The inquisitive semantics and pragmatics of modified numerals[1]

Matthijs Westera

Santa Cruz, February 4th, 2013

- Example (1) seems to show that superlatively modified numerals implicate/entail ignorance, while comparatively modified numerals don't (Nouwen, 2007, 2010).

(1) a. # A hexagon has at least five sides.
b. A hexagon has more than four sides.
c. # A hexagon has at most seven sides.
d. A hexagon has fewer than eight sides.

- In the literature:
  - No explanation of (1) exists that does not stipulate a semantic difference between the two kinds of modifiers.
  - Actual patterns in natural language, to be discussed, are more subtle (Coppock and Brochhagen (ms.)).

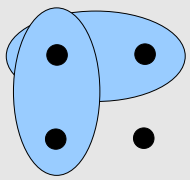
Claim of this talk:
The finer grain of unrestricted inquisitive semantics provides sufficient foothold for a Gricean pragmatics to derive the relevant patterns (and more).

- **Outline:** First the framework, then the data.

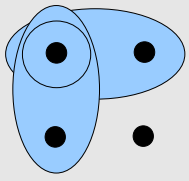
1. Unrestricted inquisitive semantics (Ciardelli, 2009; Westera, 2012)

- A *possibility* is a set of worlds. A *proposition* is a set of possibilities.
- I assume the following FO formulae and meanings for the expressions in (2) and (3):

(2)
a. John came or Bob came $Cj \vee Cb$
b. n people came $\exists x.|x|{=}n \wedge Cx$
(depicted for *n=1*)



(3)
a. John came or Bob came or both $Cj \vee Cb \vee (Cj \wedge Cb)$
b. at least *n* people came $\exists x.|x| \geq n \wedge Cx$
(depicted for *n=1*)
c. more than *n* people came $\exists x.|x| > n \wedge Cx$
(depicted for *n=0*)

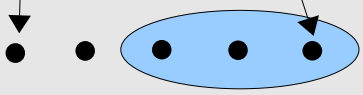


- We can easily distinguish "*n*" from "at least *n*" even on a one-sided account of numerals.

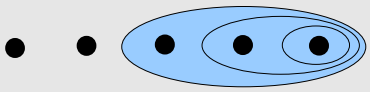
- **Indifference assumption:** (mainly for easier drawing; perhaps linguistically interesting) The individuals in the domain are not/cannot be distinguished.

1 Financial support from the Netherlands Organisation for Scientific Research is gratefully acknowledged. Many thanks to Elizabeth Coppock and Thomas Brochhagen for intense discussions on the topic.

(4)a 2 people came
(Here 0 people came)
(Here 4 people came)



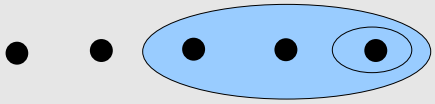
b. At least 2 people came
c. More than 1 person came



- On top of inquisitive semantics, I assume:

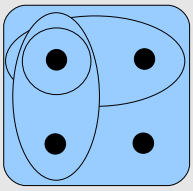
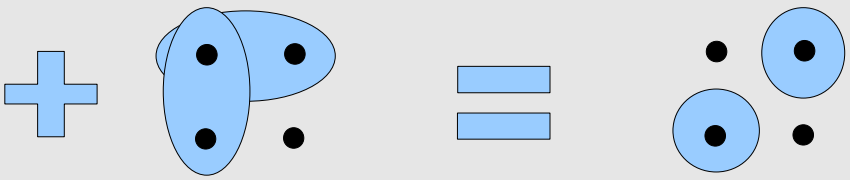
Semantic domain restriction
Natural language quantifiers are semantically incomplete without a domain restriction. One might add the restriction to the formulae in (2) and (3), but I will leave it implicit.

(5) At least 2 people came (with implicit domain restriction: it was an even number of people)



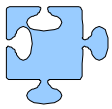
2. Inquisitive pragmatics (Westera, 2012+)

- A straightforward (…) application of Gricean pragmatics to inquisitive semantics.
- Most implicatures are computed only relative to an (explicit or implicit) QUD.

QUD	Response	Implicatures
(6) Who came? $\exists x.Cx$ 	a. John came or Bob came. 	Possibly John, poss. Bob (***possibility***) I'm not sure who (***ignorance***) Only one person came (***exhaustivity***)
	Response	**Implicatures**
	b. John came or Bob came or both 	Possibly John, poss. Bob, poss. both I'm not sure who ~~Only one person came~~

- The ignorance and exhaustivity implicatures, being quantity implicatures, occur only if a complete answer to the QUD is asked for (see *granularity*, below).

