Quantifiers in *Than*-Clauses
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1. Introduction

The problem of quantifiers in *than*-clauses has been puzzling linguists for a long time (beginning with von Stechow (1984), until Schwarzschild & Wilkinson (2002), Schwarzschild (2004), and Heim (2006)). It emerges from von Stechow's (1984) theory of the comparative and can be illustrated with the examples below.

(1) Knut is cuter than every other animal in the Berlin Zoo is.

(1') a. For all x, x≠Knut & x is an animal in the Berlin Zoo: Knut is cuter than x

b. # The degree of cuteness that Knut reaches exceeds the degree of cuteness that every other animal in the Berlin Zoo reaches.

= Knut's cuteness exceeds the cuteness of the least cute animal in the Berlin Zoo (say, their sea cucumbers).

(2) Knut is bigger than a black bear pup is.

(2') a. # There is an x, x a black bear pup, such that Knut is bigger than x.

b. The size degree that Knut reaches exceeds the size degree that a black bear pup reaches.

= Knut's size exceeds the size of the largest black bear pup.

While (1) intuitively only has a reading that appears to give the universal NP scope over the comparison, (2) only has a reading that gives the nominal quantifier narrow scope relative to the

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comparison. We must ask ourselves how a quantifier contained in the than-clause can have wide
scope at all, why it cannot get narrow scope in (1), and why (2) is the opposite.
Since these questions look unanswerable under the standard analysis of comparatives, the
researchers cited above have been led to a revision of the semantic analysis of comparison. They
employ an interval semantics for the than-clause. Different strategies have been tried to combine this
with the comparative operator. Schwarzschild & Wilkinson (2002) give the comparative itself an
interval semantics. Heim (2006) ultimately reduces the interval back to a degree through semantic
reconstruction.
In this paper, I will adopt the interval analysis and propose a different strategy for combination with
the comparative operator. I reduce the interval back to a point than-clause internally. This reduction
is influenced by some pragmatic factors. I show that this strategy has empirical advantages over
both of my immediate theoretical predecessors. To my view, it also has the advantage of theoretical
simplicity in the analysis of the comparative.
In section 2, I present the current state of our knowledge in this domain. In section 3, I digress into
the issue of quantifiers in before-clauses, which provides important motivation for the kind of
strategy I propose in order to solve the problem of quantifiers in than-clauses. The analysis of than-
clauses is presented in section 4. Section 5 ends the paper with a summary and some conclusions.

2. State of Affairs

I first sketch a sample of data that I take to be representative of the interpretational possibilities that
arise with quantifiers in than-clauses. Then I sketch Schwarzschild & Wilkinson's (2002) and
Heim's (2006) analyses.

2.1. Data

The data are grouped according to whether the quantifier appears to take wide scope over the
comparison according to the classical analysis, or whether it would have to be seen as taking narrow
scope relative to the comparison. My presentation assumes a general theoretical framework like
comparison (see also Beck (to appear) for an exposition). For illustration, I discuss the simple
element example (3a) below. In (3b) I provide the Logical Form and in (3c) the truth conditions derived by
compositional interpretation of that Logical Form, plus paraphrase. Interpretation relies on the
lexical entries of the comparative morpheme and gradable adjectives as given in (4).
(3) a. Paule is older than Knut is.
   b. \[\text{[-er } <d,t> \text{ than } 2 \text{ [Knut is t2 old]}] \]
   \[\text{[<d,t> 2 [Paule is t2 old]]} \]
   c. \[\text{max(} d.\text{Paule is d-old}\text{)} > \text{max(} d.\text{Knut is d-old}\text{)} \]
   'The largest degree of age that Paule reaches exceeds the largest degree of age that Knut reaches' = Paule's age exceeds Knut's age

(4) a. \[\text{[[-er ]] = [D<d,t> . D'<d,t> . max(D') > max(D)} \]
   b. \[\text{[old]<d,<e,t> = [d. [x. x is d-old] = [d. [x. Age(x) \geq d]} \]

2.1.1. Apparent Wide Scope Quantifiers

Universal NPs are a standard example for an apparent wide scope quantifier (see e.g. Heim (2006)). The sentence in (5) below only permits the reading in (5'a), not the one in (5'b). This can be seen from the fact that the sentence would be judged false in the situation depicted below. The Stechow semantics of comparatives makes this look as if the NP had to take scope over the comparative.

(5) John is taller than every girl is.

(5') a. \[\text{[x} \text{girl(x) -> max([d.John is d-tall)}>\text{max([d.x is d-tall])]} \]
   = For every girl x: John's height exceeds x's height.
   b. \# \[\text{max([d.John is d-tall)}>\text{max([d. [x[girl(x) -> x is d-tall]]]} \]
   = John's height exceeds the degree to which every girl is tall;
   = John is taller than the shortest girl.

|----------------------x------------------x------------------x----------------x---------|
| g1's height           J's height           g2's height           g3's height |

Thus, strangely, the sentence appears to permit only the LF in (6a), which violates constraints on Quantifier Raising (QR), and not the one in (6b) which would be unproblematic. The LF in (6a) can straightforwardly be interpreted to yield (5'a); analogously for (6b) and (5'b). The example with the differential in (7) shows the same behaviour.
The problem posed by (5) is exacerbated in (8), as Schwarzschild & Wilkinson (2002) observe. We have once more a universal quantifier, but this time it is one that is taken to be immobile at LF. Still, the interpretation that is intuitively available looks to be one in which the universal outscopes the comparison.

(8) John is taller than I had predicted (that he would be).

(9) My prediction: John will be between 1,70m and 1,80m. Claim made by (8): John is taller than 1,80m.

(10) a. \[
\forall w[wR@ \rightarrow \max(\forall d.\text{John is } d\text{-tall})=\max(\forall d.\text{John is } d\text{-tall} in w)]
\]
= For every world compatible with my predictions: John's actual height exceeds John's height in that world.

b. \# max(\forall d.\text{John is } d\text{-tall in } @)\rightarrow \max(\forall d.\ [wR@ \rightarrow \text{John is } d\text{-tall in } w])
= John's actual height exceeds the degree of tallness which he has in all worlds compatible with my predictions; i.e. John's actual height exceeds the shortest prediction, 1,70m.

