Range Expressions
Ameliorate Depictive Sincerity Violations

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PolitiFact’s Truth-O-Meter

“The Truth-O-Meter is based on the concept that – especially in politics – truth is not black and white.”
Depictive sincerity implicature example

Right now, the [Congressional Budget Office] says up to 20 million people will lose their insurance as Obamacare goes into effect next year.

(Mitt Romney in 2012)
Depictive sincerity implicature example

Right now, the [Congressional Budget Office] says **up to 20 million people** will lose their insurance as Obamacare goes into effect next year.

(Mitt Romney in 2012)
Depictive sincerity implicature example

Right now, the [Congressional Budget Office] says **up to 20 million people** will lose their insurance as Obamacare goes into effect next year. (Mitt Romney in 2012)

The Congressional Budget Office calculated several estimates:

![Graph showing range of estimates]

- 3
- -5
- -10
- -12
- -20

(baseline)
Two classes of modified numerals

Class A
- more/fewer/less than 5 (comparative modifiers)
- under/over 5

Class B
- at least 5, at most 5 (superlative modifiers)
- up to 5, maximally 5, 5 tops
- 5 or more/fewer/less
- from 100 to 200

(Nouwen 2010, cf. also Schwarz et al. 2012, Blok 2015)
A study of more than 2,500 retired NFL players found that those who had \{ more than two at least three \} concussions during their careers had triple the risk of clinical depression as those who had no concussions.
A study of more than 2,500 retired NFL players found that those who had \{ \text{more than two} \quad \text{or} \quad \text{at least three} \} concussions during their careers had triple the risk of clinical depression as those who had no concussions.
The maximum number of cards in an Extra Deck is 15, although it is allowed to have \( \left\{ \begin{array}{l} 
\text{fewer than 15} \\
\text{at most 14} 
\end{array} \right\} \text{ in it.} \)
The maximum number of cards in an Extra Deck is 15, although it is allowed to have \{ fewer than 15, at most 14 \} in it.
I asked a bunch of my mom’s friends (none of whom had \{ more than two, at least three \} kids) what they thought about having three.
I asked a bunch of my mom’s friends (none of whom had \{ \text{more than two } \at \text{ least three } \text{ kids} \}) what they thought about having three.
I am in my 60s and had \{ \text{more than two at least three} \} parents growing up.
Guess the original version

I am in my 60s and had \( \{ \text{more than two at least three} \} \) parents growing up.
Superlative modifiers and ignorance

A hexagon has more than four sides.

#A hexagon has at least five sides.

(Nojwen 2010)

At least conveys ignorance; more than does not.
Empirical views on ignorance with modified numerals

<table>
<thead>
<tr>
<th>Modifier</th>
<th>QUD</th>
<th>Received</th>
<th>W&amp;B</th>
<th>M&amp;M</th>
<th>C&amp;B</th>
<th>CSS</th>
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<td>At least</td>
<td>How many</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
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<td>How many</td>
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<td>Yes</td>
<td>No</td>
<td>Yes</td>
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<td></td>
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<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Received view = Geurts & Nouwen 2007; Büring 2008; Cummins & Katsos 2010; Kennedy 2015
W&B = Westera & Brasoveanu 2014
M&M = Mayr & Meyer 2014
C&B = Coppock & Brochhagen 2013
CSS = Cummins et al. 2012
Mary's cards:

Sue: “How many clubs do you have?”
Mary: “At least six of the cards on my deck are clubs.”

Is Mary's answer appropriate?

Not at all 1 2 3 4 5 Completely
Situation manipulation

- **FALSE**: Mary knows $x < N$
- **EXACT**: Mary knows $x = N$
- **EXCEED**: Mary knows $x > N$
- **IGNORANCE**: Mary is uncertain if $x = N$ or $x > N$

$x = \text{number of clubs on Mary’s deck}$
QUD manipulation

- **HowMany**: Sue asks, *How many face cards do you have?*
- **PolarRelevant**: Sue asks: *Will you win this round?*; Mary responds only with relevant information (e.g., *Yes, at least six/more than five of my eight cards are clubs*).
- **PolarOverInf**: Sue asks: *Will you win this round?*; Mary responds providing more information than necessary (e.g., *Yes, at least seven/more than six of my eight cards are clubs*).
at least $n$

more than $(n-1)$

bare $n$

How many

(n=2/3/4)

Polar

(relevant: n=6)

Polar

(over-informative: n=7)

False Exact Exceed Ignorance False Exact Exceed Ignorance

Mean response

Elizabeth Coppock (BU)

Range Expressions
Interim Conclusion

At least $n$ carries an ignorance implicature:

- Possibly $n$
- Possibly more than $n$
Whence ignorance?


