Antonymy in space and other strictly ordered domains*

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1 Overview

- natural language references different types of entities; some of these entities, in a given context, are strictly linearly ordered (e.g. degrees, locations, and times)

- the individuals in these domains relate to each other differently than those entities that are not strictly linearly ordered (e.g. individuals, possible worlds)

- my empirical goal: to show that some linguistically-encoded relations display a polar asymmetry, while others do not

- my theoretical goal: to argue that this asymmetry – and its restriction to only certain relations – is due to intrinsic properties of strictly ordered domains, coupled with a bias in how we perceive these domains

2 A puzzle in degree semantics

- in comparatives with possibility modals: a polar asymmetry (Seuren, 1979; Rullmann, 1995; Meier, 2002; Heim, 2007; Büring, 2009):

(1) a. Lucinda is driving faster than is allowed on this highway.
    b. Lucinda is driving slower than is allowed on this highway.

(2)   U.S. CONTEXT
       The highway's speed laws impose a maximum speed (100kph) and a minimum speed (65kph)

- the positive-polar comparative in (1a) is true if Lucinda is driving 120kph (i.e., above the maximum)
- the negative-polar comparative in (1b) is true if Lucinda is driving 50kph (i.e., under the minimum)

(3)   LATVIAN CONTEXT
       The maximum speed on the highway is 100kph (there is no minumum)

- again, positive-polar comparative in (1a) is true if Lucinda is driving 120kph (i.e., above the maximum)
- instead, the negative-polar comparative in (1b) is true if Lucinda is driving 80kph (i.e., under the <u>maximum</u>)

- another example:

(4) a. The helicopter was flying higher than a plane can fly.
    b. The helicopter was flying lower than a plane can fly.

- semantic generalizations:
  - positive comparatives relate a degree to a maximum;
  - negative comparatives relate a degree to a minimum, else a maximum

- Rullmann 1995; Heim 2007; Büring 2009 (roughly):
  - the negative examples (e.g. (1b)) are ambiguous;
  - negative antonyms are formed from positive antonyms plus a negation (cf. *Lucinda is driving less fast than is allowed*);
  - the negation can scope above or below the possibility modal

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3   A parallel puzzle for locations and times

3.1   A polar asymmetry for locatives

- in locative PPs (Zwarts, 1997), an asymmetry between antonyms

  (5)   a.   The mouse is above the hut.
         b.   The mouse is under the hut.

  COLD CONTEXT   WARM CONTEXT

- cold context:
  - the positive-polar locative sentence in (5a) is true if the mouse is on the roof (i.e., above the maximum)
  - the negative-polar locative sentence in (5b) is true if the mouse is below ground (i.e., under the minimum)

- warm context:
  - again, the positive-polar locative sentence in (5a) is true if the mouse is on the roof (i.e., above the maximum)
  - instead, the negative-polar locative sentence in (5b) is true if the mouse is under the roof (i.e., under the <u>maximum</u>)

- another example:

  (6)   The mouse is higher/lower than the hut.

- semantic generalizations:
  - positive locatives relate an individual to a maximum;
  - negative locatives relate an individual to a minimum, else a maximum

3.2   A polar asymmetry for times

- relies on the difference between telic and atelic events (Vendler, 1957), which map to runtimes via a homomorphism (Krifka, 1989)
- instead of two different contexts, two pairs of sentences

(7)   ATELIC EVENT
       a.   Mary met John after she was single.
       b.   Mary met John before she was single.

- the positive adverbial sentence in (7a) is true if the meeting happened after Mary was single (i.e., after the end of her being single)
- the negative adverbial sentence in (7b) is true if the meeting happened before Mary was single (i.e., before the beginning of being single)

(8)   TELIC EVENT
       a.   Mary met John after he climbed to the top of the mountain.
       b.   Mary met John before he climbed to the top of the mountain.