This is the interpretive behaviour of many quantified NPs, quantificational adverbs, verbs of propositional attitude and some modals (e.g. must, might). See Schwarzschild & Wilkinson (2002) and Heim (2006) for a more thorough empirical discussion.

2.1.2. Apparent Narrow Scope Quantifiers
Not all quantificational elements show this behaviour. A universal quantifier that does not is the modal *have to*, along with some others (*be required, be necessary, need*). This is illustrated below.

(11) Mary is taller than she has to be.

(12) Mary wants to play basketball. The school rules require all players to be at least 1,70m. Mary is taller than 1,70m.

(13) a. # \( \forall w[wR@ \rightarrow \max(\forall d.Mary is d-tall in @) > \max(\forall d.Mary is d-tall in w)] \)
    = For every world compatible with the school rules:
      Mary's actual height exceeds Mary's height in that world;
      i.e. Mary is illegally tall.

   b. \( \max(\forall d.Mary is d-tall in @) > \max(\forall d. \forall w[wR@ \rightarrow Mary is d-tall in w]) \)
    = Mary's actual height exceeds the degree of tallness which she has in all worlds
      compatible with the school rules;
      i.e. Mary's actual height exceeds the required minimum, 1,70m.

These modals permit only what appears to be a narrow scope interpretation relative to the comparison. Existential modals like 'be allowed' are parallel:

(14) Mary is taller than she is allowed to be.

(15) a. # \( \exists w[wR@ \& \max(\forall d.Mary is d-tall in @) > \max(\forall d.Mary is d-tall in w)] \)
    = It would be allowed for Mary to be shorter than she actually is.

   b. \( \max(\forall d.Mary is d-tall in @) > \max(\forall d. \exists w[wR@ \& Mary is d-tall in w]) \)
    = Mary's actual height exceeds the largest degree of tallness that she reaches in
      some permissible world; i.e. Mary's actual height exceeds the permitted maximum.

And so are some other existential quantifiers:

(16) Mary is taller than anyone else is.

(17) a. # There is someone that Mary is taller than.

   b. Mary's height exceeds the largest degree of tallness reached by one of the others.
(18) Mary is taller than John or Fred are.

(19)  
   a.  # For either John or Fred: Mary is taller than that person.
   b. Mary's height exceeds the maximum height reached by John or Fred.

This is the interpretive behaviour of some modals (e.g. *need, have to, be allowed, be required*), some indefinites (especially NPIs) and disjunction (compare once more Heim (2006)). It is also the behaviour of negation and negative quantifiers, with the added observation that the apparent narrow scope reading is one which often gives rise to undefinedness, hence unacceptability (Stechow (1984), Rullmann (1995)). (That this is not invariably the case is shown by (22), illustrating that we are concerned with a constraint on meaning rather than form).

(20)  * John is taller than no girl is.

(21)  
   a. John's height exceeds the maximum height reached by no girl.
   the maximum height reached by no girl is undefined, hence: unacceptability of this reading.
   b.  # There is no girl who John is taller than.

(22) I haven't been to the hairdresser longer than I haven't been to the dentist.

Here is how I would sketch the empirical picture from the point of view of the classical analysis of comparatives. It appears that there are two different scope readings possible for quantifiers embedded inside the *than*-clause, wide or narrow scope relative to the comparison. But there is never an ambiguity. Each individual quantifier permits at most one reading (negation frequently permits none).

2.2. Theories

It is very hard to see how the data can be derived under the classical theory. As Schwarzschild & Wilkinson argue, they are beyond the reach of an LF analysis. The two theories summarized below (Schwarzschild and Wilkinson (2002) and Heim (2006)) both change the semantics of the comparative in ways that reanalyze scope. The quantificational element inside the *than*-clause can
take scope there even under the apparent wide scope reading. The two theories differ with respect to the semantics they attribute to the comparison itself. They also differ in their empirical coverage.


Schwarzschild & Wilkinson (2002) are inspired by the scope puzzle to a complete revision of the semantics of comparison. According to them, the quantifier data show that the than-clause provides us with an interval on the degree scale - in (23) below an interval into which the height of everyone other than Caroline falls.

(23) Caroline is taller than everyone else is.
'Everyone else is shorter than Caroline.'

\[
\begin{array}{|c|c|c|c|}
\hline
\text{x1} & \text{x2} & \text{x3} & \text{C} \\
\hline
\end{array}
\]

There is an interval on the height scale that covers everyone else's height and that is below Caroline's height.

(23') \([\text{than everyone else is}] = [D. \text{everyone else's height falls within D}]\)

(24) Joe is taller than exactly 5 people are.

Here is a rough sketch of Schwarzschild & Wilkinson's analysis of this example.

(25) Subord: \([D'. \text{exactly 5 people's height falls within D'}]\)

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1 I present the discussion in terms of the classical theory's ontology here, where degrees (elements of \(D_d\)) are points on the degree scale and an interval is (a kind of) set of points (see Sauerland (2007) for a discussion of intervals vs. sets of points). Fox & Hackl (2007) propose that all scales in natural language are dense. This would make what I call a point an interval. Their proposals are, I think, completely compatible with my plot, as will become clear later.
Matrix + Comp: \[ \text{MAX } \text{D'}:[\text{Joe's height - D'}] \neq 0 \]
the largest interval some distance below Joe's height

whole clause: the largest interval some distance below Joe's height is an interval into
which exactly 5 people's height falls.

Note that the quantifier is not given wide scope over the comparison at all under this analysis. The interval idea allows us to interpret it within the \textit{than}-clause. While solving the puzzle of apparent wide scope operators, the analysis makes wrong predictions for apparently narrow scope quantifiers (cf. example (26)). The available reading cannot be accounted for ((27a) is the semantics predicted by the classical analysis, corresponding to the intuitively available reading; (27b) is the semantics that the Schwarzschild & Wilkinson analysis predicts).

(26) John is taller than anyone else is.

