Typological\(^1\) and experimental\(^2\) evidence for a refined view on proportional \textit{most}

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Outline

1. A view on *most*
2. Typological study
3. Experimental studies
Proportional *most*’s rise to fame

- Barwise & Cooper (1981)
Proportional *most*’s rise to fame

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  Proportional *most* can’t be represented in first-order logic!
Proportional *most*'s rise to fame

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  Solution: Generalized quantifiers as semantic primitives
Proportional *most*’s rise to fame

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- Hackl (2009)
Proportional *most*’s rise to fame

- **Barwise & Cooper (1981)**
  Proportional *most* can’t be represented in first-order logic!
  Solution: Generalized quantifiers as semantic primitives

- **Hackl (2009)**
  Proportional *most* is the superlative of *many*;
Proportional *most*’s rise to fame

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  Proportional *most* is the superlative of *many*;
  all you need is pluralities and degree semantics!
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  Solution: Generalized quantifiers as semantic primitives

- **Hackl (2009)**
  Proportional *most* is the superlative of *many*;
  all you need is pluralities and degree semantics!
  (cf. also Hoeksema 1983)
Absolute vs. relative

*Gloria caught the biggest fish.*

- **Absolute**
  Gloria caught the fish that was bigger than all other fish.

- **Relative**
  Gloria caught a bigger fish than anyone else caught.
Two kinds of analyses of relative readings

- **Movement**
  The superlative takes scope outside the object DP\(^1\)

- **In situ**
  The superlative is interpreted inside the DP as usual, just with a different comparison class\(^2\)

\(^1\)Szabolcsi 1986; Heim 1999; Hackl 2009
\(^2\)Farkas & É. Kiss 2000; Sharvit & Stateva 2002; Teodorescu 2009, i.a.
Movement analysis: DP-external structure

\[ \text{Gloria}_F \text{ caught the biggest fish} \]

\[
\begin{array}{c}
\text{Gloria}_F \\
\text{\text{-est}_C} \\
\lambda d \\
\text{caught} \\
\text{DP} \\
\text{the} \\
\text{d-big fish}
\end{array}
\]
Movement analysis: DP-external structure

$Gloria_F$ caught the biggest fish

Diagram:

```
Gloria_F
  /-est_C
  \    \lambda d
       caught
          DP
             / the
                / d-big fish
```
DP-internal structure

\( \text{Gloria}_F \) caught the biggest fish
Two readings with quantity superlatives

Assume:

- Gloria has visited North America, Africa, and Europe.
- Everyone else has visited only North America and Europe.

*True:* Gloria has visited the most continents.
Two readings with quantity superlatives

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Two readings with quantity superlatives

Assume:

- Gloria has visited North America, Africa, and Europe.
- Everyone else has visited only North America and Europe.

True: Gloria has visited the most continents.
False: Gloria has visited most continents.

[relative]
[proportional]
Two readings with quantity superlatives

Assume:
• Gloria has visited North America, Africa, and Europe.
• Everyone else has visited only North America and Europe.

*True*: Gloria has visited the **most** continents.

*False*: Gloria has visited **most** continents.
Hackl: Proportional as absolute

quantity superlatives  quality superlatives

proportional : relative :: absolute : relative
DP-external structure for quantity superlative

Gloria_F caught the many-est fish

```
Gloria_F
   \-est_C
     \lambda d
     caught
     DP
       the
       d-many fish
```
DP-external structure for quantity superlative

\( \text{Gloria}_F \text{ caught the many-est fish} \)

\[
\begin{array}{c}
\text{Gloria}_F \\
\quad \text{-est}_C \\
\quad \lambda d \\
\quad \text{caught} \\
\quad \text{DP} \\
\quad \text{the} \\
\quad d\text{-many fish}
\end{array}
\]
DP-internal structure for quantity superlative

$Gloria \ caught \ many\text{-}est \ fish$

Diagram:

- $Gloria$
- $caught$
- DP
  - $-est_C$
  - $\lambda d$
  - $d\text{-}many \ fish$
Hackl’s route to proportional readings

‘many-est’
holds of any $x$ that is more numerous than all $y \in C$
which do not overlap with $x$. 
Hackl’s route to proportional readings

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‘many-est’ holds of any $x$ that is more numerous than all $y \in C$ which *do not overlap with* $x$. 

