When to quantify: syntactic cues in the acquisition of novel superlatives

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We know a lot about the semantics of quantification (broadly speaking)

... or, what has to be acquired

Also a lot about when it is acquired

Our question: how do kids learn when number, as opposed to some other property, is relevant?
Syntactic and extralinguistic information are used to determine the meaning of a novel word.

- Most previous work: nouns, verbs, exact number words
our idea

- Test children’s preferences for interpreting a novel superlative in different syntactic contexts
- ... when given data supporting both quantity- and quality-based interpretations
Previous bootstrapping proposals have posited the partitive frame as a strong cue to quantity meanings.

Experimental results were mixed.

Our hypothesis: *syntactic category* is a strong cue.
why superlatives?

- Superlative adjectives have quantity- or quality-based meanings:
  - *The most (of the) cows*
  - *The spottiest (of the) cows*

- Superlative determiners have only quantity-based meanings:
  - *Most of the cows*
  - *Spottiest of the cows*
Previous bootstrapping proposals for (exact) number
acquiring exact number

- Kids around 2;6 know that exact number words denote quantities, they just don’t know which (Wynn)
- How do they know that?
  - What are the available cues?

partitive as cue

- In CHILDES, number words frequently occur in the partitive frame (e.g. *two of the cows*) (Bloom & Wynn)
- The partitive signals the semantic role of quantification (citing Jackendoff)


A variety of expressions appear here (Syrett et al):

- **Amount**: all, both, each, most, much, none, some
- **Segment**: back, bottom, edge, end, front, side
- **Measure**: mile, hour, pound, bucket, cup, glass

Test: *pim trains/pim of the trains*

- With possible meanings “2” and “red”

Result: partitive predicted quantity responses... in restricted cases.

- Otherwise, overriding bias to interpret *pim* as “red” across conditions
our observation

- Indeed, the numerals and most quantifiers appear as $X$ in $X$ of the NPs
- But, it matters what occurs on the left:
  - All/both/each/most of the cows are happy
  - *(The) back/bottom/edge of the fridge is blue
  - *(One) mile/hour of the race was difficult
A strong cue to quantity meanings: syntactic category
Determiners have a stable syntax-semantics mapping.

Their semantics expresses relations between sets: they care only about *quantities*, not *qualities* of individuals.

*They have the property of *permutation invariance*.

most of the animals are happy: true by cardinality

*heaviest of the animals are happy: T in c1, F in c2
quality superlatives

- Adj bad with partitive, bad without D
  - *The spotty cows*
  - *The spotty of the cows*
  - *Spotty of the cows*

- Superlative OK with partitive, needs D
  - *The spottiest (of the) cows*
  - *Spottiest of the cows*
quantity superlatives

- Adj bad with partitive, OK without D
  - *The many cows*
  - *The many of the cows*
  - *Many of the cows*

- Superlative is totally free
  - *The most (of the) cows*
  - *Most of the cows*

*many+est is (count) most: Bobaljik (2007). On comparative suppletion. University of Connecticut, m.s.*
Adjectival—quantity or quality:
  • *The spotty/many of the cows

... but not with partitive:
  • *The spotty/many of the cows

... unless superlative:
  • The spottiest/most of the cows

But Ds only support quantity:
  • Most/*spottiest of the cows
hypotheses

○ Linguistic:
  • In *X of the NP*, *X* is *D* unless *D* appears to the left of *X*

○ Developmental:
  • *Parsing an expression as D* cues quantity interpretations
Testing the developmental hypothesis
experiment design

- Picky puppet task
- Novel word *gleebest*
- Ambiguous training cards, unambiguous test cards
- Between subjects syntactic contexts
- Measure: quantity-based response
quantity v quality

“(the) gleebest (of the) cows are by the barn”
The puppet likes the cards where...

<table>
<thead>
<tr>
<th>Condition</th>
<th>Adjunct</th>
<th>overt the</th>
<th>Partitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>the gleebest cows</td>
<td>ADJ</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>the gleebest of the cows</td>
<td>CON</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>gleebest of the cows</td>
<td>DET</td>
<td>✗</td>
<td>✓</td>
</tr>
</tbody>
</table>

...are by the barn.
training
“(the) gleebest (of the) cows are by the barn”
(1/2 of the) test cards
predictions

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>QUANTITY-based response</th>
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</thead>
<tbody>
<tr>
<td>No bootstrapping</td>
<td>- - - -</td>
</tr>
<tr>
<td>Partitive as strong cue</td>
<td>- + +</td>
</tr>
<tr>
<td>Category as strong cue</td>
<td>- - +</td>
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ADJ: the gleebest cows

CON: the gleebest of the cows

DET: gleebest of the cows
test
results

- N=36
- 12 participants each ADJ, CON, DET
- Age range 4;0-5;2, mean 4;7
% quantity by condition

ADJ: the gleebest cows

CON: the gleebest of the cows

DET: gleebest of the cows
## Results

### Hypothesis

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Different from chance (sign tests):
- ADJ **, CON *, DET **

**DET** significantly different from others (t-tests):
- ADJ-DET **, CON-DET **
conclusions

A syntactic bootstrapping hypothesis for acquiring novel superlatives is supported.

... Syntactic category is a strong cue to quantity-based meanings.

Partitive is quite a weak cue.
ROADMAP

motivation
hypotheses
experiment
discussion
What biases kids towards quality meanings for adjectival expressions?

• Can’t think number thoughts?  (Clearly false.)
• Qualities just so much more salient?
• Require more evidence to think number is relevant?
• The nature of the input?  (frequency/...
further questions

- *most* is semantically (near-)identical to *spottiest* (Hackl)
  - But D accepts *most*, never *spottiest*

- How fundamental to language is the notion of *quantity*?
  - Wherefore correlates (imperfectly) the *functional* and *logical* vocabulary

Hackl. (2009). On the grammar and processing of proportional quantifiers: *most* versus *more than half*. Natural Language Semantics, 17, 63-98.
RAs Leah Whitehill & Jessica Lee
UMD’s infant & preschool labs
UMD’s Center for Young Children
Cognitive Neuroscience of Language lab
UMD Language Science community (http://languagescience.umd.edu)
UMD’s NSF-IGERT
Social Sciences & Humanities Council of Canada (SSHRC) doctoral award
% quantity by subject

- ADJ
- AMB
- DET
Ratio of numerosities equal to ratio of (numerosities of) spots

Ratio 1:3
Number 6:3
Spots 9:18
numberized Ds

- GQ-style interpretations of some Ds:
  - $\lbrack \text{the} (A_{\text{sg}})(B) \rbrack = \lvert A \rvert = 1 \& \lvert A \cap B \rvert = 1$
  - $\lbrack \text{some}(A)(B) \rbrack = \lvert A \cap B \rvert > 0$
  - $\lbrack \text{every}(A)(B) \rbrack = \lvert A \cap B \rvert = \lvert A \rvert$
  - $\lbrack \text{most}(A)(B) \rbrack = \lvert A \cap B \rvert > \lvert A - B \rvert$
  - $\lbrack \text{both}(A)(B) \rbrack = \lvert A \rvert = 2 \& \lvert A \cap B \rvert = 2$

*In count contexts, of course. A suitable generalization of GQ theory to mass contexts is still wanting.*