

# How many *most*'s?

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## The Broader Issue

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Majority

• Fred has read most Shakespeare plays

Relative

• Fred has read the most Shakespeare plays

Adjectival  
Superlative

• Fred bought the most expensive book

Superlative  
Quantifier

• Fred has read at most 15 Shakespeare plays

Same underlying core semantics?

## Outline

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- Unifying **majority** & **relative most** as *many* + *-est* (Hackl 2009)
- Degree-operator analysis of *many/much*
- Extension to **adjectival superlative most**
- Extension to **superlative quantifier most**
- A closer look at **majority most** – and a connection to analog quantity comparison
- Summary

## Majority vs. Relative Most

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**Majority**

- Fred has read most Shakespeare plays

**Relative**

- Fred has read the most Shakespeare plays

Out of 37 Shakespeare plays...	Majority	Relative
Fred: 28 John: 30	True	False
Fred: 14 All other relevant individuals: <10	False	True

## Hackl (2009)

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- *Most* = *many* + *-est* [majority & relative]
  - cf. German *die meisten*
- Availability of majority vs. relative reading parallels ambiguity in superlatives

Fred climbed the highest mountain	Fred has read...
• Higher than any other mountain (Absolute)	...most Shakespeare plays (Majority)
• Higher than mountains climbed by any other relevant individual (Relative)	...the most Shakespeare plays (Relative)

- Ambiguity derives from 2 scope options for superlative morpheme, corresponding to 2 choices for comparison class (Heim 1999):

## Hackl (2009)

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- Semantics:

$$[[\text{-est}]](C_{\langle \text{et} \rangle})(D_{\langle \text{d, et} \rangle})(x) = 1 \text{ iff}$$

$$\forall y \in C [y \neq x \rightarrow \max\{d:D(d)(x)\} > \max\{d:D(d)(y)\}]$$

defined iff  $x \in C$  and  $C$  has multiple members

$$[[\text{many}]] = \lambda P_{\langle \text{et} \rangle} \lambda d \lambda x. P(x) \wedge |x| \geq d$$

- Syntax

### Majority

Fred has read  $[_{DP} [_{NP} \text{-est}_1 [_{NP} \text{d}_1\text{-many Shakespeare plays}]]]$

### Relative

Fred  $[_{\text{-est}_1} [_{\text{has read}} [_{DP} \text{the} [_{NP} \text{d}_1\text{-many Shakespeare plays}]]]]]$

## Hackl (2009)

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### Relative

- Fred has read the most Shakespeare plays

Fred [-est<sub>1</sub> [has read [<sub>DP</sub> the [<sub>NP</sub> d<sub>1</sub>-many Shakespeare plays]]]]

$C = \{\text{Fred, Sue, Jane, Bob, ...}\}$

$$\forall x \in C [x \neq \text{fred} \rightarrow \max\{d: \exists y [S\text{-play}(y) \wedge \text{fred read } y \wedge |y| \geq d]\} > \max\{d: \exists y [S\text{-play}(y) \wedge x \text{ read } y \wedge |y| \geq d]\}]$$

- True iff # of plays Fred read exceeds # read by all other members of C

## Hackl (2009)

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### Majority

- Fred has read most Shakespeare plays

Fred has read [<sub>DP</sub> [<sub>NP</sub> -est<sub>1</sub> [<sub>NP</sub> d<sub>1</sub>-many Shakespeare plays]]]]

$C = \{\text{Hamlet} \sqcap \text{Othello} \sqcap \text{Lear}, \text{Hamlet} \sqcap \text{Othello}, \text{Othello} \sqcap \text{Romeo\&Juliet}, \dots\}$

$$\exists x [S\text{-play}(x) \wedge \text{fred read } x \wedge \forall y: S\text{-play}(y) [x \neq y \rightarrow \max\{d: |x| \geq d\} > \max\{d: |y| \geq d\}]]$$

- If non-identity ( $x \neq y$ ) construed as non-overlap ( $x \sqcap y = \emptyset$ ), true iff set of plays Fred read outnumbered set of plays he hasn't read