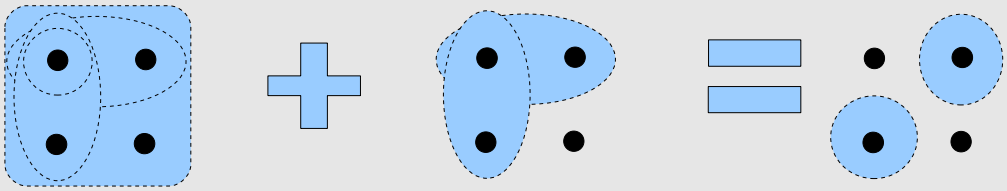
- On top of a Gricean backbone, I assume:



Privacy Principle (Schwarzschild, 2002)
The domain restriction of a quantifier may be known to only the speaker.

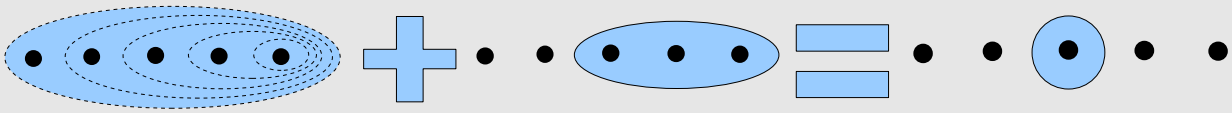
- As a consequence, the hearer may not be sure which possibilities are actually in the proposition conveyed. We can depict this as follows:
  - Solid ——— if the possibility is in the proposition for sure.
  - Dashed ------- if the possibility may not be in the proposition.
- Only the solid lines may yield possibility implicatures.

QUD	Response	Implicatures
(7) Who came?	1 person came	~~Possibly John, possibly Bob~~ Possibly (and certainly) one person ~~I'm not sure who~~ Only 1 person came



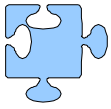
- The following question-answer pair is more natural, though with the same results, as the QUD in (8) is equivalent to the QUD in (7) with indifference assumption.

QUD	Response	Implicatures
(8) How many people came? $\exists n.!\exists x.\lvert x\rvert = n \wedge Cx$	*2* people came	~~Possibly John, possibly Bob~~ Possibly (and certainly) 2 people ~~I'm not sure who~~ Only 2 people came



Beware: Solid vs. dashed is not conceptually analogous to highlighted versus non-highlighted (Farkas and Roelofsen); though it may play the same role technically. Rather, the pictures give a hearer's perspective on what is communicated.

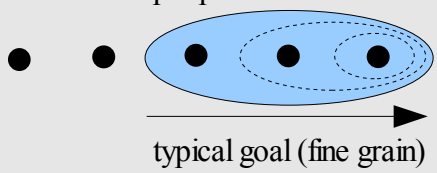
- I need one more assumption, that helps predict when quantity implicatures arise:



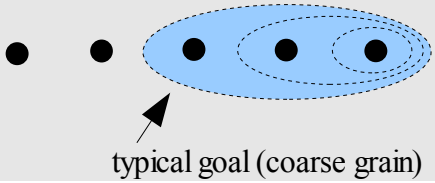
Granularity assumption
Mentioning a (witness for a) possibility (typically) commits one to a fine grain, and to seeking the *strongest answer* at that level of granularity.

- Superlative modifiers, but not comparatives, mention a possibility, and hence:
  - reveal part of their domain restriction; and
  - typically commit the speaker to a fine grain.

(9)a. At least *2* people came

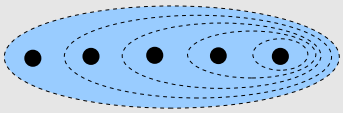
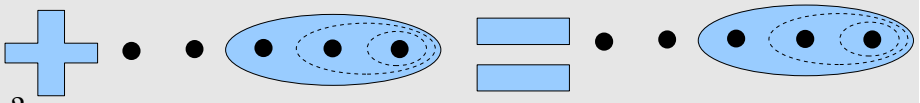
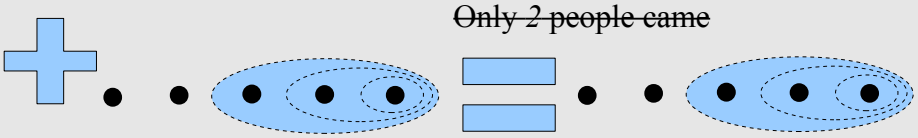


b. More than 1 person came



Prediction: Comparative modifiers are more typically used with round numbers, or with contextually already salient numbers.

- We can now compare the implicatures of superlative vs. comparative modifiers:

QUD	Response	Implicatures
(11) How many people came? 	a. At least 2 people came 	~~Possibly John, possibly Bob~~ Possibly 2 people I'm not sure how many ~~Only *2* people came~~
	b. More than 1 person came 	~~Possibly John, possibly Bob~~ ~~Possibly 2 people~~ ~~I'm not sure how many~~ ~~Only *2* people came~~

- This yields two predictions that would seem incompatible with a *semantic* approach.

