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The Scope of the Degree Operator

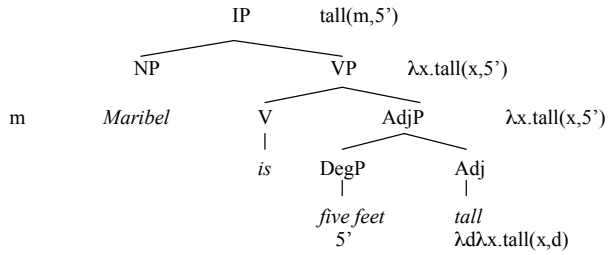
(Heim 2001)

1. Introduction: Degree Phrases.

- We saw that gradable adjectives denote relations between individuals and degrees. E.g., in (1), *five feet* is a **referential degree argument** that refers to the particular measure 5'. Furthermore, Heim assumes phrases like *five feet tall* means "at least five feet tall".

(1) Maribel is five feet tall.

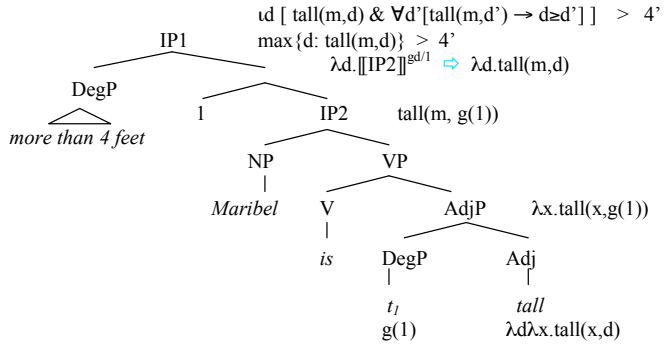
(2)



- But what happens if we have **quantificational degree arguments**, as in (3)? We will assume that the same procedure that resolves Quantificational NP interpretation will resolve the interpretation of these arguments: QR, in the present Heim-Kratzer framework. We will label (referential or quantificational) degree arguments as DegreeP (DegP).

(3) a. Maribel is more than 4 feet tall.
b. Maribel is exactly one foot taller than 4 feet.

(4)



(5) a. [[*more than 4 feet*]] = $\lambda P_{<d,t>}$. max(P) > 4'
b. [[*exactly one foot –er than 4 feet*]] = $\lambda P_{<d,t>}$. max(P) = 4'+1'

(6) For any $P \in D_{<d,t>}$:
max (P) = ιd [P(d) & ∀d'[P(d') → d≥d']]

- It is assumed that QR allows us to explain / predict certain properties of QuNPs, namely:
  A. Ability to scope over other operators (in the same clause).
  B. Resolution of the "infinite regress problem" in Antecedent Contained Deletion constructions.
  C. Crossover.

  The question arises whether DegPs exhibit some version of properties A-C. Heim (2001) looks at A and B, which we will discuss in the next sections. It is not clear how to construct an example to test C, but see section 4.

- More on compositionality: complex *than*-clauses.
  Heim (p.227) proposes "(the LF of) *than*-clauses to be derived by wh-movement of a covert operator from the degree-argument position of an adjective". The denotation of such structure is comparable to that of a free relative.

(7) a. more than <u>five feet</u>.
b. more than <u>Mary (is tall)</u>
c. more than <u>the bed is long</u>

(8) a. Free Relative: [[*What$_1$ Mark brought t_1*]] = max {x: bring(m,x) }
b. *Than*-clause: [[*(than) wh$_1$ the bed is t_1-long*]] = max {d: long(the bed,d) }

(9) a. [[*more / -er*]] = $\lambda d_d \lambda P_{<d,t>}$. max(P) > d
b. [[*exactly one foot –er*]] = $\lambda d_d \lambda P_{<d,t>}$. max(P) = d+1'

QUESTION 1. The denotations in (8b) and (9) allow us to handle all the cases in (7). However, they break the parallelism between QuNPs and DegPs in that Det^0 and Deg^0 will not have parallel semantic types: <<et>,<et,t>> versus <d, <dt,t>>. Leaving expressions like (7a) aside for the sake of the exercise, let us consider the alternative denotation (10) (cf. regular Relative Clauses). Construct <<dt>, <dt,t>> denotations for *more/-er*, *as* and *less*. Once you have those, recall that all (simple) Determiners of NatLg have been claimed to be conservative, as defined in (12). Are the three new denotations in (11) conservative functions?