- again, the sentence with the positive temporal adverb in (8a) is true if the meeting happened after the summiting (i.e., after the end)
- instead, the sentence with the negative temporal adverb in (8b) is true if the meeting happened before the summiting (i.e., before the <u>end</u>)

- another pair of examples:

(9)   ATELIC/TELIC EVENT
       a.   Mary called an ambulance after John was sick/drowned.
       b.   Mary called an ambulance before John was sick/drowned.

- semantic generalizations:
  - *after* relates a punctual event to an endpoint
  - *before* relates a punctual event to an onset, else an endpoint

3.3   Interim summary

- cross-domain generalization:
  - positive relations use maxima as endpoints
  - negative relations use maxima or minima (in a predictable way)

- we can't extend the scoping analysis to the phenomenon generally:
  - the negative sentences don't seem to be ambiguous;
  - contrary to the scoping analysis, the asymmetry doesn't require modals or scoping elements in the embedded clause (Beck 2012; cf. (5)– (9)).

– also contrary to the scoping analysis, the asymmetry does not arise for all negative relations with modals in the embedded clause.

(10)   a.   John is the father of the kids who are allowed to eat nuts.
       b.   Mary met the guests who could speak Italian.

(11)   a.   John is not the father of the kids who are allowed to eat nuts.
       b.   Mary did not meet the guests who could speak Italian.

∗ while the object relatives denote pluralities, there is no noticable difference between (10) & (11) in how the relative clauses are interpreted

- new questions:
  - how do individual relations differ from degrees, locations, and times?
  - what's the relationship between the possibility modals in the standard comparative clauses in (1) and e.g. the cold and warm contexts in (5)?
  - what is it about the negative relations that causes this meaning flexibility: semantic complexity, markedness, or something else?

4   Ecnonomy of bounds

- this asymmetry is the result of two things:

  - the strict ordering of degrees, locations, and times (and their corresponding monotonicity); and
  - the way we most naturally perceive space, time, etc.

4.1   Some quick assumptions

- antonymic relations are duals...

(12)   a.   A is taller than B. ↔ B is shorter than A.
       b.   A is above B. ↔ B is under A.
       c.   A is after B. ↔ B is before A.

- ...and natural language is sensitive to the orderings they encode.

(13)   a.   John is very tall.   b. Bill is very short.

(14)   An order-sensitive maximality operator (Rullmann, 1995; Heim, 2000)
       Let X be a non-empty set of entities ordered by the relation $>_*$. Then
       $\mathrm{MAX}(X) = \iota x[x \in X \wedge \forall x' \in X[x' \neq x \rightarrow x' <_* x]]$

- while the domains of degrees, locations, and times are not necessarily strictly ordered, the degrees, locations and times relevant to any one sentence are.

  - irreflexive (for all a, it's not the case that $a > a$)
  - asymmetric (for all a and $b \neq a$, if $a < b$ then it's not the case that $b < a$)
  - transitive (for all a, $b \neq a$ and $c \neq b \neq a$, $a < b$ and $b < c$ entails $a < c$)
  - total (for all a and $b \neq a$, $a < b$ or $b < a$)

- so while degree properties are not necessarily monotonic (Beck and Rullmann, 1999), natural language predicates encode only monotonic properties.

(15)   A function f of type $\langle e, \langle d, t \rangle \rangle$ is **downward-monotonic** iff
       $\forall x, d, d'[f(x)(d) \wedge d' < d \rightarrow f(x)(d')]$ (Heim, 2000)

- consequently, plurals denote different things in different domains:

  - individual plurals denote join semi-lattices (Link, 1983), while

  - degree, location, and time plurals denote scales or intervals

(16)   a.   **open**: $(a, b) = \{x : a > x > b\}$
       b.   **partially closed**: $(a, b] = \{x : a > x \geqslant b\}$ or $[a, b)$
       c.   **closed**: $[a, b] = \{x : a \geqslant x \geqslant b\}$

4.2   The proposal

- cross-domain generalization, rephrased, for some relation R: 'aRb' is true iff some member of the a scale exceeds$_*$ the greatest closed bound of the b scale.

