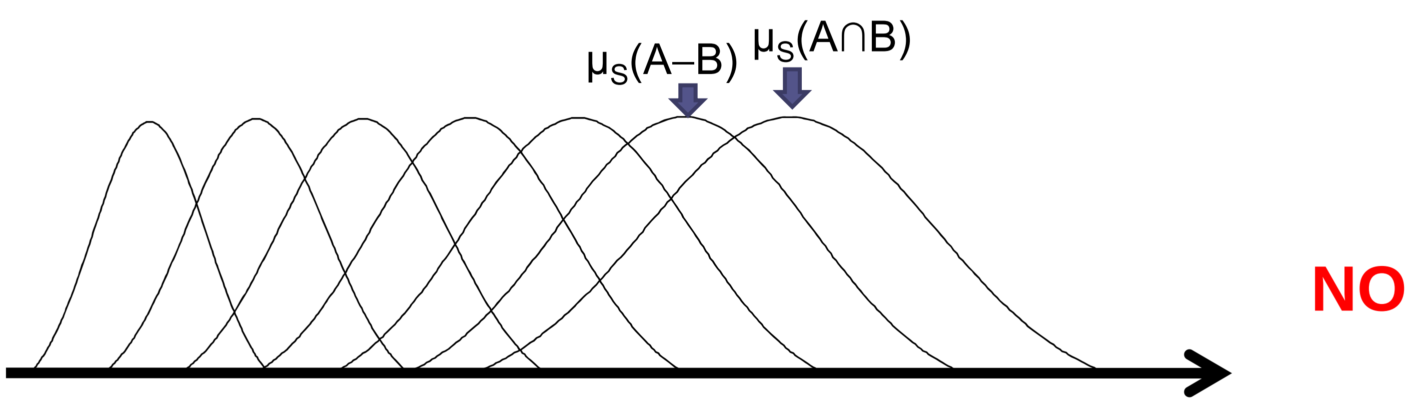
- Sufficient to support logical form of *most*: true if $\mu_S(A \cap B)$ 'significantly' exceeds $\mu_S(A - B)$



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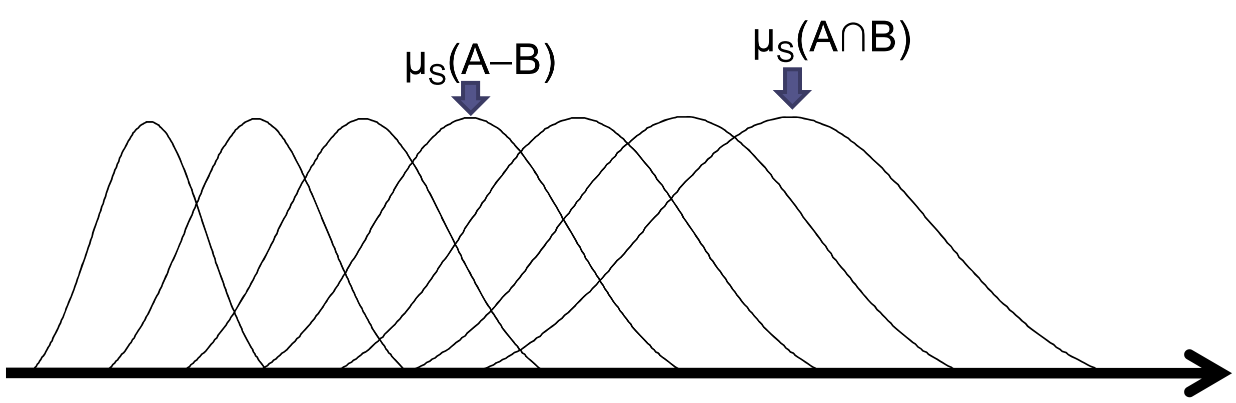


