Processing Degree Operator Movement: Implications for the Analysis of Differentials

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1. Introduction: [1] identifies an ambiguity arising with *exactly* differentials, (1a), but not *at least* differentials, (1b). Under the "exactly" reading, there is exactly one height that allows John to meet the requirements; under the "at least" reading, there is a range of acceptable heights.

(1) a. John is required to be exactly 2" taller than Mary is.
b. John is required to be at least 2" taller than Mary is.

[1] gives the syncategorematic semantics for comparatives with differentials in (2) and shows that moving the comparative phrase [*exactly 2" –er than Mary is*] to a position below *required* produces the "exactly" reading, (3a), while moving it above *required* produces the "at least" reading, (3b). With *at least*, in contrast, both scope positions result in the same "at least" reading.

(2) a. ⟦exactly 2"–er⟧(P)(Q) = 1 iff max(P)+2" = max(Q)
b. ⟦at least 2" –er⟧(P)(Q) = 1 iff max(Q) ≥ max(P)+2"

(3) a. John is required [[exactly 2" -er than Mary is <d-tall>]$_i$ [$_{VP}$ to be t$_i$ tall]].
∀w[w ∈ Acc$_{w0}$ → max(λd. M. is d-tall)+ 2" = max(λd. J. d-tall in w)]
b. [[exactly 2" -er than Mary is <(required to be) d-tall>]$_i$ [$_{VP}$ John is required to be t$_i$ tall]].
max(λd. M is (required to be) d-tall)+2" = max(λd.∀w[w ∈ Acc$_{w0}$ → J. is d-tall in w])

We provide support for this account from real time sentence processing and discuss implications for the analysis of differentials.

2. Real time processing of Antecedent Contained Ellipsis in *than*-Clauses (ACE): Our study exploits the fact that the *than*-clause in (1) involves ACE of a constituent (AP or VP) whose size correlates with the two readings: Under the "exactly" reading the elided constituent is the AP <$_{AP}$d-tall>; under the "at least" reading it can be <$_{AP}$d-tall> or the larger VP <$_{VP}$BE required to be d-tall>. In both cases, the comparative phrase containing the elided constituent has to move above the antecedent (AP or matrix VP) to resolve antecedent containment. [2] shows that resolving an ACE site during real time sentence processing incurs costs, which are, importantly, ameliorated if the parser has encountered a previous trigger for the movement required for the resolution of the ACE site at hand. Following this logic, we use contexts in which the "at least" reading is the only plausible interpretation to test whether *exactly* differentials are up-stream triggers for non-local movement of the degree operator and thus ameliorate processing costs for non-local ACE, (4b), in comparison to *a few*, which can give rise to the desired interpretation in local scope position.

(4) In order to become the all-time champion, the American athlete was required to win…
a. **a few/exactly 3** more matches than the British athlete **did** (local ACE)
b. **a few/exactly 3** more matches than the British athlete **was** (non-local ACE)
… and so practiced arduously for several months.

3. Results: Data from 36 subjects show a significant interaction in the region following the ellipsis marker, supporting the predictions of [1] (Diff.×ACE-Size: $F(1,35) = 7.9138$; $p < 0.01$). Specifically, rRTs for [exactly/local-ACD] are higher than [a_few/local-ACD] while rRTs for [exactly/non-local-ACD] are lower than [a_few/non-local-ACD] (Figure 1).

4. Implications for the Analysis of Differentials: Note that our results are expected only if *exactly* differentials cannot scope above *require* independently of the comparative operator. [1] ensures this via non-compositional stipulation. A fully compositional analysis of comparatives with differentials will have to derive the effect differently. We suggest that *exactly* 2" denotes a degree (rather than a quantifier over degrees) and that the absence of *exactly* is associated with existential quantification over degrees greater-or-equal to 2".

(5) a. ⟦exactly 2"⟧ = 2" b. ⟦exactly⟧ = $\lambda P.\ \iota d\,[\forall d'[P(d') \rightarrow d' \leq d]]$
c. ⟦2"⟧ = $\lambda d.\ d \geq 2''$ d. ⟦tall⟧ = $\lambda d.\ \lambda x.$ x's height = d

(6) a. John is 6 feet tall.
⟦[∃ 6 feet]$_i$[John is d_i tall]⟧ = 1 iff there is a $d \in \{d{:}d \geq 6\text{ ft}\} \cap \{d{:}d = \text{John's height}\}$
iff John's height ≥ 6 ft

b. John is exactly 6 feet tall.
⟦John is exactly 6 ft tall⟧ = 1 iff John's height = 6 feet

This predicts that *exactly* phrases by themselves are scopally inert. If there is a scope ambiguity it must be attributed to a distinct scope-bearing element. To support this prediction we point out that the "at least" reading seems unavailable in parallel sentences to (1) which do not contain a comparative.

(7) In order to join the NBA, John is required to be exactly 6 feet tall.

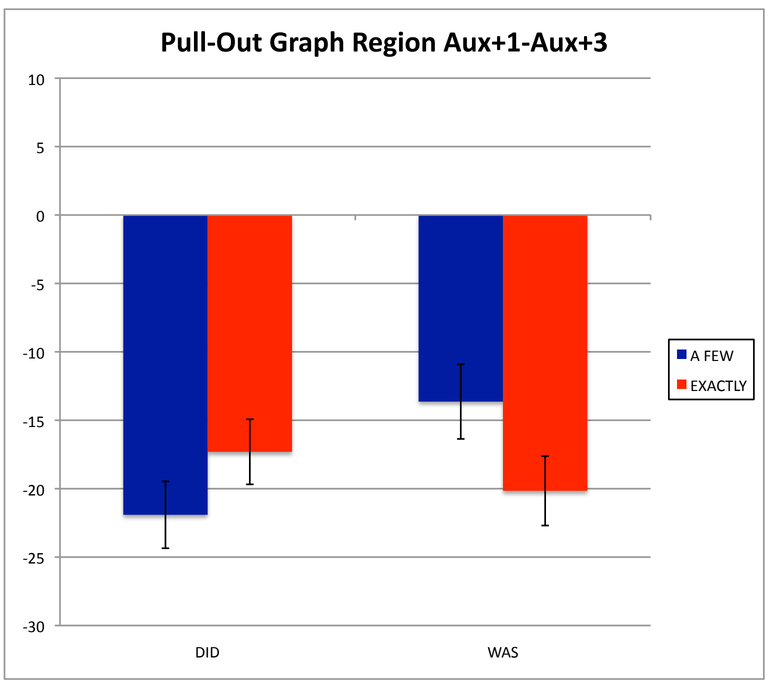

Figure 1

Word count: 749

[1] Heim, Irene (2000): 'Degree Operators and Scope', Proceedings of SALT X, 40–64.
[2] Hackl M., Koster-Moeller, J. & Varvoutis, J. (submitted): 'Quantification and ACD: Evidence from Real Time Sentence Processing'.