(27) a. John's height > \text{max}(\text{[d. [x[x \neq \text{John} \& x \text{ is d-tall}]]])}

b. \# the largest interval some distance below John's height is an interval into which
someone else's height falls = Someone is shorter than John.

The breakthrough achieved by this analysis is that we can assign to the \textit{than}-clause a useful semantics while interpreting the quantifier inside that clause. For this reason, the interval idea is to my mind a very important innovation. The analysis still has a crucial problem in that it does not extend to the apparently narrow scope quantifiers. I will also mention that the semantics of comparison becomes rather complex under this analysis, since the comparative itself compares intervals.

2.2.2. Heim (2006)

Heim (2006) adopts the interval analysis, but combines it with a scope mechanism that derives ultimately a wide and a narrow scope reading of a quantifier relative to a comparison. Let us consider her analysis of apparent wide scope of quantifier data, like (28), first. Heim's LF for the sentence is given in (29). She employs an operator \text{Pi} (Point to Interval, credited to Schwarzschild (2004)). Compositional interpretation (somewhat simplified for the matrix clause) is given in (31).

(28) John is taller than every girl is.
(29)  [IP  [CP  than  [1[ every girl [2[ [Pi t1] [3[ t2 is t3 tall]]]]]]])
[IP  4 [ [-er t4]  [5[ John is t5 tall]]]]

(30)  [[Pi ]] = ◇D. □P.max(P)□D

(31)  a. main clause:
[[ [4[ [-er t4] [5[ John is t5 tall]]]] ]] = □d. John is taller than d

b. than-clause:
[[ [3[ t2 is t3 tall]] ]] = □d.x is d-tall
[[ [2[ [Pi t1] [3[ t2 is t3 tall]]]] ]] = □x.[ □D. □P.max(P)□D](D')( □d.x is d-tall)
= □x. max( □d.x is d-tall) □D'
= □x. Height(x) □D'

[[ [than [1[every girl [2[ [Pi t1] [3[ t2 is t3 tall]]]]]]]] ] =
□D'. □x[girl(x) -> Height(x) □D']
intervals into which the height of every girl falls

c. main clause + than-clause:
[[ (28)]]

□D'. □x[girl(x) -> Height(x) □D']( □d. John is taller than d) =
□x[girl(x) -> Height(x) (□d. John is taller than d)] =
for every girl x: John is taller than x

The than-clause provides intervals into which the height of every girl falls. The whole sentence says that the degrees exceeded by John's height is such an interval. Semantic reconstruction (i.e. lambda conversion) simplifies the whole to the claim intuitively made, that every girl is shorter than John. The analysis assumes that the denotation domain D_d is a set of degree 'points', and that intervals are of type D_d.<d,t>.
The analysis is a way of interpreting the quantifier inside the than-clause, and deriving the apparent wide scope reading over the comparison through giving the quantifier scope over the shift from degrees to intervals (the Pi operator). This is applicable for other kinds of quantificational elements like intensional verbs in the same way. A differential makes no difference to the derivation. This is demonstrated below.

(32)  John is 2" taller than every girl is.
(33) \[ [[\text{than} [1\text{ every girl} [2[ [\Pi \text{ t1}] [3[ \text{t2 is t3 tall}]])])] = (\mathcal{D}'. \sqcap [x \mapsto \text{Height}(x)] \mathcal{D}')\]

intervals into which the height of every girl falls

\[ [[(32)]] = [[\mathcal{D}'. \sqcap [x \mapsto \text{Height}(x)] \mathcal{D}']] (\mathcal{D}. \text{ John is 2" taller than d})\]

= for every girl \(x\): John is 2" taller than \(x\)

(34) a. John is taller than I had predicted (that he would be).

b. \[\square w[wR@ \rightarrow \max(\mathcal{D}. \text{ John is d-tall in } @) \rightarrow \max(\mathcal{D}. \text{ John is d-tall in } w)]\]

= For every world compatible with my predictions:
John's actual height exceeds John's height in that world.

(35) [IP [CP \text{ than} [1[ I had predicted [CP [Pi t1] [2[AP John t2 tall]]])]])

[IP 3 [ John is taller than t3]]

(36) a. main clause:

\[ [[[3[ \text{John is taller than t3]]]] = (\mathcal{D}. \text{John is taller than d in } @)\]

b. \textit{than} -clause:

\[ [[2[AP John t2 tall]]] = (\mathcal{D}. \text{ John is d-tall in } w)\]

\[ [[\text{CP [Pi t1]} [2[AP John t2 tall]]]] = ([w. \max(\mathcal{D}. \text{ John is d-tall in } w)) \mathcal{D}']\]

\[ [[\text{than} [1[ I had predicted [CP [Pi t1] [2[AP John t2 tall]]])] = (\mathcal{D}'. \sqcap [w[wR@ \rightarrow John's height in w \mathcal{D}'])\]

intervals into which John's height falls in all my predictions

c. main clause + \textit{than} -clause:

\[ [[(34a)]] = [[\mathcal{D}'. \sqcap [w[wR@ \rightarrow J's height in w \mathcal{D}']) (\mathcal{D}. J is taller than d in @)\]

= for every \(w\) compatible with my predictions:
J's actual height exceeds J's height in \(w\).

(37) Pi shifts from degrees to intervals:

\[ (\mathcal{D}. \text{x is d-tall}) \Rightarrow (\mathcal{D}. \max(\mathcal{D}. \text{x is d-tall}) \mathcal{D}) = (\mathcal{D}. \text{Height}(x) \mathcal{D})\]

In contrast to Schwarzschild & Wilkinson's original interval analysis, Heim is able to derive apparently narrow scope readings of an operator relative to the comparison as well. The sentence in
(38a) is associated with the LF in (39). Note that here, the shifter takes scope over the operator *have to*. This makes *have to* combine with the degree semantics in the original, desired way, giving us the minimum compliance height (just like it did before, without the intervals). The shift is essentially harmless.