## Degree-based theory of Q-adjectives

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- *Most* = superlative of *many* & *much* (Bresnan 1973)
- *Many/much* (and *few/little*) as degree operators (Solt 2009, 2010)

$$\llbracket \text{many} \rrbracket = \llbracket \text{much} \rrbracket = \lambda d \lambda \mathcal{P}_{\langle d, \tau \rangle} . \mathcal{P}(d)$$

- Motivated by non-quantificational/non-adjectival uses  
Many fewer than 100 students attended to lecture
- Quantificational uses involve null measure function MEAS and quantification via existential closure  $\exists$
- Consequence: *many/much* null (identity functions) – cf. Corver's (1997) *much* support  
 Fred is diligent; in fact, he is too much so

## Applied to (the) *Most*

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Relative

- Fred has read the most Shakespeare plays

Fred [-est<sub>2</sub> [d<sub>2</sub>-many<sub>1</sub> [has read [<sub>DP</sub> the [<sub>MEAS</sub> d<sub>1</sub>-MEAS [<sub>NP</sub> S. plays]]]]]]

$\llbracket \text{has read the } d_1\text{-MEAS Shakespeare plays} \rrbracket =$

$$= \lambda d_1 \lambda x . \exists y [S\text{-play}(y) \wedge x \text{ read } y \wedge |y| \geq d_1]$$

$\llbracket d_2\text{-many}(\text{has read the } d_1\text{-MEAS Shakespeare plays}) \rrbracket =$

$$= \lambda x . \exists y [S\text{-play}(y) \wedge x \text{ read } y \wedge |y| \geq d_2]$$

$$\rightarrow \lambda d_2 \lambda x . \exists y [S\text{-play}(y) \wedge x \text{ read } y \wedge |y| \geq d_2]$$

- Application of *-est* produces same results as Hackl (2009)

## Adjectival Superlative *Most*

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### Adjectival Superlative

- Fred bought the most expensive book

- Looks like spell-out of superlative morpheme
  - *the smartest*
  - *the most intelligent*
- Allows absolute and relative readings (like synthetic superlatives)
- Captured as (null) *much* + *-est*

## Adjectival Superlative *Most*

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### Adjectival Superlative

- Fred bought the most expensive book

### Relative

Fred [-est<sub>2</sub> [d<sub>2</sub>-much<sub>1</sub> [bought [<sub>DP</sub> the [<sub>NP</sub> d<sub>1</sub>-expensive book]]]]]

[[bought the d<sub>1</sub>-expensive book]] =

=  $\lambda d_1 \lambda x. \exists y [\text{book}(y) \wedge x \text{ bought } y \wedge \text{COST}(y) \geq d_1]$

[[d<sub>2</sub>-much(bought the d<sub>1</sub>-expensive book)]] =

=  $\lambda x. \exists y [\text{book}(y) \wedge x \text{ bought } y \wedge \text{COST}(y) \geq d_2]$

→  $\lambda d_2 \lambda x. \exists y [\text{book}(y) \wedge x \text{ bought } y \wedge \text{COST}(y) \geq d_2]$

- Identical set of degrees; serves as argument to *-est*
- Adjectival superlative *most* aligned to superlatives

## Superlative Quantifier *Most*

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### Superlative Quantifier

- Fred has read at most 15 Shakespeare plays

- Evidence of link to superlative:
  - Paraphrasable with explicit superlative
    - The largest number of Shakespeare plays Fred could have read is 15
  - Similar use of other superlatives
    - Fred will arrive by 11 at the latest
    - Fred is 30 at the oldest
  - Cross-linguistic parallels (e.g. German):
    - Fred hat höchstens 15 Stücke von Shakespeare gelesen

## Superlative Quantifier *Most*

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### Superlative Quantifier

- Fred has read at most 15 Shakespeare plays

- Requires a range of values (Nouwen 2010):
  - Fred invited at most 15 friends
    - Infelicitous if speaker knows precisely how many
    - Felicitous on epistemic reading
  - Fred can invite at most 15 friends
  - The students invited at most 15 friends
- Parallels restriction on the superlative
  - ?You're the best mother I have
- Existing accounts (e.g. Krifka 1999; Geurts & Nouwen 2007; Nouwen 2010) do not capture these connections

## Superlative Quantifier *Most*

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Fred has read...

