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Scope Splitting in the Comparative

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I. Intervals & the Unique Witness Property

(1) John is taller than Mary.

(2) $\exists!d\ \exists!d'$ John is d-tall $\wedge$ $(d \succ d')$ $\wedge$ Jill is d′-tall.

(3)	$\exists!d\ \exists!d'\ \varphi(d) \wedge (d \succ d') \wedge \psi(d')$.	(p-p)

(4) SNEAKERS. Grant expresses interest in a pair of sneakers. I offer to buy them for him, having the impression that they cost somewhere in the \$20-\$30 range. We arrive at the store and to my horror I discover that the sneakers cost \$150.

(5) The sneakers are more expensive than I expected them to be.

(6) $\exists!d\ \exists!d'$ snks are d-expensive $\wedge$ $(d \succ d')$ $\wedge$ expected(*i*, expensive(s,d′))

(7) $\exists!d\ \exists!K$ snks are d-expensive $\wedge$ $K = \{d' : d \succ d'\}$ $\wedge$ expected(*i*, expensive(s,K))

(8) ‘x is K-expensive’ SHOULD BE READ: “x’s price falls somewhere within K”

(9) ‘expected(*i*, expensive(s,K))’ SHOULD BE READ

“according to my expectations, x’s prices is somewhere within K”

(10)	$\exists!d\ \exists!K\ \varphi(d) \wedge K = \{d' : d \succ d'\} \wedge \psi(K)$.	(p-I)

Relating (3) and (10):

(11) φ has the Unique Witness Property $\overset{\text{def}}{=}$ $\exists!d\ (\forall I\ \varphi(I) \leftrightarrow d \in I)$

Note: If φ has the Unique Witness Property, $\varphi(\{d\})$ holds for the witness d, and in that case I will just write $\varphi(d)$.

(12) (λK. Mary is K-tall) has the Unique Witness Property. The witness is Mary’s height.

(13) (10) reduces to (3), when ψ has the Unique Witness Property.

Example (5) motivates (p-I) readings. Quantifiers in the main clause motivate (I-p) readings, and quantifiers in both clauses motivate (I-I) readings.

The comparative generates (I-I) readings in every case (see Schwarzschild 1998 for details). (1) has an (I-I) reading, but since both the main clause and the *than* clause have the Unique Witness Property, it reduces to a (p-p) reading.

If φ has two witnesses, the comparative can be reduced to a conjunction of p- readings. And so on, for multiple witnesses and witness sets. I believe that this is the basis for the apparent wide-scope of quantifiers in comparatives:

(14) John is taller than most of the others were.
(15) Most of the others are such that John is taller than they were.

II. Indeterminacy Projection

(16) I’d like all the tall people in this room to raise their right hand.

(17) Danny is tall and Roger is not tall.

- Degree of truth based on a pattern of interpretations.
- Comparative defined in terms of a pattern of interpretations.

- If the comparative has sentential scope, then Kamp paints with too broad a brush.

(18) Rutgers is further from a big airport than MIT is Δ

(19) LF: $[_{DegP}$ er than MIT is $\Delta]_i$ [Rutgers is t_i far from a big airport].

Lewis-like logical forms:

(20) Danny is d-tall and Roger is not d-tall

If "x is d-tall" means "d corresponds to x's height" then we incorrectly predict (21) false (assuming Danny and Sabine are **not** of equal height)

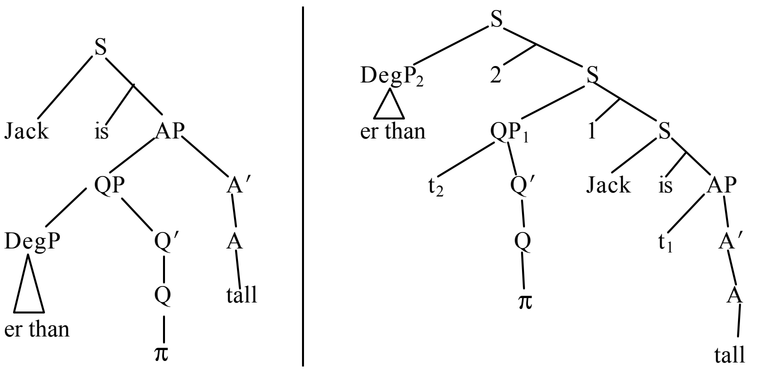
(21) Danny is tall and Sabine is tall.