(10) [[*(than) wh$_1$ the bed is t_1-long*]] = λd. long(the bed,d)

(11) a. [[*more / -er*]] =
b. [[*as*]] =
c. [[*less*]] =

(12) A function f of type <σt,<σt,t>> is convervative iff, for any P, Q ∈ $D_{<\sigma t>}$:
f(P)(Q)=1 iff f(P)(P∩Q)=1

2. Can DegP QR over other operators?

2.1. Case 1: The scope of *(at least n) –er* with respect to QuNPs.

- Background: upward-monotonicy, downward-monotonicity and non-monotocicity for QuNPs.

(13) The function $f_{<et,t>}$ denoted by a QuNP is **↑-monotone** iff
for any $S,T \in D_{<e,t>}$ such that $S \subseteq T$: if $f(S)=1$, then $F(T)=1$

(14) The function $f_{<et,t>}$ denoted by a QuNP is **↓-monotone** iff
for any $S,T \in D_{<e,t>}$ such that $S \subseteq T$: if $f(T)=1$, then $F(S)=1$

(15) The function $f_{<et,t>}$ denoted by a QuNP is **non-monotone** iff it is not ↑-monotone and not ↓-monotone.

- In some cases, the surface scope and the inverse scope are indistinguishable**:** when **QuNP is ↑-monotone**.

(16) Every girl is taller than 4 feet.

(17) a. LF1: [every girl]$_1$ [-er than 4 feet]$_2$ [$_{IP}$ t_1 is t_2-tall]
b. $\forall x$ [girl(x) → max{d: tall(x,d)} > 4']
c. "For each girl x: x is taller than 4'."

(18) a. LF2: [-er than 4 feet]$_2$ [every girl]$_1$ [$_{IP}$ t_1 is t_2-tall]
b. max{d: $\forall x$ [girl(x) → tall(x,d)]} > 4'
c. "The shortest girl is taller than 4'."

- In some other cases, the missing inverse scope is ruled out independently due to semantic ill-formedness: when **QuNP is ↓-monotone**.

(19) At most two girls are taller than 5 feet.
a. Surface scope: |{x: girl(x) & max{d:tall(x,d)} > 5'}| ≤ 2
b. * Inverse scope: max {d: |{x: girl(x) & tall(x,d)}| ≤ 2 } > 5'
⇒ The set of degrees to which at most two girls are tall has no maximum!!!

- Yet, some missing inverse scope readings may be due to a ban against sets of degrees that fail to be initial or final segments of a scale: when **QuNP is non-monotone**.

(20) Exactly two girls are taller than five feet.
a. Surface scope: |{x: girl(x) & max{d:tall(x,d)} > 5'}| = 2
b. * Inverse scope: max {d: |{x: girl(x) & tall(x,d)}| = 2 } > 5'
⇒ The set of degrees to which exactly two girls are tall is not at an edge of the scale.

- Conclusion from section 2.1: So far, we cannot tell whether *(at least n) –er* can QR over other QuNPs or not.

2.2. Case 2: The scope of *less* and *exactly n –er* with respect to QuNPs. Kennedy's generalization.

- Instead of trying different QuNPs, let us try different DegPs. In (21)-(22), the inverse scope reading is semantically well-formed and distinct from the surface reading (and not a subcase of it). So finally we can ask our question. We see that the DegP cannot QR over the QuNP in these examples.

(21) (John is 4' tall.) Every girl is exactly 1" taller than that.
a. Surface scope: $\forall x$ [girl(x) → max{d: tall(x,d)} = 4'+1"]
b. * Inverse scope: max{d: $\forall x$ [girl(x) → tall(x,d)]} = 4'+1"
"The shortest girl is exactly 4'+1" tall."

(22) (John is 4' tall.) Every girl is less tall than that.
a. Surface scope: $\forall x$ [girl(x) → max{d: tall(x,d)} < 4']
b. * Inverse scope: max{d: $\forall x$ [girl(x) → tall(x,d)]} < 4'
"The shortest girl is less than 4' tall."

- Note, though, that DegP can certainly take scope over a QuNP if it was generated over it to begin with (Heim's reference to Kennedy 1997 in p. 223 fn. 11):

(23) Every student showed up less often than that. (Heim)
✓ less often >> every

- Conclusion:

(24) Kennedy's generalization:
If the scope of a QuNP contains the trace of a DegP, it also contains the DegP itself.