![Diagram](attachment:diagram.png)
Hoeksema’s (1983) idea
Outline

1. A view on *most*

2. Typological study
   - Background
   - Previous theories
   - Proposal

3. Experimental studies
Proportional as absolute

quantity superlatives   quality superlatives

proportional : relative :: absolute : relative
Proportional as absolute

**quantity superlatives**  **quality superlatives**

proportional : relative  ::  absolute : relative

*Prima facie prediction*: In any language in which absolute readings are available for superlatives, the superlative of ‘many’ should have a proportional reading.
Counterexample: Slovenian

(1) **Naj-več ljudi pije pivo.**  
    sprl-many people drink beer  
    ‘More people drink beer than any other beverage.’  
    (Unavailable reading: ‘More than half the people drink beer.’)
Typological study

We coded a diverse set of languages for:
Typological study

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1. Primary strategy for forming superlatives
   - M, PERIPH, CMPR+DEF, CMPR, CMPR+ALL, CMPR+ANY
Typological study

We coded a diverse set of languages for:

1. Primary strategy for forming superlatives
   - M  PERIPH  CMPR+DEF  CMPR  CMPR+ALL  CMPR+ANY

2. Whether that strategy, when applied to many or most, has:
   - Both a relative and a proportional reading
   - A relative reading but no proportional reading
   - A proportional reading but no relative reading
   - Indeterminate
   - N/A (e.g. no superlative of MANY)
   (based on translations of a contrived story about cookies + follow-up)
A view on most

Typological study

Experimental studies

References

Background

Typological study: Results

Unattested: Proportional but not relative.
Previous theories

Proportional reading licensed by:

- **Separate lexical item** (traditional, e.g. Barwise & Cooper 1981, also Dobrovie-Sorin & Giurgea 2015)
- **DP-layer** (Bošković & Gajewski 2008, building on Hackl 2000).
- **Measure pseudopartitive** (Pancheva, 2015)
DP-layer hypothesis

- Živanović (2007) observes a correlation between allowing a proportional reading is and having definite determiner.
- Bošković & Gajewski (2008) propose:
  - Some languages have a DP projection over NP, and some lack one.
  - Languages that lack a DP projection do not have a definite determiner, and also lack a landing spot for -est within the DP.
Counterexample: Bulgarian

Definite article, yet superlative of many has only relative reading:

(2) Maria pročete naj-mnogo-(to) statii
    Maria read sprl-many-the articles
    ‘Maria read the most articles.’

More counterexamples

- Macedonian (Slavic)
- French, Spanish, Catalan, Italian (Romance)
- Hebrew, Turoyo (Semitic)
- Kurdish (Turkic)
- Albanian
- ...

Previous theories
Underlying pseudopartitive hypothesis

- In all languages, quantity superlatives spell out a pseudopartitive structure with a NUMBER amount noun.
- In some languages, the superlative of ‘many’ spells out an *individuating* pseudopartitive structure (yielding relative readings); in others, it spells out a *measure* pseudopartitive structure (yielding either relative or proportional readings).

(Pancheva, 2015)
Underlying pseudopartitive hypothesis

- See critique in Wilson (2016) and Coppock et al. (submitted) (or appendix)
- But basic insight sheds light on agreement patterns
Agreement Generalizations

Generalization I: Number

- On a proportional reading, quantity superlatives never disagree in number with the modified noun.

- On a relative reading, the superlative may show default agreement, disagreeing with the noun.
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Generalization I: Number

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Generalization II: Adverbial-relative connection

- A relative reading of a quantity superlative may always be expressed with adverbial superlative morphosyntax.
German

(3) Hans hat die meisten Bücher gelesen. Hans has def.pl many.sppl.wk book.pl read ‘Hans has read { the most books, most of the books }.’

(4) Ich bin das Mitglied unserer Familie, das am meisten Plätzchen isst. I am the member our family that on_def.neu.sg much.sppl cookies eats ‘I am the member of our family who eats the most cookies.’

(5) Meine Schwester am schnellsten rennen. 1poss sister on_def.neu.sg fast.sppl runs ‘My sister runs the fastest.’
Flemish Dutch

(6) Jan heeft de meeste bergen beklimmen.
John has the.pl many.sp{}l mountain.pl climbed
‘John has climbed \{ the most books, most of the books \}.’