(38) a. Mary is taller than she has to be.
    b. \[ \text{max}(\{d. \text{Mary is d-tall in @}\}) \text{max}(\{d. \text{w}[\text{wR} \rightarrow \text{Mary is d-tall in w}]\}) \]

Mary's actual height exceeds the degree of tallness which she has in all worlds compatible with the school rules;

i.e. Mary's actual height exceeds the required minimum, 1,70m.

(39) [IP [CP than [1 [1 [Pi t1] [2 [ has-to [Mary t2 tall]]]]]]] [IP 3 [Mary is taller than t3]]

(40) a. main clause:

[[ [3[Mary is taller than t3]]] ] (\{d.\text{Mary is taller than d in @}\})

b. than-clause:

[[ [2 [ has-to [Mary t2 tall]]] ] (\{d. \text{w}[\text{wR} \rightarrow \text{Mary is d-tall in w}]\})

[[ than [1[1 [Pi t1] [2 [ has-to [Mary t2 tall]]]]]] ] =

\[ [\square D'. \text{max}(\{d. \text{w}[\text{wR} \rightarrow \text{Mary is d-tall in w}]\}) \square D'] \]

intervals into which the required minimum falls

c. main clause + than-clause:

[[ (38a) ]] =

\[ [\square D'. \text{max}(\{d. \text{w}[\text{wR} \rightarrow \text{Mary is d-tall in w}]\}) \square D'] \]

(\{d.\text{Mary is taller than d in @}\})

= Mary is taller than the required minimum.

Other apparent narrow scope operators receive a parallel analysis. Pi-phrase scope interaction is summarized below:

(41) Pi takes narrow scope relative to quantifier

\[ \Rightarrow \] apparent wide scope reading of quantifier over comparison

Pi takes wide scope relative to quantifier

\[ \Rightarrow \] apparent narrow scope reading of quantifier relative to comparison
The idea behind this analysis is that than-clauses include a shift from degrees to intervals, which allows us to assign a denotation to the than-clause with the quantifier. The shift amounts to a form of type raising. Through semantic reconstruction, the matrix clause is interpreted in the scope of a than-clause operator when that operator has scope over the shifter. Comparison is ultimately between points/degrees, not intervals.

Heim's analysis is able to derive both wide and narrow scope readings of operators in than-clauses. It does so without violating syntactic constraints. There is, however, an unresolved question: when do we get which reading? How could one constrain Pi-phrase/operator interaction in the desired way? One place where this problem surfaces is once more negation, where we expect an LF that would generate an acceptable wide scope of negation reading.²

(42) a. John is taller than no girl is.
   b. \[ \text{IP CP than } [1 \text{ no girl } [2 [\text{Pi t1} [3 [t2 is t3 tall]]]]]]
      \[ \text{IP 4 } [[-er t4} [5 [\text{John is t5 tall}]])]

(43) a. main clause:
   \[ [[4 [-er t4} [5 [\text{John is t5 tall}]]]] \] = \[d. John is taller than d
   b. than-clause:
   \[ [[\text{than } [1 \text{ no girl } [2 [\text{Pi t1} [3 [t2 is t3 tall]]]]]]]] \] =
      \[ \[D'. \text{for no girl } x: \text{max( } [d.x is d-tall) D']\]
      \[ \text{intervals into which the height of no girl falls}\]
   c. main clause + than-clause:
   \[ [[(42a)]] = \[D'. \text{for no girl } x: \text{max( } [d.x is d-tall) D'])( [d. John is taller than d]
      \[ = \text{for no girl } x: \text{John is taller than } x\]

Adopting the interval analysis, but combining it with a scope mechanism and semantic reconstruction, allows Heim to derive both types of readings (apparent narrow and apparent wide scope), and to reduce the comparison ultimately back to a comparison between points=degrees. Thus her empirical coverage is greater and the semantics of comparison simpler than Schwarzschild & Wilkinson's analysis. The problem that this analysis faces is overgeneration. We do not have an

² Gajewski (2008) presents a solution to this problem which maintains the general framework of Heim's (2006) analysis in so far as it lets a than-clause quantifier semantically take scope over the
obvious way of predicting when we get which reading. The fact that in all the data that we have seen so far, only one scope possibility is available makes one doubt that this is really a matter of scope.

3. Suggestive: Before-Clauses

Before developing my own proposal for the analysis of quantifiers in than-clauses, I will discuss quantifiers in before-clauses. They have proven to be an important guide to the direction that my reasoning about this issue has taken. I owe to Irene Heim (p.c.) the suggestion to consider them in this context.

3.1. An Interval Analysis of Quantifiers in Before-Clauses

3.1.1. Empirical Parallels

It is intuitively obvious that before-clauses, just like comparatives, express a comparison between the main clause and the subordinate clause. The comparison is temporal, i.e. relates a main clause time and a subordinate clause time on a scale ordered by 'earlier than'. Simple examples, situations that could be truthfully described, and suggested truth conditions (see e.g. Stechow (2002), Beaver and Condoravdi (2003)) are given below.

(44) a. Mary was born before John was.
     b. Mary was in the US before John was.

(45)  

(46)  

(47) there is a time at which Mary was in the US that precedes the earliest time at which John was in the US.

comparison. His approach agrees with mine, though, in not postulating a general pattern of scope interaction.
Just like comparatives, before-clauses can host a differential.

(48) a. Mary was born exactly 27 days before John was born.
    b. There is a t such that Mary was born at t &
       t+27days = the (earliest) time at which John was born

Nominal quantifiers like 'everyone' and propositional attitude verbs like 'predict' appear to take scope over the temporal comparison. Thus (49) is paraphrased by (51b), but not by (51a) which would make the sentence true in the situation depicted by (50). Parallel observations apply to (52) and (53).3

(49) Mary was in the US before everyone else was.

(50) \-----------------------------x--------------------------------->
    ///:///://:" M in US  \:\: others in US
    \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\

(51) a. # There is a time at which Mary was in the US that precedes the earliest time
     at which everyone else was in the US.
    b. For every x≠Mary: Mary was in the US before x was.

(52) a. Mary was in the US exactly 2 weeks before everyone else was.
    b. For every x≠Mary: Mary was in the US exactly 2 weeks before x was.