YES

Number cognition and scales

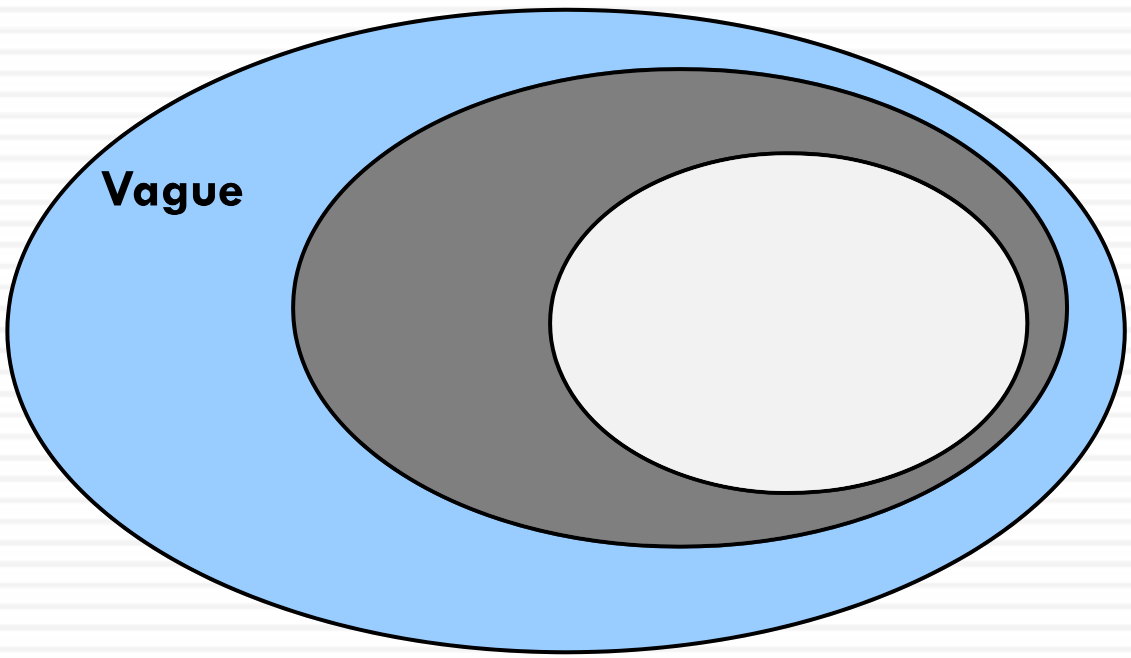
- Approximate Number System (ANS)
  - Primitive capacity for number
  - Present in preverbal infants, societies without complex number systems – and animals
  - Number encoded as analog magnitudes on mental number line
  - Characterized by ratio dependence

    - Leading psychological model of ANS parallel in structure to semi-ordered scale discussed above

Summary

- *Most* – unlike *more than half* – may be interpreted relative to a semi-ordered scale structure modeled on humans' most basic numerical abilities
  - In some contexts only option; in other cases, pragmatic strengthening
- Accounts for:
  - Broader distribution vs. *more than half*
  - Imprecise lower bound
- Extending typology to include scales that are not totally ordered a productive approach to the vagueness / imprecision borderline

To vagueness…



Implicit comparatives

Context: Anna's height -164cm; Lisabeth's height - 163 cm

Anna is taller than Lisabeth — Explicit

#Anna is tall compared to Lisabeth — Implicit

- Fults 2011: 'Analog magnitude scale'
- Van Rooij 2011: Semi-order

> A structure $S, \succ$ *where S is a set and* $\succ$ *is a binary relation on S, is a* ***semi-order iff***
>
> $\forall x, y, z, v, w \in S$:
>
> a. $\neg(x \succ x)$
>
> b. $((x \succ y) \wedge (v \succ w)) \rightarrow ((x \succ w) \vee (v \succ y))$
>
> c. $((x \succ y) \wedge (y \succ z)) \rightarrow ((x \succ v) \vee (v \succ z))$

$\forall x,y$: $x \succ y$ iff $f(x) > f(y) + \epsilon$, for some small fixed ϵ

Vagueness more broadly

- Van Rooij 2009: Semi-orders can account for other properties of vagueness
  - Sorites paradox
- **Hypothesus:** Semi-ordered scale structures required to model speakers' use and interpretation of vague expressions
  - Talk by Nicole Gotzner, 17:20 today
- **Scale structure matters**

Thank you!