2.3. Case 3: Intensional verbs.

■ When we move onto intensional verbs, inverse scope readings become available.[1] (See Rullmann 1995 for examples with comparatives and Stateva 2000 for examples with superlatives).

(25) (This draft is 10pp.) The paper is required to be exactly 5 pp. longer than that.

(26) a. LF1: required [[exactly 5pp –er than that]$_1$ the paper be t_1-long]
b. $\forall$w Acc w_0 [max{d: long(p,d,w)} = 15pp]

(27) a. LF2: [exactly 5pp –er than that]$_1$ [required [the paper be t_1 long]]
b. ✓ max {d: $\forall$w Acc w_0 [long(p,d,w)]} = 15pp
= "The shortest acceptable paper is exactly 15pp long."

(28) The paper is required to be less long than that.
a. Surface: $\forall$w Acc w_0 [max{d: long(p,d,w)} < 10pp]
b. ✓ Inverse: max {d: $\forall$w Acc w_0 [long(p,d,w)]} < 10pp
= "The shortest acceptable paper is less than 10 pp."
= "The paper is not required to be as long as 10pp."

QUESTION 2. Do these two readings occur independently of whether or not we have the Degree operator *–er* in DegP? Spell out the reading for (29) and check the intuitions:

(29) The paper is required to be at most 15 pp. long.
a. Surface:
b. Inverse:

■ The Neg Split Hypothesis: No QR for DegP; we have NEG splitting and raising of NEG.

(30) No deposit is required.
a. *No* = *NEG + a*
b. ¬ $\forall$w Acc w_0 [$\exists$x (deposit(x,w))]

(31) At most three attempts are allowed.
a. *At most three* = *NEG + more than three*
b. ¬ $\exists$w Acc w_0 [|{x: attempt(x,w)}| > **3**]

(32) *less than that* = *NEG + as…as that*

(33) The paper is required to be less long than that.
a. Split NEG reading:
i. ¬ $\forall$w Acc w_0 [max{d: long(p,d,w)} ≥ 15pp] =
ii. $\exists$ w Acc w_0 [max{d: long(p,d,w)} < 15pp] =
iii. max {d: $\forall$w Acc w_0 [long(p,d,w)]} < 15pp

[1] Caveat: the inverse reading does not seem available with some intensional verbs like *might*, *want, to be supposed to* and *should*, which are either epistemic verbs or Neg raising verbs. Heim p. 226 leaves the question open, why these verbs behave differently.

■ Problem 1 for NEG Split Hypothesis : Split for *exactly 5pp. –er than that.*

QUESTION 3. Would the proposed decompositions in (34) and (35) work for sentence (36) and for the inverse / split reading of (37) (=(25)?

(34) *exactly 5pp –er than that* = *NEG + more than 5pp –er than that*
(35) *exactly 5pp –er than that* = *NEG + (more than 5pp –er than that or less than 5pp –er than that)*

(36) The paper is exactly 5pp longer than that.

(37) The paper is required to be exactly 5pp longer than that.
Inverse reading: "The shortest acceptable paper is exactly 15pp long."

■ Problem 2 for the NEG Split Hypothesis: combining scopal and Russell's ambiguity.

(38) The box is required to be less wide than it is tall.

(39) Possible LFs predicted by QR approach:
a. Narrow, opaque: required$_{w'}$ [[less than it is tall$_{w'}$]$_1$ the box to be t_1-wide]
b. Narrow, transparent: required$_{w'}$ [[less than it is tall$_{w0}$]$_1$ the box to be t_1-wide]
c. * Wide, opaque: * [less than it is tall$_{w'}$]$_1$ [required$_{w'}$ [the box to be t_1-wide]]
d. Wide, transparent: [less than it is tall$_{w0}$]$_1$ [required$_{w'}$ [the box to be t_1-wide]]

(40) Possible LFs predicted by the NEG Split approach:
a. Narrow, opaque: required$_{w'}$ [NEG [as as it is tall$_{w'}$]$_1$ the box to be t_1-wide]
b. Narrow, transparent: required$_{w'}$ [NEG [as as it is tall$_{w0}$]$_1$ the box to be t_1-wide]
c. Wide, opaque: NEG required$_{w'}$ [[as as it is tall$_{w'}$]$_1$ the box to be t_1-wide]
d. Wide, transparent: NEG required$_{w'}$ [[as as it is tall$_{w0}$]$_1$ the box to be t_1-wide]

(41) Intuitive paraphrases:
a. "This is required: that the box be less wide than tall."
b. "This is required: that the box be less wide than n", where n would its actual tallness.
c. __ "This is allowed: that the box be less wide than tall."
d. "The minimal width required for the box is less than n", where n is its actual tallness.