... most Shakespeare plays

Majority

- Comparison of plays

... the most Shakespeare plays

Relative

- Comparison of readers

... at most 15 Shakespeare plays

Superlative Quantifier

- Comparison of worlds

## Superlative Quantifier *Most*

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Superlative  
Quantifier

- Fred has read at most 15 Shakespeare plays

- Covert modality (Nouwen 2010) captured via set of accessible worlds as comparison class

$\llbracket \text{at most } 15 \rrbracket =$

$$= \lambda D_{\langle dt \rangle} \cdot \forall w [ \llbracket \text{most} \rrbracket (\text{Acc})(\lambda w' \lambda d. D(d) \text{ in } w')(w) \rightarrow$$

$$\max\{d: D(d) \text{ in } w\} = 15 ]$$



## Superlative Quantifier *Most*

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[at most 15; [Fred read  $d$ ; Shakespeare plays]]

$$\forall w \left[ \forall w'_{\text{Acc}} \left[ \begin{array}{l} w' \neq w \rightarrow \\ \max\{d: \exists y[S\text{-play}(y) \wedge \text{Fred read } y \text{ in } w \wedge |y| \geq d]\} \rightarrow \\ \max\{d: \exists y[S\text{-play}(y) \wedge \text{Fred read } y \text{ in } w' \wedge |y| \geq d]\} \end{array} \right] \rightarrow \right. \\ \left. \max\{d: \exists y[S\text{-play}(y) \wedge \text{Fred read } y \text{ in } w \wedge |y| \geq d]\} = 15 \right]$$

where two worlds are considered distinct ( $w' \neq w$ ) iff the maximum # of plays Fred read in them is different

'In the worlds where Fred read the most plays, he read 15'

- To satisfy the presupposition that C has multiple distinct elements, must be distinct epistemic possibilities

## Majority *Most* Revisited

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- Unified analysis of majority & relative *most* (Hackl 2009 and present extension)
  - *Most* = *many* + *-est*
  - Majority vs. relative readings reflect scope of *-est*
  - Majority *most* aligned to superlatives on absolute reading
- Facts explained
  - Cross-linguistic pattern: both readings available to superlative form of *many*

*Cei mai multi oameni beau bere*

most people drink beer

'Most/the most people drink beer'

Romanian

(Živanović 2008)

## Majority Most Revisited

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- Facts explained
  - Absence of *fewest* corresponding to majority *most* (Hackl 2009)

[[ [NP -est [NP d-many [NP d-MEAS Shakespeare plays]] ] ] =  
 = {x: x is a plurality of Shakespeare plays larger than any other non-overlapping plurality of Shakespeare plays}

[[ [NP -est [NP d-few [NP d-MEAS Shakespeare plays]] ] ] =  
 = {x: x is a plurality of Shakespeare plays smaller than any other non-overlapping plurality of Shakespeare plays}

✗

## Majority Most Revisited

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- An objection diffused:
  - Absence of definite article with majority *most* (vs. absolute superlative *the longest*)

[[ [NP -est [NP d-long Shakespeare play]] ] ] =  
 = {x: x is a Shakespeare plays longer than any Shakespeare play}

- Singleton set

[[ [NP -est [NP d-many [NP d-MEAS Shakespeare plays]] ] ] =  
 = {x: x is a plurality of Shakespeare plays larger than any other non-overlapping plurality of Shakespeare plays}

- Not a singleton set

## However...

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Fred has read most Shakespeare plays

Plays Fred has read: 19/37 Plays Fred hasn't read: 18/37

**INFELICITOUS (FALSE?)**

Fred has read the most Shakespeare plays

Fred: 19 Sue: 18 Other members of C: <18

**TRUE**

Fred read the longest book

Book Fred read: 300pp Next-longest book: 299pp

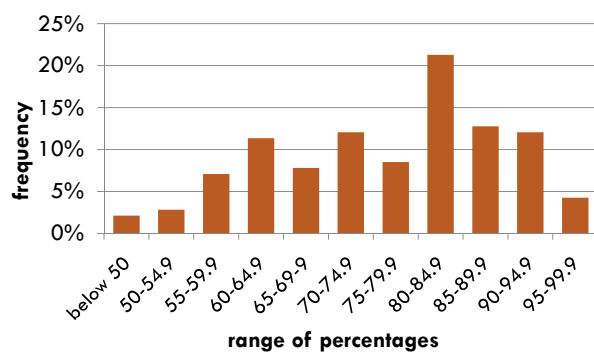
**TRUE**

- Majority *most* (unlike both relative *most* and absolute superlatives) is insensitive to small differences in measure

