Lexical alternatives in different forms of pragmatic processing

Judith Degen\(^1\)  Richard Breheny\(^2\)

\(^1\)Department of Brain and Cognitive Sciences
University of Rochester

\(^2\)Division of Psychology and Language Sciences
University College London

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What to accomplish today

- shed some new light on the processing of different kinds of Gricean reasoning generated by statements containing scalar item *some*, by investigating interaction of linguistic and non-linguistic factors:
  - lexical alternatives to *some*
  - different syntactic contexts
  - set subitizability
  - low-level biases
Outline

1. Scalar implicature processing
2. Experiments in the gumball paradigm
3. Summary and conclusion
Scalar implicature

(1) A: What time is it?
B: Some guests are already leaving.
⇝ Some, but not all guests, are already leaving.
The time course of scalar implicature processing

Motivation

- insight into architecture of the system
- status of semantic vs. pragmatic information
The time course of scalar implicature processing

Motivation
- insight into architecture of the system
- status of semantic vs. pragmatic information

Some early results and questions
- comprehenders compute implicatures online (Breheny et al., 2006)
- How quickly is the pragmatic interpretation of some computed compared to literal controls like all?
- default vs. 2-stage vs. context-driven/constraint-based models of scalar implicature (Levinson, 2000, Huang & Snedeker, 2009, Degen & Tanenhaus, 2011)
“Point to the girl that has some/all/two/three of the socks/cer balls”
“Point to the girl that has some/all/two/three of the socks/cceer balls”
“Point to the girl that has some/all/two/three of the socks/ccer balls”
“Point to the girl that has some/all/two/three of the socks/ccer balls”

- measure: eye movements
- predictions:
  - default: same pattern in all conditions (fast convergence on target after quantifier)
  - 2-stage: delayed looks to target only for “some”
“Point to the girl that has some/all/two/three of the so...”

The graph shows the proportion of looks to targets across different phases: Baseline Phase, Gender Cue Phase, Quantifier Phase, Disambiguation Phase, and End Phase. The graph plots the proportion of looks to the target for different quantifiers: Two (open circles), Some (filled triangles), Three (open squares), and All (filled triangles). The x-axis represents the different parts of the sentence: Point to the, girl that has, ___of the soc-, -ks, and (end).
“Click on the girl that has some/all/none of the balls/lloons”
“Click on the girl that has some/all/none of the balls/lloons”
“Click on the girl that has some/all/none of the balls/loons”
“Click on the girl that has some/all/none of the ba...”
“The man has poured some/all of the water with limes/oranges into...”
“The man has poured some/all of the water with limes/oranges into...”
Conflicting evidence

- under certain conditions pragmatic enrichment is delayed, under others it’s not
- difference between Huang & Snedeker, 2009 and Grodner et al., 2010: use of number terms
- difference between Huang & Snedeker, 2009 and Grodner et al., 2010 on one hand and Breheny et al. on the other: sentence type
- different explanations for the difference in results...
### Proposed explanations I: pre-coding

<table>
<thead>
<tr>
<th></th>
<th>HS</th>
<th>Grodner</th>
<th>BFK</th>
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<tbody>
<tr>
<td>number terms</td>
<td>present</td>
<td>absent</td>
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<tr>
<td>target set size</td>
<td>small</td>
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<tr>
<td>sentence type</td>
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<tr>
<td>effect</td>
<td>slow</td>
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- pre-coding of partitioned set as *some* set due to lack of number term items in Grodner et al., 2010 leads to rapid effects
Proposed explanations II: subitizability

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- for subitizable sets, number terms are more natural lexical alternatives than the vague *some*, so availability of number terms in experimental items in Huang & Snedeker, 2009 leads to slow effects
- support from the gumball paradigm: Degen & Tanenhaus (in preparation)
Subitizing (Kaufmann et al 1949)

- Fast, accurate judgments of set size
- No counting necessary
- Increase in time to respond for each added object
Subitizing (Kaufmann et al 1949)

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Subitizing (Kaufmann et al 1949)

- fast, accurate judgments of set size
- no counting necessary
- increase in time to respond for each added object
Eye-tracking: **slow/rapid implicatures**  

- big set *some* / small set *all*
- big set *all* / small set *some*

> “You got some/all/two/six of the gumballs.”
Eye-tracking: slow/rapid implicatures

Degen & Tanenhaus, 2011

big set *some* / small set *all*

big set *all* / small set *some*

“You got some/all/two/six of the gumballs.”
Eye-tracking: **slow/rapid** implicatures  
Degen & Tanenhaus, 2011

big set *some* /  
small set *all*

big set *all* /  
small set *some*

“You got some/all/two/six of the gumballs.”
"You got some of the blue gumballs"
Proposed explanations II: subitizability

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- Absence of numbers prevents precoding of partitioned set as some-set.
- Presence of numbers leads to slowdown only in subitizing range, where natural use of some is blocked by more natural alternatives (number terms).
Gricean reason to think that slow effect not due to presence or absence of number terms per se, but interaction thereof with syntactic form of experimental items (and associated Gricean reasoning):

- **Quantity implicature** – *all*-statement more informative:
  The man poured some of the water with limes. . .
  \(\leadsto\) The man poured some, but not all, of the water with limes. . .