(7) Jan heeft het meeste bergen beklimmen.
John has the.neu.sg many.sp{}l mountain.pl climbed
‘John has climbed the most mountains.’

(8) Mijn zus kan het hardest lopen.
1poss sister can def.neu.sg fast.sp{}l run
‘My sister can run the fastest.’

(Roelandt, 2016)
Faroese

(9) Mamma bakaði smákøkur í gjár, og eg át tær
Mom baked cookie.pl yesterday and I ate def.fem.pl
flest-u (av teinum).
many.sp.pl-wk of them.dat.pl
‘Mom baked cookies yesterday and I ate most of them.’ (Faroese)

(10) Eg eri tann í familjuni, sum etur flest køkur.
I am dem in family.dat.def as eats many.sp.neu.sg cookie.pl
‘I’m the one in the family who eats the most cookies.’ (Faroese)

(11) Systir mín rennur skjótast.
sister 1poss runs fast.sprl
‘My sister runs the fastest.’
Basque

(12) Liburutegi horrek ditu liburu gehi-en-ak.
library that.erg has book much-sprl-def.pl
‘That library has *most of* the books.’ ‘Mom baked cookies yesterday and I ate *most of* them.’

(13) Liburutegi horrek ditu liburu gehi-en.
library that.erg has book much-sprl
‘That library has *the most* books.’

(14) Gurasoek sufritu dutu gehi-en.
parent.pl.erg suffer aux much-sprl
‘The parents suffered *the most*.’

(Etxeberria, 2005; Hualde & de Urbina, 2003)
Schema: Relative reading (quality)

*John climbed the highest mountain on Tuesday*$_F$
Schema: General

*John climbed* the highest *mountain on Tuesday*. 

contrast set → association relation → measure

measurands

degrees
Schema: Absolute reading (quality)

*John climbed the highest mountain on Tuesday*

\[ y = x \quad y \text{ is } d\text{-high} \]
Proposal: Overview

- The ‘contrast set’ of a superlative:
Proposal: Overview

- The ‘contrast set’ of a superlative:
  - must consist of individuals
Proposal: Overview

- The ‘contrast set’ of a superlative:
  - must consist of individuals
  - must be identified either with measurands or through focus
Proposal: Overview

- The ‘contrast set’ of a superlative:
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- Measurands events or degrees
Proposal: Overview

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  ⇒ cannot be identified with contrast set
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- Quantity words normally measure quantities, rather than individuals.
Proposal: Overview

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- Quantity words normally measure quantities, rather than individuals.
- Gradable adverbs measure events.
Proposal: Overview

- The ‘contrast set’ of a superlative:
  - must consist of individuals
  - must be identified either with measurands or through focus

- Measurands events or degrees
  ⇒ default agreement (loose)
  ⇒ cannot be identified with contrast set

- Quantity words normally measure quantities, rather than individuals.
- Gradable adverbs measure events.
Schema: Relative reading (adverbial)

*John F ran the fastest.*

- **people**
  - *x did y*

- **runnings**
  - *y is d-fast*

- **degrees**
  -
Quantity words as predicates of degrees

\[ \text{much} \sim \lambda d \cdot \text{size}(d) \]
Proposal: Relative reading (quantity)

*John read the most books on Tuesday.*
What licenses proportional readings?

- Relative $\Rightarrow$ measurands are degrees
- Proportional $\Rightarrow$ measurands are individuals
Proposal: Proportional reading

*John has read most books.*

\[ y = x \]

\[ y \text{ is } d\text{-many} \]
General constraint

Constraint on contrast sets
A contrast set consists of individuals.
General constraint

Constraint on contrast sets
A contrast set consists of individuals.

- So: Relative readings only with adverbial and quantity superlatives (normally).
General constraint

Constraint on contrast sets

A contrast set consists of individuals.

- So: Relative readings only with adverbia and quantity superlatives (normally).
- Is this grounded in cognition?
### Interim Conclusion

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- When they do arise, it is based on a version of *many/much* that applies to individuals.
Interim Conclusion

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- When they do arise, it is based on a version of *many/much* that applies to individuals.
- Would Hackl’s theory work then?
Outline

1 A view on *most*

2 Typological study

3 Experimental studies
   - Background
   - Our study
   - Discussion

References
Which is more accurate?

\[
(15) \quad \{ \text{Most} \quad \text{More than half of} \} \quad \text{Americans have broadband internet access.}
\]
Which is more accurate?