Instead (following Kamp 1975):

(22) x is d-tall IFF x's height exceeds d.

☞ Gradable adjectives have point arguments, comparatives are interval quantifiers, what glues them together? A point-to-interval (pi) operator.

(23)



(24) Preliminary: height definition.

If John is 5′7′′ then: {d: John is d-tall} = [0′,5′7′′)

John's height = Upper Limit ({d: John is d-tall})

(25) Likewise: x's price = Upper Limit ({d: x is d-expensive})

(26) $\|\pi\|(I_{<dt>})\,(P_{<dt>}) = 1$ IFF UpperLimit(P) $\in$ I

Putting (23)-(26) together we have:

(27) $\|t_2\ \pi\ \lambda d(\text{John is d-tall})\|$ IFF John's height is in $\|t_2\|$.

III. Modals in Comparatives

◎ *should* is weaker than *had to*.
Suppose Jack wants to be a pilot and he learns the following:

(28) The pilot should be between 4ft and 6ft tall.
(29) The pilot has to be between 4ft and 6ft tall.

◎ Under the *than* they appear to flip in strength:

(30) Jack is taller than he should be.
(31) Jack is taller than he has to be.

CLAIM: This difference comes about in part because in (31) there is scope-splitting (following a suggestion in Heim(2001), but in (30) there isn't. This difference between *had to* and *should* shows up in other scope splitting contexts (von Fintel & Iatridou and references therein).

- relevant parts of LF:

(32) Jack is taller than $[_{DegP}\ Wh_i]$ he should $[_{QP}\ t_i\ \pi]_j$ PRO be t_j tall.

(33) Jack is taller than $[_{DegP}\ Wh_i]$ he $[_{QP}\ t_i\ \pi]_j$ has to t_j PRO be t_j tall.

- Another preliminary observation before we go to the calculation:

(34) If Jack is required to be between 4′ and 6′ to be a pilot, then no matter what, if he is to be a pilot, Jack's height must exceed 2′, 3′, 3.4′, 3.5′… up to but not including 4′. So 4′ is the upper limit for:

(i) {d: Jack has to be d-tall}

so: UpperLimit({d: Jack has to be d-tall}) = 4′ = the minimum required height.

(35) $\|t_i\ \pi\ \lambda d(\text{John has to be d-tall})\|$ IFF the min-required height is in $\|t_i\|$.

Jack is taller than he should be ~~tall~~

$[_{DegP}$ er than-CP$]_i$ λk $[_{QP}$ t_k $[_Q \pi$ $]]_j$ λj Jack is $[_{AP}$ t_j $[_{A^\circ}$ tall$]]$ CP = $[_{DegP}$ Wh$]_k$ λk Jack should^w $[_{QP}$ t_k $[_Q \pi$ $]]_j$ λj PRO be $[_{AP}$ t_j $[_{A^\circ}$ tall$_w]]$

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er λK $[K\,\pi\,]$ (λd Jack is d-tall$_@$) than λK should^w $[K\,\pi\,]$ (λd Jack be d-tall$_w$)

{d: Jack's height exceeds d in w}

K contains Jack's height in w.

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for any world w, compatible with the regulations: K contains Jack height in w.

{K: K contains Jack's actual height}

{K: K contains Jack's height in w, for any regulation world w}

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Jack's actual height

{d : Jack's actual height $\succ$ d} $\in$ {K: K contains Jack's height in w, for any regulation world w}

{d : Jack's actual height $\succ$ d} contains Jack's height in w, for any regulation world w

for every regulation world w: Jack's actual height $\succ$ Jack's height in w

Jack's actual height exceeds his height in every regulation world. $\therefore$ *Jack's actual height exceeds the maximally permitted height.*

Jack is taller than he has to be ~~tall~~

$[_{DegP}$ er than-CP$]_i$ λk $[_{QP}$ t_k $[_Q \pi$ $]]_j$ λj Jack is $[_{AP}$ t_j $[_{A^\circ}$ tall$]]$ CP = $[_{DegP}$ Wh$]_i$ λi Jack $[_{QP}$ t_i $[_Q \pi$ $]]_j$ λj has^w to PRO be $[_{AP}$ t_j $[_{A^\circ}$ tall$_w]]$

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er $\lambda K\ [K\ \pi\ ]\ (\lambda d$ Jack is d-tall$_@$)

than λK $[K\ \pi\ ]$

λd (has to^w Jack be d-tall$_w$)

d is such that: in every world w compatible with the regulations, Jack's height in w exceeds d

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{d : d is below the minimal required height}

K contains the minimal required height. (see (34)-(35))

{K: K contains Jack's actual height}

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Jack's actual height

{K: K contains the minimal required height}

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the minimal required height

Jack's actual height exceeds the minimal required height.