- **Referential expression** – *all*-statement not more informative:
  Click on the girl with some of the socks
  \(\leadsto\) You don’t have to click on the girl with all of the socks.

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Proposed explanations III (the present): implicature type

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- Gricean reason to think that slow effect not due to presence or absence of number terms per se, but interaction thereof with syntactic form of experimental items (and associated Gricean reasoning):

(2) *Quantity implicature* – *all*-statement more informative:
The man poured some of the water with limes. . .
\(\leadsto\) The man poured some, but not all, of the water with limes. . .

(3) *Referential expression* – *all*-statement not more informative:
Click on the girl with some of the socks
\(\leadsto\) You don’t have to click on the girl with all of the socks.
QI vs reasoning about referential expressions with some

- **QI:**
  - task: is statement true
  - Gricean reasoning makes reference to *more informative alternatives*

- **Referential:**
  - task: figure out what is being referred to
  - Gricean reasoning makes reference to *better alternative cues to the referent*
The gumball paradigm

You got some of the orange gumballs.

Task: click on the side of the chamber that contains the mentioned gumballs.
The gumball paradigm

- click flashing button
The gumball paradigm

- click flashing button
- *You got some of the orange gumballs*
The gumball paradigm

- click flashing button
- *You got some of the orange gumballs*
- task: click on the side of the chamber that contains the mentioned gumballs
Predictions

Interaction of sentence type, quantifier, number term presence, and target set subitizability

1. numbers **absent**: no differences expected
2. numbers **present**: interference of number terms with speed of pragmatic enrichment of *some* for referential but not QI items
   1. delay in looks to target for *some* relative to *all* with referential items but not with QI items
   2. delay should be larger in **subitizing** range, where numbers are better alternatives to *some* than outside the subitizing range
Materials

- **Sentence type**
  QI: You got some/all of the blue gumballs.
  Referential: Click on the side with some/all of the blue gumballs.

- **Number terms**
  present or absent in experimental items (between-subjects manipulation – 88 trials when numbers present, 44 when numbers absent)

- **Quantifier**
  some, all (two, three, eight, nine)

- **Target set subitizability**
  target set was subitizable (set size 2/3) or not subitizable (set size 8/9)
Target set subitizability

big set *some* / small set *all*

small set *some* / big set *all*
Target set subitizability

big set *some* / small set *all*

small set *some* / big set *all*
Target set subitizability

big set *some* / small set *all*

small set *some* / big set *all*
Results: numbers absent

"Click on... / You got some of the blue gumballs"

predicted: no differences across conditions
got: interaction between quantifier and target subitizability
Results: numbers present, subitizing range

<table>
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<th>Time (ms)</th>
<th>Proportion of fixations to target</th>
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<tr>
<td>0</td>
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</tr>
<tr>
<td>200</td>
<td>0.2</td>
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<td>400</td>
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<td>600</td>
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<td>800</td>
<td>0.8</td>
</tr>
<tr>
<td>1000</td>
<td>1.0</td>
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"Click on... / You got some of the blue gumballs"

predicted: delayed some with referential, but not QI items
got: overall advantage for some (as in numbers absent condition)
Results: numbers present, non-subitizing range

"Click on... / You got some of the blue gumballs"

predicted: delayed *some* with referential, but not QI items

got: delayed *some* with QI but not referential items
...how to make sense of this?
...how to make sense of this?

indirect evidence for a special status of Gricean reasoning after taking into account visual and lexico-pragmatic biases
assumptions:

- big set bias prior to quantifier input
- for *some*, bias to move away from big set
- for *all*, bias to remain

result:

- sub: some < all
- negsub : all < some
Why these particular biases?

- for *some*, bias to move away from big set:
- for *all*, bias to remain

- two ways to get to right target:
  1. correctly code and recall
  2. check in display: look at upper chamber

- 1 favored for *all*
- 2 favored for *some*

- for *some*, both ways require making Gricean inference
result:
- sub: some < all
- \neg sub : all < some

assumptions:
- big set bias prior to quantifier input
- for some, bias to move away from big set
- for all, bias to remain
Numbers present

result:

- sub: some < all
- ¬sub:
  - QI: all < some
  - referential: all = some

assumptions:

- big set bias prior to quantifier input
- for some, bias to move away from big set
- for all, bias to remain
result:

- sub: some < all
- \( \neg \text{sub} : \)
  - QI: all < some
  - referential: all = some

assumptions:

- big set bias prior to quantifier input
- for some, bias to move away from big set
- for all, bias to remain
Lexico-pragmatic and visual biases for subitizable sets

- presence of numbers decreases log odds of looking at target for both *some* and *all*
Lexico-pragmatic and visual biases for big sets

- Presence of numbers increases log odds of looking at target for both *some* and *all*
- Advantage is larger for *some* in referential than in QI condition!
Conclusion and future work

After taking into account visual & lexico-pragmatic biases: indirect evidence for greater interference of number terms with referential than QI items, suggesting that enrichment from *some* to *not all* is achieved via different Gricean mechanisms in different syntactic contexts.

- seeming incompatibility with Degen & Tanenhaus results
- some differences between the studies:
  - DT used only QI items
  - DT included “garden-path” trials (either false or underinformative)
  - set sizes used. DT: 2 vs. 6, DB: 2/3 vs. 8/9
Thank you
Thanks to

- Mike Tanenhaus
- EURO-XPRAG
References