(53) Mary was in the US before I had predicted that she would be.

(54) My prediction: Mary will arrive in the US between June 1 and September 1.

3 Note that temporal or aspectual factors inside the before-clause can change the interpretation to 'before the last'. This is what we get if the tense of the before-clause is a pluperfect. The cases relevant to the present discussion have the same tense in matrix and before-clause.

(i) a. She arrived before all the boys had arrived.
    b. (before) [\t.\t[\t< & all the boys arrive at \t]
Claim made by (53): Mary's visit begins before June 1.

(55)  a.  # There is a time at which Mary was in the US that is earlier than the earliest time such that Mary is in the US then in all worlds compatible with my predictions.
   b.  For all times compatible with my predictions: Mary was in the US before that.

And just like in the case of comparatives, some intensional verbs, indefinites and disjunctions appear to take narrow scope.

(56)  Mary was in the US before she had to be.

(56')  a.  There is a time at which Mary was in the US that is earlier than the earliest time such that Mary is in the US then in all worlds compatible with the requirements; i.e. Mary is in the US earlier than the latest time compatible with the requirements.
   b.  # For all times compatible with the requirements: Mary was in the US before that; i.e. Mary was in the US earlier than she was allowed to.

(57)  a.  Mary was in the US before she was allowed to.
   = earlier than permitted
   b.  Mary was in the US before anyone else was.
   = earlier than all the others
   c.  Mary was in the US before Fred or George were.
   = Mary was in the US earlier than Fred and earlier than George.

Another example of apparent narrow scope is negation, which frequently leads to unacceptability here as well. These observations lead one to hope that insights into the semantics of before-clauses will help with the issue of comparatives.

(58)  * Mary was in the US before no one else was.

3.1.2. An Independently Motivated Interval Analysis

I will suggest below a common sense interval analysis of before-clauses. Example (59a) will be associated with the semantics in (59b).
In the temporal domain, it seems obvious to associate the subordinate clause with a time interval, and indeed Schwarzschild & Wilkinson motivate their interval idea with the example of time. The suggestion I make below is common sense in that it is derived from an independently motivated clausal architecture like the one in von Stechow (2002) and fits our needs straightforwardly. In such an architecture, the VP denotes a set of eventualities. An aspectual head existentially closes off the event argument just above VP and relates the running time of the event to a time interval. I illustrate with example (60).

(60)  
\begin{align*} 
\text{a. Mary was in the US before John was.} \\
\text{b. there is a } t: \text{ Mary was in US at } t \text{ and} \\
& t< \text{begin(} \text{the min(} \text{\{I. John's US visit falls within I\}\} \text{)}\text{)} \\
\end{align*}

We now apply this analysis to the example with the quantifier, repeated from (59) above.

(63)  
\begin{align*} 
\text{a. Mary was born before everyone else was.} \\
\text{b. there is a } t: \text{ Mary was born at } t \text{ and} \\
\end{align*}
t<begin(the min(I. everyone else's birth falls within I))

(64)  [ before [TP everyone else 1 Past [AspP ASP [VP t1 be born ]]]]

[[VP ]] = \[e. x is born in e
[[AspP ]] = \[t. \[e[x is born in e & \[e]t]
[[ TP ]] = \[t. \[x|x≠Mary -> \[e[x is born in e & \[e]t]]

intervals into which the births of everyone other than Mary fall.
The beginning of the smallest such interval is later than Mary's birth.

Data with propositional attitude verbs are equally straightforward. We adopt a view of eventualities in which they are parts of possible worlds (e.g. Kratzer (1998)).

(65)  Mary was born before I had predicted that she would be.

(66)  [ before [TP I had predicted [CP that Mary would be born ]]]

[[CP ]] = \[w.\[t. \[e[Mary is born in e & e≤w & \[e]t]
[[ TP ]] = \[t. \[w[wR@ -> \[e[Mary is born in e & e≤w & \[e]t]]

intervals into which in all worlds compatible with my predictions the birth of Mary falls.
The beginning of the smallest such interval is later than Mary's actual birth.

Existential quantifiers add the small complication that there isn't a unique minimal time interval that the before-clause is true of. In order to get the right interpretation, we must look at the earliest minimal time interval described by the before-clause.

(67)  Mary was in the US before anyone else was.
    = earlier than all the others

(67')  ----------------------------------------------------------->

Mary x1 x2 x3 x4
|-------| |---| |---| |----| |---|

17
(68) Mary was in the US before Fred or George were.  
= Mary was in the US earlier than Fred and earlier than George.

(68')  ------------------------------------------------------------------
       Mary    Fred    George
       |-------|  |----|  |--------|
Some part of "Mary-Interval" is earlier than the beginning of the earliest minimal interval in the meaning of the before-clause.

(69)  
  \[ (\text{before}) \text{ anyone else was} \] = \[x \neq \text{Mary} \& \Box x \text{ is in US in e} \& \Box (e) t] \]
  intervals into which the visit of an individual other than Mary falls.
Out of the minimal such intervals, the beginning of the earliest is later than Mary's visit.

This refinement is implemented below (I thank Arnim von Stechow for helpful suggestions on this matter). We rely on an ordering of points and intervals on the time scale. On this basis we choose the maximally early interval. We can suppose that the relevant ordering relation R is chosen from what seem to be contextually relevant relations in accordance with informativity. In the case of before-clauses, temporal order is indicated by before. Choosing max \(<\) gives the most informative proposition.

(70)  a. ordering of points in time: \( t < t' \)
  \( t \) is earlier than \( t' \)
  b. ordering of intervals: \( I < J \) iff \[ t \in I \& t' \in J \rightarrow t < t' \]
  \( I \) begins before \( J \)

(71)  a. Let \( S \) be a set ordered by \( R \). Then \( \max_R(S) = [s \in S \& \Box s \in S[R s']] \]
  b. \( R \) is temporal earlier \( '<\)

(72)  a. \( \max_\text{rel} := \) the max relative to the relation on intervals
  = the interval that begins earliest
  b. \( \max_\text{rel}(p):= \) begin \( (\max_\text{rel}(p)) \)
  = the beginning of the time interval that begins earliest
I assume that Max and min are generally available interpretive mechanisms, which for convenience I represent as part of the LF structure.