Other types of examples that show similar effects:

- Possibility modals:

(36) The red book was more expensive than the blue book might have been.
(37) The red book is more expensive than the blue book is allowed to be.

If (36) is true, then the red book had to exceed the **minimum** possible blue price.
If (37) is true, then the red book had to exceed the **maximum** permitted blue price

allowed is and *might* is not a scope splitter.

- propositional attitude verbs:

(38) He went further than I was willing to go.
(39) The sneakers are more expensive than I expected them to be.

willing to: ∃ force, scope-splitting → greater than maximum (compare (37))

expect: ∀ force, no scope splitting → greater than maximum. (compare *should* (30))

- mixed cases

∀-∃

(40) He stayed in the water longer than $[_{DegP} Wh_i]$ I thought he $[_{QP}\ t_i\ \pi]_j$ could.

Maximum of a maximum: suppose I thought his maximum ability ranges from 4mins to 7mins. (40) says he was there longer than 7mins.

No scope-splitting over ∀-*thought* → maximum.
Scope-splitting over ∃-*could* → maximum.

∃-∀

(41) more than they're willing to require of him
(42) more than she might have had to.
(43) more than they allowed him to agree to.

- other constructions

(44) All you need is love.

(45) 6ft tall

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Appendix (added after talk)

A. definition of "upper limit"

The basic idea is that d is the upper limit for the set $\{d' : d \succ d'\}$

The definition works likes that of 'least upper bound' but it is given in terms of $\succ$ and not $\succeq$.

Let S be set with ordering $\succ$ and let P be a subset of S.

$z = \text{UpperLimit}(P)$ IFF $z \in S \wedge \forall x \in S: ((\forall y\ y \in P \rightarrow y \prec x) \leftrightarrow x \succeq z)$.

B. General Schema for Comparatives (without measure phrases).

Continuing the style of presentation in (3) and (10), the most general scheme for interpreting comparatives without differentials/measure phrases is:

(46)	$\varphi(\{d: \psi\{d': d \succ d'\}\})$.	(I-I)

When φ and ψ have the Unique Witness Property, then (46) reduces to (3). When just φ has the Unique Witness Property, then (46) reduces to (10). And when just ψ has the Unique Witness Property, then (46) reduces to:

(47)	$\exists!K\ \exists!d\ \ \varphi(K) \wedge K = \{d': d \prec d'\} \wedge \psi(d)$.	(I-p)

In the following example, assuming the DegP scopes over the quantifiers in the main clause (cf. (19)), then we have the situation just described, namely where just ψ has the Unique Witness Property.

(48) Earth is further from all other planets than it is from the moon.

According to (47), (48) says that the interval K containing all distances greater than the Earth-moon distance is an interval that contains the Earth-planet distances for all planets.

C. Comparatives with measure phrases.

The following examples have measure phrases preceding the comparative:

(49) Charlie is at least an inch taller than all of his predecessors were.
(50) Charlie is exactly an inch taller than all of his predecessors were.

The measure phrase information needs to be incorporated in the part of the semantics that defines an interval based on the greater-than relation. $d \succ d'$ can be understood as saying that the distance on the scale from d' up to d (written: $[d' \rightarrow d]$) is not zero.

When we add the measure phrase, we replace "not zero" with the measure given by the measure phrase. I'll write μ for the measure given by the measure phrase:

(51)	$\varphi(\{d: \psi\{d': \mu([d' \rightarrow d])\}\})$.	(I-I)

to evaluate (49) or (50), we want the simplified version that works when φ has the Unique Witness Property, which is:

(52)	$\exists!d\ \exists!K\ \ \varphi(d) \wedge K = \{d': \mu([d' \rightarrow d])\}) \wedge \psi(K)$.	(p-I)

In the case of (50), $\mu([d' \rightarrow d])$ will hold if d' is exactly an inch less than d, which in this case is Charlie's height. There is only one such d'. So in this case, K is itself a singleton set whose sole member is Charlie's height minus 1-inch. So (50) says that all of Charlie's predecessors had a height that was exactly an inch less than Charlie's height. This explains why (50), unlike (49), entails that Charlie's predecessors were all the same height.