Prediction: Although a comparative modifier does not *typically* commit one to a fine granularity, the context may do so, in which case an ignorance implicature arises.

Prediction: Although a comparative modifier does not reveal its domain restriction, the context may strongly suggest one, in which case a possibility implicature arises.

- These predictions seem borne out in (12).

(12) A: Did 11, 12 or 13 people come to the party?
B: More than 11 people came. → possibly 12, possibly 13, and I'm not sure how many.

3. Data

(1) a. # A hexagon has at least five sides.
b. A hexagon has more than four sides.
c. # A hexagon has at most seven sides.
d. A hexagon has fewer than eight sides.

- **Explanation**: a and c are bad for two reasons:
  - Superlative modifiers implicate ignorance, which is unjustified in all cases.
  - Superlative modifiers implicate possibility, which is unjustified in c.

Prediction: Because of the latter, c must be even worse than a.

- The same explanation works for Geurts et al.'s (2010) data on inference patterns (appendix).
- The prediction seems borne out in new data from Coppock and Brochhagen (submitted):

(13) a.	At least three apples are on the table.	(100%)
b.	More than two apples are on the table.	(100%)
c. #	At most five apples are on the table.	(76%)
d.	Fewer than six apples are on the table.	(100%)

- **Explanation:** Truth judgement enforces a coarse granularity, hence the ignorance implicatures occur nowhere. Nevertheless, possibility implicatures still arise for a and c. For c, the possibility implicature happens to be false.

Prediction: "at most four" should yield 100% acceptance in a truth-jugement task.

4. Conclusion

- Inquisitive semantics and pragmatics are a powerful tool (and there's more!).
- We don't need a *semantic* difference between superlative and comparative modifiers.
- We have a lot of interesting new predictions that seem intuitively right.

5. Bonus: QUD and negativity

- Brasoveanu, Farkas and Roelofsen's experiment 1 reveals that negated sentences:
  - with referential DPs elicit an agreeing response with "no".
  - with modified numerals elicit an agreeing response with "yes".
  - with "some" is in between.

Polar QUD origin of negativity: A sentence allows agreement with "no" iff it selects the negative possibility of a polar QUD.

- **Explanation:** the constructions differ regarding the QUDs they typically answer:
  - Modified numerals typically answer a "how many"-question.
  - Referential DPs typically answer a polar question.
  - "some" can answer either kind of question.
- In the absense of an explicit QUD, participants invent one according to these expectations.

Prediction: By making the QUD explicit in the experiment, we can force participants in the case of "some" to give either agreeing responses with "no", or agreeing responses with "yes".

Prediction: Like "some", unmodified numerals can answer both kinds of questions. We expect them to pattern alike (though, I expect, biased towards a "how many"-question).

- Answering a polar question rather than a "how many"-question may be easier for comparative modifiers, who enjoy coarse granularity.

Prediction: Comparative modifiers are more likely to elicit agreeing responses with "no" than superlative modifiers.

6. Other ideas

Discourse exhaustivity of modifiers:
Although upper-bound modifiers do not implicate truth-conditional exhaustivity, they do implicate *discourse exhaustivity*. E.g., in response to 'at least 5 people came', anaphor 'they' picks up the maximal set of people who came. This is so because all *continuations* of the dialogue in which the contents of the referent become known, exhaustivity will be implicated.

Exhaustivity of downward-entailing modifiers:
Downward-entailing modifiers have an upper bound because (i) like unmodified numerals, they implicate exhaustivity in response to a 'how many'-question, (ii) like all modifiers, they presuppose a 'how many'-question, (iii) without the upper bound, they are tautological. One might consider it a *lexicalized implicature*.

Narrower distribution of comparative modifiers: Superlative modifiers can modify *bigger* things, besides numbers and gradeable properties. Comparatives don't like that, because in their case processing the bigger thing, the bound, is a waste of effort – it is false, anyway. Is this also why superlative modifiers do not like being negated?

7. Appendix: Geurts et al.'s (2010) inference patterns

Premiss	Conclusion	Acceptability rate (%)
a. Berta had 3 beers	Berta had at least 3 beers	50
b. Berta had 3 beers	Berta had more than 2 beers	100
c. Berta had 3 beers	Berta had at most 3 beers	61
d. Berta had 3 beers	Berta had fewer than 4 beers	93
e. Berta had at most 2 beers	Berta had at most 3 beers	14
f. Berta had fewer than 3 beers	Berta had fewer than 4 beers	71