- E.g. *at least 4 ‘amounts to a disjunction’: 4 or more.*
- There is an ‘implicature schema’ that says, if a speaker says *A or B*, then the speaker considers both *A* and *B* to be possible.

With inquisitive semantics, we can explain what it means to ‘amount to’ a disjunction.
Traditional vs. Inquisitive Disjunction

Traditional disjunction

Inquisitive disjunction
**at most vs. fewer than**

*Liz had at most 4 beers* à la Coppock and Brochhagen:

- **logically implies** that Liz had fewer than 5 beers (like *Liz had fewer than 5 beers*)
- **brings up the issue** of whether Liz had fewer (unlike *Liz had fewer than 5 beers*)

<table>
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<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
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<td>3</td>
<td>4</td>
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Refinement (cf. Schwarz 2016)

“at most 4”

0 1 2 3 4 5 6
Quality maxims for Inquisitive Semantics

Maxim of Informative Sincerity: Believe what you say.
Quality maxims for Inquisitive Semantics

Maxim of Informative Sincerity: Believe what you say.

Maxim of Inquisitive Sincerity: Don’t bring up an issue that you already know how to resolve.
### Alternative (among several): OT analysis

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<th>Quant</th>
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<td>$[n + 1, \ldots)$</td>
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</table>
But ignorance is not all there is to the story...
Truth value judgment experiment

There are at least 6 dogs in the picture.

- True
- False
Materials
‘True’ conditions (superlative modifiers)
‘True’ conditions (superlative modifiers)

\textsuperscript{upward}\textsubscript{on} There are at least 4 butterflies.
‘True’ conditions (superlative modifiers)

\[ \text{sup:upward:on} \quad \text{There are at least 4 butterflies.} \]
\[ \text{sup:upward:off} \quad \text{at least 3} \]
‘True’ conditions (superlative modifiers)

sup:upward:on  There are at least 4 butterflies.
sup:upward:off  at least 3
sup:downward:on  at most 4
‘True’ conditions (superlative modifiers)

\[
\begin{align*}
\text{sup:upward:on} & \quad \text{There are at least 4 butterflies.} \\
\text{sup:upward:off} & \quad \text{at least 3} \\
\text{sup:downward:on} & \quad \text{at most 4} \\
\text{sup:downward:off} & \quad \text{at most 5}
\end{align*}
\]
‘True’ conditions (comparative modifiers)
‘True’ conditions (comparative modifiers)

cmp:upward:on There are more than 3 butterflies.
‘True’ conditions (comparative modifiers)

cmp:upward:on There are more than 3 butterflies.
cmp:upward:off more than 2
‘True’ conditions (comparative modifiers)

cmp:upward:on  There are more than 3 butterflies.
cmp:upward:off  more than 2
cmp:downward:on  fewer than 5
‘True’ conditions (comparative modifiers)

(cmp:upward:on) There are more than 3 butterflies.
(cmp:upward:off) more than 2
(cmp:downward:on) fewer than 5
(cmp:downward:off) fewer than 6
Results for superlative modifiers
Results for superlative modifiers

98.5% There are at least 4 butterflies.
Results for superlative modifiers

98.5% There are at least 4 butterflies.
97.0% at least 3
Results for superlative modifiers

98.5% There are at least 4 butterflies.
97.0% at least 3
87.4% at most 4
Results for superlative modifiers

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Statement</th>
</tr>
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<tbody>
<tr>
<td>98.5%</td>
<td>There are at least 4 butterflies.</td>
</tr>
<tr>
<td>97.0%</td>
<td>at least 3</td>
</tr>
<tr>
<td>87.4%</td>
<td>at most 4</td>
</tr>
<tr>
<td>57.6%</td>
<td>at most 5</td>
</tr>
</tbody>
</table>
Why? Ignorance can’t be it.