■ Conclusion of section 2: DegP is able to QR, though not freely: it can QR over intensional operators, but not over QuNPs. The reason for such discrimination is still an open issue.

3. DegP QR and Ellipsis.

■ Some background on Antecedent Contained Deletion (ACD) within a QuNP:
An extense body of current linguistic research assumes that QuNPs with an ACD gap QR outside VP in order to avoid the infinite regress problem, as in (42).
Also, that explains Sag's observation that the scope of the QuNP containing the gap delimits the size of the ellipsis (Sag 1976): (43).

(42) I sent a present to everybody you did ▲$_{VP}$.
a. LF: [everybody you did ▲]$_1$ I PAST send a present to t_1
b. LF: [everybody (that$_1$) you did <u>send a present to t_1</u>]$_1$ I PAST <u>send a present to t_1</u>

(43) Betsy's father wants her to read everything her boss does. (Sag 1976)
a. Wide scope *everything>>want* and large VP-ellipsis:
"For all the particular things that Betsy's boss **wants her to read**, Betsy's father wants her to read them too."
b. Wide scope *everything>>want* and small VP-ellipsis:
"For all the particular things that Betsy's boss **reads**, Betsy's father wants her to read them too"
c. * Narrow scope *want>>everything* and large VP-ellipsis:
"Betsy's father wants that, for every thing that Betsy's boss **wants her to read**, she reads it"
d. Narrow scope *want>>everything* and small VP-ellipsis:
"Betsy's father wants that, for every thing that Betsy's boss **reads**, she reads it"

■ *Than*-clauses can have ACD-like gaps, too, and these are resolved sometimes by DegP movement. To see this, compare (44) and (45) (noticed by Carlson 1975): the bare plural in (44) cannot QR outside VP and, hence, cannot resolve the ACD gap; but the ACD-like gap in (45) is licensed; something else –namely, the DegP *–er than Bill was*— must QR to resolve the ellipsis.

(44) * John was climbing trees that Bill was ▲.

(45) John was climbing higher trees than Bill was ▲.
a. LF: [-er than Bill was ▲]$_1$ John was climbing t_1-high trees
b. LF: [-er than wh$_1$ Bill was <u>climbing t_1-high trees</u>]$_1$ John was <u>climbing t_1-high trees</u>

■ The relation between ellipsis-size and scope of DegP obtains:

(46) Mary needs to drive less fast than John does ▲
c. * ▲ = *need to drive*, *need >> less*.

■ ACD and intervening QuNP:

QUESTION 4. Recall that we saw that DegP cannot QR over a QuNP. What happens if we need to QR for ACD resolution but there is a QuNP inside the VP, as in (47)? Consider an LF1 where the DegP is –for once– allowed to QR over the QuNP, and an LF2 where the QuNP is forced to QR further than the DegP. Compute the corresponding semantic interpretations.

(47) John pushed every weight higher than Mary did ▲.

4. On Binding and Crossover. (Not from Heim)

■ Background on crossover:

(48) Strong Crossover:
a. * Who$_1$ does he$_1$ like t_1?
b. * He$_1$ likes every boy$_1$.

(49) Weak Crossover:
a. *?? Who$_1$ does his$_1$ mother like t_1?
b. *?? His$_1$ mother likes every boy$_1$.

■ First, we need to know whether a quantificational DegP can bind a coindexed proform:

(50) John is nicer than you to a woman that nice.
a. LF: [-er than you ~~are t_1-nice to a woman that$_1$ nice~~]$_1$ John is t_1-nice to a woman that$_1$ nice.
b. __ max {d: John is d-nice to a woman d-nice} > max {d: you are d-nice to a woman d-nice}

■ If so, then we can conduct a Weak Crossover test with (51).

(51) John is that nice to a woman nicer than you.
a. LF: [-er than you ~~are nice~~]$_1$ John is that$_1$ nice to a woman t_1-nice.
b. __ max {d: John is d-nice to a woman d-nice} > max {d: you are d-nice}