Comparatives, Semantics of*

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Abstract: Comparative constructions are used to express explicit orderings between two objects with respect to the degree or amount to which they possess some gradable property. The semantic analysis of comparatives is built on top of a more general analysis of gradable predicates, which makes crucial uses of abstract representations of measurement (scales), formalized as sets of objects (degrees) ordered with respect to some dimension (size, speed, brightness, etc.). The interaction of the basic semantics of gradability with the combinatorics of clausal syntax permits the expression of an unlimited number of arbitrarily complex comparisons, and leads to interactions between comparatives and other logical expressions in a sentence.

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Crossreferences: Ambiguity, vagueness and partial information; Monotonicity and generalized quantifiers; Negation: semantic aspects; Quantifiers, the semantics of

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Introduction

The ability to establish orderings among objects and make comparisons between them according to the amount or degree to which they possess some property is a basic component of human cognition. Natural languages reflect this fact: all languages have syntactic categories that express gradable concepts, and all languages have designated comparative constructions, which are used to express explicit orderings between two objects with respect to the degree or amount to which they possess some property (Sapir 1944).

In many languages, comparatives are based on specialized morphology and syntax. English exemplifies this type of system: it uses the morphemes *more/-er, less* and *as* specifically for the purpose of establishing orderings of superiority, inferiority and equality, respectively, and the morphemes *than* and *as* to make the 'standard' against which an object is compared, as illustrated by the examples in (1).

(1) a. Mercury is closer to the sun than Venus.
b. The Mars Pathfinder mission was less expensive than previous missions to Mars.
c. Uranus doesn't have as many rings as Saturn.

In the case of properties for which specific measure units are defined, it is also possible to express differences between objects with respect to the degree to which they possess some property, even when the predicate out of which the comparative is formed does not permit explicit measurement:

(2) a. Mercury is .26 AUs closer to the sun than Venus.
b. ??Mercury is .46 AUs close to the sun.

Languages like English also allow for the possibility of expressing more complex comparisons by permitting a range of phrase types after *than/as*. For example, (3a) expresses a comparison between the degrees to which the same object possesses different properties; (3b) compares the degrees to which different objects possess different properties; and (3c) relates the actual degree that an object possesses a property to an expected degree.

(3) a. More meteorites vaporize in the atmosphere than fall to the ground.
b. The crater was deeper than a 50 story building is tall.
c. The flight to Jupiter did not take as long as we expected.

Finally, many languages also have related 'degree constructions' that do not directly compare two objects, but rather provide information about the degree

to which an object possesses a gradable property by relating this degree to a standard based on some other property or relation. The English examples in (4) using the morphemes *too, enough* and *so* exemplify this sort of construction.

(4) a. The equipment is too old to be of much use to us.
b. Current spacecraft are not fast enough to reach the speed of light.
c. The black hole at the center of the galaxy is so dense that nothing can escape the pull of its gravity, not even light.

(4b), for example, denies that the speed of current spacecraft is as great as the speed required to reach the speed of light.

Gradability

A discussion of the semantics of comparison must begin with the semantics of gradable predicates more generally. As shown by the contrast between the examples in (1) and those in (5), not all properties can be used in comparatives.

(5) a. ??Giordano Bruno is more dead than Galileo.
b. ??The new spacecraft is more octagonal than the old one.
c. ??Carter is as former a president as Ford.

The crucial difference between predicates like *expensive* and *close* on the one hand, and *dead, octagonal*, and *former* on the other is that the former but not the latter are gradable: they express properties that support (non-trivial) orderings. Comparatives thus provide a test for determining whether a predicate is inherently gradable or not.

The most common analysis of gradable predicates assigns them a unique semantic type that directly represents their order-inducing feature: they are analyzed as expressions that map their arguments onto abstract representations of measurement, or SCALES. Scales have three crucial parameters, the values of which must be specified in the lexical entry of particular gradable predicates: a set of DEGREES, which represent measurement values; a DIMENSION, which indicates the property being measured (*cost, temperature, speed, volume, height*, etc.); and an ORDERING RELATION on the set of degrees, which distinguishes between predicates that describe increasing properties (like *tall*) and those that describe decreasing properties (like *short*) (see Sapir 1944; Seuren 1978; Bartsch and Vennemann 1973; Cresswell 1977; von Stechow 1984a; Bierwisch 1989; Klein 1991; Kennedy 1999; Schwarzschild and Wilkinson 2002).