(16) \[ \{ \text{Most} \quad \text{More than half} \} \text{ of the American population is female.} \]

From Solt (2016); the American population is 50.8% female
Which sounds better?

\[(17) \quad \{ \text{Most} \quad \text{More than half of} \} \text{ pastel hues have a calming effect.} \]

Solt (2016)
¿: Are most of the dots blue?
Kotek et al. (2015): *Most vs. more than half*
Kotek et al. (2015): *Most vs. more than half*
Solt (2015): Usage patterns with *most* and *more than half*
Our study: Fitting world to word

Question 18/27

There are 10 items below. Press "False. Change another item." to make one of the dogs brown. Press submit as soon as you think the following sentence is true.

**Most of the dogs are brown.**
Our study: Fitting world to word

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**Most of the dogs are brown.**
Our study: Fitting world to word

Question 18/27

There are 10 items below. Press "False. Change another item." to make one of the dogs brown. Press submit as soon as you think the following sentence is true.

Most of the dogs are brown.
Rationale

- Slightly different from an ordinary true/false task
- Finds lower bound where sentence becomes *comfortably* true
Design

- 50 MTurk participants
- 9 items (popcorn, dots, cups, etc.)
- $3 \times 3$ target trials
  - "{Most/More than half/The majority} of the [items] are [quality]." (between-subjects)
  - 10, 20, or 30 pictures.
- 18 fillers
- Random order of presentation, starting with two fillers
Results for *most vs. more than half*
Two cognitive systems for quantity

- Precise number system
  - Lost in some aphasics (Dehaene & Cohen, 1991)
  - Culture-dependent (Pica et al., 2004)

- Approximate number system
  - Universal
  - Ratio-dependent
    (Dehaene, 1997; Gallistel & Gelman, 2000; Feigenson et al., 2004)
Which weighs more?
Strategy 1

- Place the bag on a scale and record its weight.
- Repeat for the basket.
- Compare the two recorded values.
Strategy 2

- Place the items on the two pans of a balance scale.
- Observe which side hangs lower.
Two modes of comparison

- Assigning objects to real numbers
  - Uses a *ratio scale*, which supports division

- Comparing objects directly
  - Uses an *ordinal scale*, which doesn’t
Solt’s lexical entries

(18) \( \text{most} \ A \ B \rightarrow \mu_S(A \cap B) > \mu_S(A - B) \) (allows ordinal scale)

(19) \( \text{more than half} \ A \ B \rightarrow \mu_S(A \cap B) > \mu_S(A)/2 \) (requires ratio scale)

Weber-Fechner law

The differentiability of two stimuli is a function of the ratio of their measures.

- Two pairs of values with comparable ratios are equally differentiable
- Two values whose ratio is sufficiently close to 1 are not differentiable
Just Noticable Difference

For in adults in literate societies, the minimum ratio required for reliable differentiation is estimated at between 8 : 7 (ratio of 1.14) and 11 : 10 (ratio of 1.1) (Pica et al., 2004; Halberda & Feigenson, 2008).
Recall results from Kotek et al. (2015)
Our results for *most vs. more than half*
Our results in comparable format
Our results in comparable format (by Weber ratio)
Puzzle

The gap here is much larger than the Just Noticeable Difference.
### Puzzle

The gap here is much larger than the Just Noticeable Difference. Why?
Discussion

Puzzle

The gap here is much larger than the Just Noticeable Difference. Why?

• Changing the scene is too fun? Or MTurkers discriminate poorly?
## Puzzle

The gap here is much larger than the Just Noticeable Difference. Why?

- Changing the scene is too fun? Or MTurkers discriminate poorly?
  - Indeed, the counts are higher than expected for *more than half* as well.
Puzzle

The gap here is much larger than the Just Noticeable Difference. Why?

- Changing the scene is too fun? Or MTurkers discriminate poorly?
  - Indeed, the counts are higher than expected for *more than half* as well.
  - But why the contrast between *most* and *more than half* then?
Puzzle

The gap here is much larger than the Just Noticeable Difference. Why?