“at most 5”

0 1 2 3 4 5 6 7

“at most 4”

0 1 2 3 4 5 6 7

“at least 4”

0 1 2 3 4 5 6 7
Adding highlighting

“at most 5”

```
0 1 2 3 4 [5] 6 7
```

“at most 4”

```
0 1 2 3 [4] 5 6 7
```

“at least 4”

```
0 1 2 3 [4] [5] 6 7
```
A New Gricean Maxim

Maxim of Depictive Sincerity: If a sentence highlights a possibility, then the speaker considers it possible (or likely).
A New Gricean Maxim

Maxim of Depictive Sincerity: If a sentence highlights a possibility, then the speaker considers it possible (or likely).

Strong pragmatic requirement!
A New Gricean Maxim

Maxim of Depictive Sincerity: If a sentence highlights a possibility, then the speaker considers it possible (or likely).

Strong pragmatic requirement!

Violation of strong pragmatic requirements can lead people to judge true sentences as false.
Back to the Romney example

“Right now, the [Congressional Budget Office] says up to 20 million people will lose their insurance as Obamacare goes into effect next year.”
What about *at least 3*?

“at least 3”
Question

What if multiple possibilities are highlighted, including one that entails the speaker’s information state?
Disjunctions and highlighting

There are 1 or 2 pianos in the picture.
Disjunctions and highlighting

There are 1 or 2 pianos in the picture.
Disjunctions and highlighting

There are 1 or 2 pianos in the picture.

97.5%
Disjunctions and highlighting

There are 2 or 3 elephants in the picture.
Disjunctions and highlighting

There are 2 or 3 elephants in the picture.
Disjunctions and highlighting

97.5%  There are 2 or 3 elephants in the picture.
Doubly-bounded range expressions

100% There are 4 to 7 potatoes in the picture.
Experiment: Doubly-bounded range expressions

There are at least 5 and at most 7 dogs in the picture.

○ True
○ False
Conditions (superlative modifiers)
Conditions (superlative modifiers)

\text{sup:range:on} \text{ There are at least 2 and at most 4 butterflies.}
Conditions (superlative modifiers)

\textbf{sup:range:on} There are at least 2 and at most 4 butterflies.

\textbf{sup:range:off} at least 3 and at most 5
Conditions (superlative modifiers)

**sup:range:on** There are at least 2 and at most 4 butterflies.

**sup:range:off** at least 3 and at most 5

**sup:bound:on** at most 4
Conditions (superlative modifiers)

\[
\text{sup:range:on} \quad \text{There are at least 2 and at most 4 butterflies.}
\]
\[
\text{sup:range:off} \quad \text{at least 3 and at most 5}
\]
\[
\text{sup:bound:on} \quad \text{at most 4}
\]
\[
\text{sup:bound:off} \quad \text{at most 5}
\]
Conditions (path modifiers)
Conditions (path modifiers)

`path:range:on` There are 2 to 4 butterflies.
Conditions (path modifiers)

**path:range:on**  There are 2 to 4 butterflies.
**path:range:off**  3 to 5
Conditions (path modifiers)

- **path:range:on** There are 2 to 4 butterflies.
- **path:range:off** 3 to 5
- **path:bound:on** up to 4
Conditions (path modifiers)

- **path:range:on**: There are 2 to 4 butterflies.
- **path:range:off**: 3 to 5
- **path:bound:on**: up to 4
- **path:bound:off**: up to 5
Results

Proportion 'True' judgments

Upper edge

- on (=#objects)
- off

bound: up to k (path) / at most k (sup)
range: m to k (path) / at least m and at most k (sup)
Proposal: Two strong pragmatic constraints

- Highlight all possibilities you believe.
- Do not highlight non-believed possibilities.
Discussion

• This proposal explains the amelioration of range edge effects by doubly-bounded range expressions.
• It also explains why they do not disappear entirely.
• Remaining mystery: Why disjunctions highlighting non-believed possibilities do not behave the same way.
Thank you!


Mayr, Clemens & Marie-Christine Meyer. 2014. More than at least. Slides presented at the *Two days at least* workshop, Utrecht.