(73) before - 2nd version:

\[ \text{[ main clause [ (differential) before [ MaxR [ min [before-clause]]]]]} \]

\[ [[\text{before}]] = [t. [t.q. [t'.q(t') & t'<t]}} \]

The example with the indefinite can now be analysed as in (74). The revised analysis of the predict example is given in (75) for completeness.

(74) Mary was in the US before anyone else was.

Mary's visit is before Max\(<\ (\text{min (}[t. [x[x≠Mary & \forall e[x \text{is in US in } e & \exists (e)[t]]])}) \)

(75) Mary was born before I had predicted that she would be.

Mary's birth is before Max\(<\ (\text{min([t. [w[wR@ \to \exists e[Mary is born in } e & e≤w & \exists (e)[t]])}) \)

The behaviour of negation can be derived from this semantics. The unacceptability of the example below follows from the fact that there is no earliest minimal before-clause time.

(76) * Mary was in the US before no one else was.

(77) [[no one else was in the US ]] = [t. [t.x[x≠Mary & \forall e[x \text{is in US in } e & \exists (e)[t]]]

Intervals into which no US visits fall
there are no shortest such intervals - min may be undefined (dep. on nature of scale).
there may not be a beginning of an earliest such interval - Max\(<\ may be undefined

This is not necessarily so, as illustrated below.

(78) I will stop before no one listens anymore.

= I will stop before the last member of the audience stops listening
= I will stop before z3

4 Remember that 'min' here means 'shortest' - a different ordering relation altogether.
3.1.3. Remarks on Differences to Heim's Analysis of Comparatives

In accordance with the theories presented in section 2, we adopt the idea that the subordinate clause describes intervals into which the relevant 'points' fall. Points are given by eventualities (not degrees); they are related to intervals via their run times. Quantifiers are interpreted within the subordinate clause. Unlike Schwarzschild & Wilkinson's analysis, and like Heim's, the analysis above ultimately compares points. But, unlike under Heim's analysis, this not achieved through semantic reconstruction. We use a process of selection instead: from the interval (=set of points) described, a particular point is selected, and that point is then compared. Note that for before-clauses, semantic reconstruction is implausible because the type of times is not that of a set of eventualities. Replacing semantic reconstruction with selection of point from interval is a first important difference to Heim's strategy.

A second important difference is that we took the place of the shifter from points to intervals, ASP, to be fixed. ASP occurs in the Logical Form just above the VP. The analysis above derives the meaning for apparent narrow scope operators without changing the relative scope of quantifier and shifter. This, I think, is the plausible strategy here; a scope solution is implausible because (i) ASP normally wouldn't take variable scope, (ii) the standard semantics of the modal wouldn't fit, and (iii) we would run into ontological problems. The three points are illustrated below. Remember our example for apparently narrow scope have to:
(80) a. Mary was in the US before she had to be.

b. there is a time at which Mary was in the US that is earlier than the earliest time such that Mary is in the US then in all worlds compatible with the requirements; i.e. Mary is in the US earlier than the latest time compatible with the requirements.

A Logical Form that has the shifter, ASP, move across the quantifier to take wide scope (in analogy to Pi in than-clauses) would look as follows:

(81)  [ before [ ASP [[e[ have-to [ Mary be in the US (e) ]]]]]

[ [[ Mary be in the US ]] = [e'. Mary is in US in e']

[ [[[e[ have-to [ Mary be in the US (e)]]]]] = [e. wR@ -> Mary is in US in e & e≤w]

In order for this LF to be interpretable, the modal has to combine with predicates of events, not propositions (because we have not 'shifted' to intervals yet). This requires a new semantics for 'have to' which I will not attempt to provide. Moreover, the output of have to and input to ASP is a set of events, and I take them to be the be_in_the_US-events of the complement of have to. BUT: an event e cannot be part of all relevant worlds (this is the empty set of events as soon as we have more than one world). Thus I think a scope analysis needs to be abandoned for before-clauses.5

We examine the have to case more closely in the next subsection.

3.2. Two Refinements

The following two refinements of the selection analysis concern types of data that are parallel in before- and than-clauses. A motivated analysis from the temporal comparisons will help us with apparently problematic facts in comparatives.

3.2.1. 'Have to'- type modals and Exhaustification

5 Note that a semantics along the lines of Hacquard (2006) might make such LF structures possible in terms of semantic types. I believe that we would still encounter the semantic problem pointed out here because of the binding of the event variable across the modal.
The informed reader will have noticed that we left out *have to* in our above analysis of apparent narrow scope quantifiers. This is because *have to* looks problematic at first sight in that it does not quite fit the selection strategy as developed so far.

(82) Mary was in the US before she had to be.

(83)  \[
\begin{align*}
[[\text{XP}] &= \Box w. \Box t. \Box e [\text{Mary is in US in } e \& e \leq w \& \Box (\text{e})[t] \\
[[\text{TP}] &= \Box t. \Box w [\text{wR} \rightarrow \Box e [\text{Mary is in US in } e \& e \leq w \& \Box (\text{e})[t]]
\end{align*}
\]

intervals into which in all worlds compatible with the requirements, Mary's visit falls
The end of the smallest such interval is later than Mary's actual visit.

We could view the interpretation of 'have to'-type modals in *before*-clauses as pragmatic flexibility in choosing a particular time (cf. Beaver & Condoravdi). Instead of choosing the beginning, we may alternatively choose the end of $\min([\text{before-clause}])$. The possibility is seen in (84). With this, the behaviour of *have to* follows.

(84) You care for a horse long after you have owned it. (Beaver & Condoravdi)

    = long after the end of your ownership

It is easily possible to allow selection of the latest part of the *before*-clause interval instead of the earliest by changing the ordering relation for Max from '<' (temporal earlier) to '>' (temporal later). This begs the question, however, of just why 'have to'-type modals should choose the end point rather than the beginning, like all the rest. It also does not go with the idea that informativity dictates which ordering relation matters.