- Changing the scene is too fun? Or MTurkers discriminate poorly?
  - Indeed, the counts are higher than expected for *more than half* as well.
  - But why the contrast between *most* and *more than half* then?
- In this task, participants lump together ‘false’ with ‘misleading’?
The gap here is much larger than the Just Noticeable Difference. Why?

- Changing the scene is too fun? Or MTurkers discriminate poorly?
  - Indeed, the counts are higher than expected for more than half as well.
  - But why the contrast between most and more than half then?
- In this task, participants lump together ‘false’ with ‘misleading’?
  - Why would it be misleading below 75%?
Puzzle

The gap here is much larger than the Just Noticeable Difference. Why?

- Changing the scene is too fun? Or MTurkers discriminate poorly?
  - Indeed, the counts are higher than expected for more than half as well.
  - But why the contrast between most and more than half then?

- In this task, participants lump together ‘false’ with ‘misleading’?
  - Why would it be misleading below 75%?
  - There must be more to the story...
Preview of next talk

- Versions of this experiment with descending instead of ascending, adding instead of changing, three colors.
- Covered box experiments with two & three colors
- More quantifiers, incl. *the majority*, and proportional quantifiers in other languages.


Dobrovie-Sorin, Carmen & Ion Giurgea. 2015. Quantity superlatives vs.
Outline

4 Descending
   Descending 2-Color Changing

5 Pancheva critique
Example Stimuli

Question 18/27

There are 10 items below. Press "Still true. Change another item." to make one of the dogs brown. Press submit as soon as you think the following sentence is false.

Most of the dogs are brown.

Still true. Change another item.   False. Submit.
There are 10 items below. Press "Still true. Change another item." to make one of the dogs brown. Press submit as soon as you think the following sentence is false.

**Most of the dogs are brown.**
Example Stimuli

Question 18/27

There are 10 items below. Press "Still true. Change another item." to make one of the dogs brown. Press submit as soon as you think the following sentence is false.

Most of the dogs are brown.
Procedure

Participants are given 27 questions.

- 9 target items
  - "{Most/More than half/The majority} of the [items] are [quality]."
  - Target quantifier is a between-subjects factor.

- 18 filler items
  - "{Many/A few/etc.} of the [items] are [quality]."

- Items can either contain 10, 20, or 30 pictures.

The order of these questions is randomized, with the caveat that two questions with the same number of pictures or same quantifier, are not shown in a row.
Participants

- 50 participants, $1.50 ea.
- 12 excluded
  - 4 non-English
  - 8 bad faith
Descending 2-Color Changing

Results

- **Most 10**
- **More than half**
- **Majority 10**

- **Most 20**
- **More than half**
- **Majority 20**

- **Most 30**
- **More than half**
- **Majority 30**
Outline

4 Descending

5 Pancheva critique
Wilson (2016, 17)

If there is a silent *number* noun in combination with *largest*, then we might expect just *largest* to realize a structure excluding *number*.

(20) He ate the smallest almond tarts.

doesn’t mean

(21) He ate the smallest number of almond tarts.
Mandarin *de*: measure only

Rothstein (2017, 156) writes: “As Cheng & Sybesma (1998) show, *de* forces a measure reading, and is infelicitous in a context which requires the individuating interpretation. (22-a) requires the individuating interpretation (and *de* is out); (22-b) requires the measure interpretation (and *de* is in).”

(22) a. #Wo kai le san ping de jiu.
   I open pfv three cl*bottle* *de* wine
   Intended: ‘I opened three bottles of wine.’

b. Wo de wei neng zhuangxia san ping de jiu.
   my *de* stomach can hold three cl*bottle* *de* wine
   ‘My stomach can hold three bottles of wine.’ (Rothstein, 2017, 156)
Mandarin *de* and quantity superlatives

The Mandarin superlative structure (23) only permits a relative interpretation. In this structure, *de* is permitted (although not strictly required, according to an informant):

(23)  Wo chi le zui duo de binggan.
     I eat asp sprl many de cookie
     ‘I ate the most cookies.’

So relative readings can reflect an underlying measure pseudopartitive structure, rather than an individuating one (as predicted by Pancheva).