The standard implementation of this general view claims that gradable predicates have (at least) two arguments: an individual and a degree. Gradable predicates further contain as part of their meanings a measure function and a partial ordering relation such that the value of the measure function applied to the indvidual argument returns a degree on the relevant scale that is at least as great as the value of the degree argument. The adjective *expensive*, for example, expresses a relation between an object x and a degree of cost d such that the cost of x is at least as great as d.

In order to derive a property of individuals, it is necessary to first saturate the degree argument. In the case of the 'positive' (unmarked) form, the value of the degree argument is contextually fixed to an implicit 'norm' or 'standard of comparison', whose value may vary depending on a number of different contextual factors (such as properties of the subject, the type of predicate, and so forth; see the entry on VAGUENESS). For example, the truth conditions of a sentence like (6a) can be represented as in (6b), where *size* is a function from objects to degrees of size and d_s is the contextually determined standard — the cutoff point for what 'counts as' large in the context of utterance.

(6) a. Titan is large.
b. $\mathit{size}(t) \succeq d_s$

In a context in which we are talking the various objects in the solar system, the value of d_s would typically be such that (6a) is false. If we are talking about Saturn's moons, however, then d_s will be such that (6a) is true. This sort of variablity is a defining feature of gradable adjectives as members of the larger class of vague predicates.

Comparison

In contrast to the positive form, comparatives (and degree constructions in general) explicitly fix the value of the degree argument of the predicate. There are a number of implementations of this basic idea (see von Stechow 1984a for a comprehensive survey), but most share the core assumption that the comparative morphemes fix the value of the degree argument of the comparative-marked predicate by requiring it to stand in a particular relation — $\succ$ for *more*, $\prec$ for *less*, and $\succeq$ for *as* — to a second degree — the comparative standard — which is provided by the comparative clause (the complement of *than* or *as*).

One common strategy is to assign the comparative morpheme essen-

tially the same semantic type as a quantificational determiner: it denotes a relation between two sets of degrees. One of these sets is derived by abstracting over the degree argument of the comparative predicate; the second is derived by abstracting over the degree argument of a corresponding predicate in the comparative clause. This analysis presupposes that the comparative clause contains such a predicate. In some cases it is present in the surface form (see (3b) above), but typically — in particular, whenever it is identical to the comparative predicate — it is eliminated from the surface form by an obligatory deletion operation.

For example, in the analysis developed in Heim (2000), *more (than)* denotes a relation between two sets of degrees such that the maximal element of the first (provided by the main clause) is ordered above the maximal element of the second (provided by the comparative clause). At the relevant level of semantic representation, a sentence like (7) has the constituency indicated in (8a) (where material elided from the surface form is struck through), and the truth conditions in (8b).

(7) Titan is larger than Hyperion.

(8) a. [Titan is d large] more than [Hyperion ~~is d' large~~]
b. $max\{d \mid large(t) \succeq d\} \succ max\{d' \mid large(h) \succeq d'\}$

Note that since the truth conditions of the comparative form do not involve reference to a contextual norm, the comparative does not entail the corresponding positive. Thus (8a), for example, can be true even in a context in which (6a) is false.

Differential comparatives like (2a) can be accounted for by modifying the basic semantics to include a measure of the difference between the respective (maximal) degrees contributed by the two arguments of the comparative morpheme (von Stechow 1984a; Schwarzschild and Wilkinson 2002). Such differences always correspond to closed intervals on a scale, and so are measurable even if the degrees introduced by the base gradable predicate themselves are not (Seuren 1978; von Stechow 1984b; Kennedy 2001).