Krasikova (to appear) examines the problem of 'have to'-type modals in comparatives. She observes that the universal modals that give rise to the apparent narrow scope reading (=the 'before the end' reading under the present view) are just the ones that occur in sufficiency modal constructions (SMC). An example is given below (von Fintel and Iatridou (2005)).

(85) You only have to go to the North End (to get good cheese).
(85') Truth conditions: You do not have to do anything more difficult than to go to the North End (to get good cheese).

Implicature: You have to go to the North End or do something at least as difficult (to get good cheese).

Krasikova argues that the use in the SMC shows us about a modal that it (i) considers alternatives to the proposition that is the complement of have to, and (ii) ranks those alternatives on a scale. The alternatives for our example and their ranking are given below. They provide the value for the resource domain variable of only, C, in (87). This gives us the desired truth conditions.

(86) a. {that you go to the North End, that you go to New York, that you go to Italy}⁶
b. NE<NY<Italy (where '<' means: is easier than)

(87) [ only (C) [have to [ you go to the North End ]]]
For all p such that p is in g(C) and NE < p: ~ [[[have to]] (p)

Krasikova further suggests that such modals can equally well use Fox's (2006) covert exhaustivity operator Exh, whose meaning is basically the same as 'only'. This is what happens in our comparatives. Exhaustification of the than-clause reduces the than-clause interval to a point. This explains the reading that have to gives rise to in comparative than-clauses.

We apply her analysis to before-clauses below. The temporal interval is reduced to a point, so that selection is trivial.

(88) a. Mary was in the US before she had to.
   = Mary was in the US before she Exh had to.
   b. [[[ (before) she Exh had to be in the US ]]] =
   \[t. she didn't have to do anything more difficult than to be in the US at t

I take the alternatives to be as in (89) below, with the indicated ranking. This derives the desired meaning of (88) in combination with the regular Max< strategy, because the argument of Max< is already reduced to a point - the minimal compliance time.

---

6 Remember that von Fintel & Iatridou's paper was written at MIT. Personally, I would prefer to buy cheese in Italy.
(89) \{\text{she be in the US at } t_1, \text{ she be in the US at } t_2, \text{ she be in the US at } t_3, \ldots\}

If the temporal order is \( t_1 < t_2 < t_3 \ldots \) then:

\text{she be in the US at } t_1 > \text{ she be in the US at } t_2 > \text{ she be in the US at } t_3 > \ldots

(where > means: is harder; arriving earlier is more difficult)

(90) \[
\min(l. \text{ she didn't have to do anything more difficult than to be in the US at } t) = \{\text{the end point of the acceptable time frame}\}
\]

This is our, or rather, Krasikova's, answer to the problem posed by 'have to'-type modals. The problem is only apparent. These modals behave scopally like other operators, but they relate to a scale of alternatives. Access to a scale of alternatives permits exhaustification, which reduces the subordinate clause interval to the minimal point. SMC use identifies the relevant modals independently as the ones to have such access. The approach explains which modals give rise to the apparent narrow scope/'before the end' readings. It uses nothing we would not need for independent reasons.

3.2.2. Granularity and Differentials

We now take a closer look at differentials in before-clauses. We note first that not all differentials fit all circumstances. I call this granularity here.

(91)

a. I got home 5 seconds before the thunderstorm came.

b. \# I got home 5 seconds before the thunderstorm gradually drew closer.

c. I got home long/hours before the thunderstorm gradually drew closer.

(92) before with a differential:

\[
[[\text{main clause} \ [\text{differential before} \ [\text{MaxR} \ [\text{min} \ [\text{before-clause}]]]]]]
\]

\[
[[\text{before}]] = \lceil t_{\text{diff}} \rceil \quad q(t) & t' + t_{\text{diff}} = t
\]

The differential measures the temporal distance from the time "point" referred to in the matrix to the time "point" referred to in the before-clause. What counts as a "point" depends on context. The granularity used in the differential must combine sensibly with the granularity supposed to be relevant in the before-clause. Another example that illustrates the same thing is given below. (93b) is strange even though the beginning of John's French-learning can be quite well-defined (say, the beginning of his first semester's first lesson).
(93)  a. We went to France before John learned French.
    b. ?? We went to France exactly 7 weeks before John learned French.
    c. We went to France exactly 7 weeks before John started to learn French.
    d. (?) We went to France several months before John learned French.

We need to be slightly more precise about our definition of 'begin' to analyse this effect. I make use of Schwarzschild's (1996) definition of a cover as a division of an entity into its contextually relevant parts, and apply it to time intervals. Covers provide the relevant granularity, and (95a) is revised to (95b).

(94)  \[ \text{Max}_< (I) := \text{begin} (\text{max}_< (I)) = \text{the beginning of the time interval that begins earliest} \]

(95)  a. \[ \text{begin}(I) = [t.t \in I \& \sim [t'[t' \in I \& t' < t] \& t \text{ counts as a point at the contextually relevant level of granularity} \]
    b. Let Cov(T) be the set of time intervals of the contextually relevant size.
       \[ \text{begin}(I) = [t.t \in I \& \sim [t'[t' \in I \& t' < t] \& t \in \text{Cov}(T) \]

The relevant granularity level for (93) is, let's say, semesters. Then, Cov(T) contains semester intervals, and Max_<(I( (before) John learned French))) is the first semester of his study. To be concrete, let us suppose that this is the summer semester of 2004. This results in a **granularity clash**: the derived truth conditions in (96) make no sense, since the time of our France visit plus 7 weeks cannot result in a semester long interval. I go through a similar reasoning with the thunderstorm example below.

(96)  # there is a t: we went to France at t & t + 7 weeks = |-- SS 2004 --|

(97)  a. I got home 5 seconds before the thunderstorm came.
    b. # I got home 5 seconds before the thunderstorm gradually drew closer.
    c. I got home long/hours before the thunderstorm gradually drew closer.