(17)   a. $\lambda X_* \lambda X'_* \exists x' \in X'_*[x' >_* \mathrm{MAX}(\lambda x.\mathsf{bound}(x, X_*) \wedge x \in X_*)]$, where
       b. $\mathsf{bound}(x, X_*) = \iota x \in X_*[\forall x'[X_*(x') \rightarrow x >_* x']]$
            $\vee \iota x \in X_*[\forall x'[X_*(x') \rightarrow x <_* x']]$

- x here is unrestricted across domains, but X_* is restricted to only those pluralities that are strictly ordered: degree intervals, vectors, temporal intervals

- the Lucinda cases in (1):

(18)   Lucinda is driving faster than is allowed on this highway.
       a.   U.S. CONTEXT: lucinda $>_+$ [65kph,100kph]
       b.   LATVIA CONTEXT: lucinda $>_+$ (0,100kph]

(19)   Lucinda is driving slower than is allowed on this highway.
   a.   U.S. CONTEXT: lucinda $>_-$ [100kph,$\underline{65\text{kph}}$]
   b.   LATVIA CONTEXT: lucinda $>_-$ [$\underline{100\text{kph}}$,0)

- the hut cases in (5):

(20)   The mouse is above the hut.
   a.   COLD CONTEXT: mouse $>_+$ [1cm,$\underline{5\text{m}}$]
   b.   WARM CONTEXT: mouse $>_+$ (0,$\underline{5\text{m}}$]

(21)   The mouse is under the hut.
   a.   COLD CONTEXT: mouse $>_-$ [5m,$\underline{1\text{cm}}$]
   b.   WARM CONTEXT: mouse $>_-$ [$\underline{5\text{m}}$,0)

- the temporal cases in (7) and (8):

(22)   Mary met John after...
   a.   ...she was single: meeting $>_+$ [2003,$\underline{2010}$]
   b.   ...he climbed to the top: meeting $>_+$ (4pm,$\underline{5\text{pm}}$]

(23)   Mary met John before...
   a.   ...she was single: meeting $>_-$ [2010,$\underline{2003}$]
   b.   ...he climbed to the top: meeting $>_-$ [$\underline{5\text{pm}}$,4pm)

4.3   A new prediction

- What is it about negative relations, then? *Nothing...* downward-monotonic relations are linguistically more common

- Beck (2012): The degree asymmetry isn't about negative comparatives, but negative comparatives with downward-monotonic properties.

- A better generalization, according to Beck (using the word "(un)ambiguous"):

(24)   a.   Positive-polar comparatives are unambiguous with downward-monotonic b arguments; ambiguous with upward-monotonic ones.
   b.   Negative-polar comparatives are ambiguous with downward-monotonic b arguments; unambiguous w/ upward-monotonic ones.

(25)   AUTOBAHN CONTEXT
       The minimum speed on the highway is 70kph (there is no maximum).

   – (1a) means 'above the minimum' (i.e., the closed lower bound); (1b) means 'below the minimum' (i.e., the closed upper bound)

- An anti-gravitational example: a bush grows from the ceiling of a cave

(26)   a.   The snake is above the bush.   *above the top (least)*
       b.   The snake is under the bush.   *under the top (greatest)*

   – (26a) true if snake is on cave ceiling ('above the minimum'); (26b) true if snake is on the ground, beneath the bush ('under the maximum')

5   Summary

- In strictly ordered domains, relations maximize informativity by relating to the highest endpoint on the relevant ordering.

- This explains the prima facie ambiguity of negative-polar relations in the degree, location, and temporal domains.

- What about cross-linguistic differences? Lexical differences (e.g. *below*)?

- How does this relate to accounts of telic events (Bach, 1986; Krifka, 1989)?

- What's the relationship to maximal/non-maximal interpretations of e.g. free relatives in the individual domain (Caponigro, 2004)?

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