## Distribution of *Most*

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

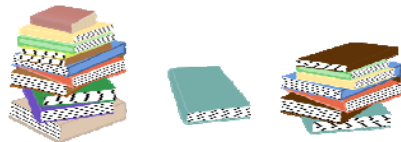


Source:  
COCA  
Davies (2008-)

## Majority vs. Relative Most

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Fred has read most Shakespeare plays

$$\lambda x. \forall y: S\text{-play}(y)[x \neq y \rightarrow \max\{d: |x| \geq d\} > \max\{d: |y| \geq d\}]$$


- Comparison of (pluralities of) plays - direct

Fred has read the most Shakespeare plays

$$\lambda x. \forall y \in C[x \neq y \rightarrow \max\{d: \exists z[S\text{-play}(z) \wedge x \text{ read } z \wedge |z| \geq d]\} > \max\{d: \exists z[S\text{-play}(z) \wedge y \text{ read } z \wedge |z| \geq d]\}]$$


- Comparison of readers - indirect

## Set comparison is different

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- Separate cognitive systems for precise and approximate quantity (Dehaene 1997 *inter alia*)
  - Digital vs. analog
- Approximate number system (ANS):
  - Involved in approx. arithmetic and **set size comparison**
  - Present in pre-verbal children, aphasia patients, cultures w/out complex number systems – and animals (lack representation of precise number)
  - ...but also active in verbal adults
  - Exhibits size & distance effects subject to Weber's law
    - I.e., requires sufficient ratio between set sizes

## Most and Analog Quantity

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- Use with non-enumerable sets (Solt ms.)

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

cf. ?But like **more than half of things**....

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

cf. ?**More than half of beliefs, worries and memories**...

Source:  
COCA  
Davies (2008-)

## Most and Analog Quantity

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- Processing

**Most of the dots are blue**

- In timed task, verification exhibits size & distance effects (Pietrowski et al. 2009)

- Acquisition

**Most of the crayons are yellow**

- Young children's acquisition of *most* independent of mastery of large exact number (Halberda et al. 2008)
  - But requires sufficient difference between set sizes

## Analog Quantity Formally

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- Approximate (analog) quantity comparison may be modeled via a semi-order on sets (van Rooij 2009)
  - Transitive with respect to  $\succ$  but not  $\sim$ , i.e. the following may obtain:  $x \sim y$  and  $y \sim z$  but  $x \succ z$
  - Ordering based on a 'significantly greater than' relationship

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.  $((x \succ y) \wedge (y \succ z)) \rightarrow ((x \succ v) \vee (v \succ z))$

## Most and Analog Comparison

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- Logical form for majority *most* allows default interpretation relative to (semi-)order on sets
  - Necessarily for non-enumerable domains
  - By strengthening to stereotypical interpretation otherwise (Horn 1984)

$$\lambda x. \forall y: S\text{-play}(y)[x \neq y \rightarrow \max\{d: |x| \geq d\} > \max\{d: |y| \geq d\}]$$



$$\lambda x. \forall y: S\text{-play}(y)[x \neq y \rightarrow x \succ y]$$

- That for relative *the most* does not
  - $\lambda x. \forall y \in C[x \neq y \rightarrow \max\{d: \exists z[S\text{-play}(z) \wedge x \text{ read } z \wedge |z| \geq d]\} > \max\{d: \exists z[S\text{-play}(z) \wedge y \text{ read } z \wedge |z| \geq d]\}]$
  - Not a comparison of sets

## Summary

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- Various uses of *most* may be unified via:
  - ▣ Degree operator analysis of superlative, with multiple scope options for superlative morpheme
  - ▣ Degree operator analysis of *many/much*
  - ▣ Extension of comparison classes to include sets of worlds
- Majority *most* exhibits properties that distinguish it from other *most*'s
  - ▣ Argued to be related to potential for evaluation via analog quantity comparison

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