Continuations for Comparatives

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Synopsis. For decades, linguists have been uneasy about positing post-surface syntactic movement (in particular, quantifier raising), as it has been considered both theoretically undesirable and empirically unsatisfactory (Williams 1986; Reinhart 1997; Chung 1998; Verkuyl 1999). In Shan and Barker 2006; Barker and Shan 2014, the authors explain the scoping and crossover effects of quantifiers without the need for such post-surface movement. They do so by importing a tool from computer science, namely continuations—a kind of type-lifting. In this work, I extend their project and apply continuations to eliminate the need for post-surface syntactic movement in another domain in which standard accounts claim that it is needed, namely comparatives.

The standard account. I follow standard accounts like Heim 2000 in presuming a theory of ellipsis wherein sentences like (1–3) are interpreted as having a structure like that of (4).

(1) John is taller than Mary.

(2) John is six inches taller than Mary.

(3) John is six inches taller than Mary is.

(4) John is six inches taller than Mary is tall.

The standard account requires two post-surface movements before interpretation. The first raises the degree-denoting comparative standard above the adjective, to parallel simple sentences like *John is six feet tall*. The second uses "*wh*-movement of a covert operator from the degree-argument position of an adjective" to allow the comparative standard *Mary is tall* to be understood as the maximum degree such that Mary is tall, with "the trace [being] interpreted as a variable over degrees" (Heim 2000: 51). The standard account, then, gives a sentence like (4) the logical form and denotation in (5), suppressing variables over worlds.

(5) $[\![\text{John is } 6'' \text{ [-er than [} wh_1 \text{ Mary is } t_1 \text{ tall]] tall}]\!] = \textsc{max}(\text{tall}, j) \geq \textsc{max}(\text{tall}, m) + 6''$

Using continuations. Using continuations, I derive the same truth conditions without either type of movement, reducing the theoretical footprint of the analysis. First, I introduce two covert degree-type operators—one scoping and one non-scoping—to produce the right semantics for these sentences. The non-scoping operator `d`, of type d, stands in for the differential (e.g., $6''$ in (2)) in sentences like (1) where that argument place is not overtly filled; it serves as a placeholder for some contextually-appropriate threshold. The scoping operator `?d` does all of the work of the post-syntactic *wh* movement in the standard account, serving as a variable over degrees (e.g., the degree to which Mary is tall in (1)). As it needs to scope, it's this operator which takes advantage of continuation types, being type $(d \,/\!\!/ (d \,\backslash\!\!\backslash\, t))$: (read from inside out:) its local type is d, it takes scope at (the embedded) t, and its output is type d. Like Heim's trace, it also explains the ungrammaticality of sentences like (6).

(6) * John is six inches taller than Mary is five feet tall.

The other puzzle piece is the comparative operator denoted by *-er than*, defined in (7).

(7) $[\![\text{-er than}]\!] = \lambda d \lambda A \lambda d' \lambda x . \textsc{max}(A, x) \geq d + d'$ type (((d\(e\t)) \(d\(e\t))) / d)

The comparative operator takes in (in order) the differential (d), an adjective (A), the comparative standard (d'), and an individual (x), and returns true if the maximum degree to which x is A is greater than or equal to the sum of the standard and the differential. For a sentence like (1), then, I argue for the much simpler logical form as in (8).

(8) John is `d` taller than Mary is `?d` tall.

With `d`, `?d`, and the comparative operator, I derive exactly the right truth conditions for sentences like (1–4) without relying on any movement.

Extension # 1: Scoping over quantifiers. This approach also neatly handles cases in which the comparative standard includes a quantifier, as in (9).

(9) John is (six inches) taller than every girl in the class.

The standard analysis (as in Heim 2006) involves the invocation of two "point to interval" operators (Π), one in the matrix clause and one in the *than* clause, which map degree predicates to generalized quantifiers over degrees. By using continuations, we can allow for the right sort of scope without any further mechanisms and without modifying the denotations of the operators already defined; continuations can scope over continuations without additional support.

Extension # 2: Non-upward entailing differentials. I also address the complications raised by Fleisher (2014), who notes that differentials which are non-monotonic or downward-entailing (as in (11) and (12), respectively) result in different interpretations of the comparative operator. (Examples and labels from Fleisher 2014.)

(10)	a.	John is (more than six inches) taller than every girl is.	MAX reading
	b.	John is (more than six inches) taller than at least four girls are.	MIN reading
(11)	a.	John is exactly six inches taller than every girl is.	MAX=MIN reading
	b.	John is exactly six inches taller than at least four girls are.	neither
(12)	a.	John is less than six inches taller than every girl is.	MIN+MAX reading
	b.	John is less than six inches taller than at least four girls are.	neither

Fleisher extends Heim's (2006) account, treating differential phrases like *less than six inches* as generalized quantifiers over degrees, taking cues from Schwarzschild (2005). And as this project began with Shan and Barker applying continuations to (type e) quantifiers, it should be no surprise that continuations can neatly handle these type d quantifiers, as I demonstrate. Following Fleisher's strategy, I define continuation-scoping denotations for *exactly*, *less than*, and *more than*, which combine in a compositional way to produce the right truth conditions for unmarked, upward entailing, downward entailing, and non-monotonic differentials.

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