Because the standard of comparison is derived by abstracting over a degree variable in the comparative clause, this approach allows for the expression of arbitrarily complex comparisons such as those in (3). There are some limits, however. First, the comparative clause is a *wh*-construction, so the syntactic operation that builds the abstraction structure is constrained by the principles governing long-distance dependencies (see Kennedy 2002 for an overview). Second, it is also constrained by its semantics: since the comparative clause is the argument of a maximalization operator, it must introduce a

set of degrees that has a maximal element. Among other things, this correctly predicts that negation (and other decreasing operators) are excluded from the comparative clause (von Stechow 1984a; Rullmann 1995):

(9) a. ??Venus is brighter than Mars isn't.
b. $max\{d \mid bright(v) \succeq d\} \succ max\{d' \mid \neg bright(m) \succeq d'\}$

The set of degrees d' such that Mars isn't as bright as d' includes all the degrees of brightness greater than the one that represents Mars' brightness. Since this set has no maximal element, the maximality operator in (9b) fails to return a value.

The hypothesis that the comparative clause is subject to a maximalization operation has an additional logical consequence (von Stechow 1984a; Klein 1991; Rullmann 1995): for any (ordered) set of degrees D and D', if $D \subseteq D'$, then $max(D') \succeq max(D)$. The comparative clause is thus a downward entailing context, and so is correctly predicted to license negative polarity items and 'conjunctive' interpretations of negation (Seuren 1973; Hoeksema 1984; but cf. Schwarzschild and Wilkinson 2002):

(10) a. The ozone layer is thinner today than it has ever been before.
b. We observed more sunspot activity in the last 10 days than anyone has observed in years.

(11) a. Jupiter is larger than Saturn or Uranus. ⇒
b. Jupiter is larger than Saturn and Jupiter is larger than Uranus.

Finally, the assumption that the comparative is a type of quantificational expression leads to the expectation that it should participate in scopal interactions with other logical operators. The ambiguity of (12), which has the (sensible) *de re* interpretation in (13a) and an (unlikely) *de dicto* interpretation in (13b), shows that this prediction is borne out.

(12) Kim thinks the earth is larger than it is.

(13) a. $max\{d \mid think(large(e) \succeq d)(k)\} \succ max\{d' \mid large(e) \succ d'\}$
b. $think(max\{d \mid large(e) \succeq d\} \succ max\{d' \mid large(e) \succ d'\})(k)$

The extent to which comparatives interact with other operators and the implications of such interactions for the compositional semantics of comparatives and gradable predicates is a focus of current investigation (see Larson 1988; Kennedy 1999; Heim 2000; Bhatt and Pancheva 2004).

Comparison cross-linguistically

As noted above, there are in fact several distinct semantic analyses of comparatives, which differ in their details but share the core assumption that gradable adjectives map objects to ordered sets of degrees. For example, one alternative analyzes the truth conditions of a sentence like (7) as in (14): roughly, there is a degree d such that Titan is at least as large as d, but Hyperion is not as large as d (Seuren 1973; Klein 1980; Larson 1988).

(14) $\exists d[[large(t) \succeq d] \wedge \neg[large(h) \succeq d]]$

(14) does not express an explicit ordering between two degrees, but instead takes advantage of the implicit ordering on the scale of the predicate to derive truth conditions equivalent to (8b) above: given the inherent ordering, (14) holds whenever the maximal degree of Titan's largeness exceeds that of Hyperion (and vice versa).

The fact that the underlying semantics of gradable predicates supports multiple equivalent logical analyses of comparatives appears at first to be a frustrating obstacle to the discovery of the 'right' semantics of the comparative. In fact, however, this may be a positive result when we take into account the extremely varied syntactic modes of expressing comparison in the world's languages (see Stassen 1985), which include forms that superficially resemble the logical representation in (14), such as the example from Hixkaryana in (15).

(15) Kaw-ohra naha Waraka, kaw naha Kaywerye
tall-NOT he-is Waraka, tall he-is Kaywerye
'Kaywerye is taller than Waraka.'

While it may turn out to be difficult to find clear empirical evidence to choose between competing, equivalent logical representations of comparatives within a particular language like English, it may also turn out that a study of the various expressions of comparison in different languages will show that all of the possible options provided by the underlying semantics of gradability are in fact attested. Comparatives therefore provide a potentially fruitful and important empirical domain for investigating broader typological questions about the mapping between (universal) semantic categories and (language specific) syntactic ones.

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