(98)  a. 'the thunderstorm came' determines a short time span.
    Cov(T) can be a division of an interval spanning (say) a couple of minutes.  
    5 seconds is appropriate to determine an element in this division.
b. 'the thunderstorm gradually drew closer' takes (say) an hour.
   Cov(T) has to be reasonable division of one hour.
   5 seconds is too short to determine an element of such a coarse division.

We observe something like the following restriction on the combination of a before-clause with a differential:

(99) a. Main Clause Differential before I
    b. for all U \in \text{Cov}[I]: U < \text{Diff}
       \text{Max}(I) < \text{Diff}

The reasoning works under the assumption that the Cover, and therefore the unit that counts as 'maximal point', is determined locally, i.e. before-clause internally.\(^7\)

With this in mind, we reconsider universal NPs in before-clauses. We observe that a differential combined with a quantifier in the before-clause leads to an assumption of simultaneity in the examples below. That is, the spread over a genuine interval induced by the quantifier collapses into a point. The effect does not occur with indefinites.

(100) Mary was born exactly 2 weeks before everyone else was born.
     -> simultaneity assumption: everyone else was born at the same time!

(101) Mary was born exactly two weeks before I had predicted that she would be.
     -> simultaneity assumption: Is this ok if I predict a time span of 2 weeks? I think not.

(102) Mary was born exactly 2 weeks before anyone else was born.
     -> no assumption of simultaneity!

\(^7\) A similar effect can be observed with Covers in the plural domain in examples like (i) below.

(i) a. The women and the men love their child.
    b. The Smiths and the Johnsons love their child.

Suppose we are talking about Angelina and Reginald Johnson and Mary and John Smith. Then the two subjects in (ia) and (ib) refer to the same group, but make different covers salient (Schwarzschild (1996)). By virtue of the cover suggested by the subject, (ia) tends to be understood as 'the women love their child and the men love their child', which is unexpected. (ib) amounts to 'the Smiths love their child and the Johnsons love their child', which is more expected. The point is that
With many universal quantifiers, a differential works only under an assumption of simultaneity of the individual subevents. Note that this amounts to the interpretation we would get if the quantifier took widest scope, and hence poses a problem for my attempt to interpret the quantifier before-clause internally.

(102') For all x≠Mary: Mary was born exactly 2 weeks before x was born.

I think that granularity offers an explanation for this effect, which I call SimAss for 'simultaneity assumption'. Consider the situation depicted below for (100). If the births are far apart, this might indicate a coarse-grained cover (as in the example 'before the thunderstorm gradually drew closer'). A reasonable division of |-- x1 - x5 --| would be into relatively long units, hence Max< is long. This would be incompatible with the differential - a granularity clash. Thus the sentence only makes sense if the births are close together. But that is exactly the SimAss.

(103) ----M-------------x1-----x2---------x3----x4-----------x5----------->

min([[ (before) everyone else was born]]) = {|-- x1 - x5 --|}

Quite generally, remember that the semantics of the before-clause itself indicates possible Covers. Their granularity may agree with the differential only under an additional assumption of temporal closeness of the individual events covered by the before-clause interval, SimAss. My suggestion is that if a granularity clash could only be avoided under an additional assumption of temporal closeness, one tends to assume simultaneity and a default Cover of the before-clause interval I in terms of the singleton set {I}. Things are different with the existential. There is no danger of a granularity clash in the first place, and no extra assumptions arise.

(104) min([[ (before) anyone else was born]]) = {x1, x2, ..., x5}

this indicates a more fine-grained cover -- Max< is short (the run time of the first birth)

There are examples with universal quantifiers in before-clauses where there is no SimAss. Two are given below. In both examples, there is no simultaneity effect where all the times that the before-

the subject group autonomously makes salient a cover, whether this leads to a plausible interpretation of the whole or not.
clause talks about would collapse into one. It is also fairly clear that the intended interpretation is one that is correctly captured by the Max< strategy that I advocate.

(105) Sally got home at most 10 minutes before I had expected her to.

(105') a. My expectation: 5:00 - 5:30; Sally's homecoming: 4:52  (no simultaneity)
   b. Sally got home at most 10 minutes before the earliest time compatible with my expectations.  (Max<)
   c. # For all times compatible with my expectations: Sally got home at most 10 minutes before that time.  (wide scope)

(106) Honors students may register two business days before everyone else is allowed to register.

(106') a. Honors students can register between 08/16 and 08/30. Continuing students can register between 08/18 and 08/30. First year students can register between 08/21 and 08/30.  (no simultaneity)
   b. Honors students may register two business days before the earliest time at which anyone else is allowed to register.  (Max<)
   c. # For every x who is not an Honors student: Honors students may register two business days before x is allowed to register.  (wide scope)

We observe that the SimAss does not always arise. At such times, Max< can be a proper part of I and no additional assumption are made. Whether the SimAss arises or not varies with the example, hence there must be something contextual/pragmatic about it. A variation on the context of the before-clause 'before all the others were born' makes the Max< interpretation possible.

(107) Background: we are running an experiment concerning pregnancy duration in snow rabbits. We vary the factors that influence it (e.g. temperature, food) and run a test series with different conditions across German zoos. It is reported that:

(108) The Berlin babies were born exactly 7 days before all the others were born.  (Max< possible)
I propose that in an uninformative context, where no expectation exists as to the length of the interval described by the *before*-clause, a SimAss arises. This can be explained as granularity panic: we make an extra assumption that ensures that the Cover is such that its Maximum unit is suitable for combination with the differential. When there is a richer context that leads to an expectation about the *before*-clause interval (everything is close together within a certain range), no such panic arises. We can peacefully choose Max < in the conviction that all will be well.

### 3.3. Section Summary

We learn from this investigation of quantifiers in *before*-clauses the following things:

(i) An interval analysis receives independent support. There hardly seems a reasonable alternative in the case of quantifiers in *before*-clauses.

(ii) Quantifiers must take wide scope relative to the operator that introduces intervals, the ASP head. Thus the different readings that we observe cannot be the result of scope interaction.

(iii) Instead, there is a selection mechanism that chooses from the *before*-clause interval a 'point', which is then temporally compared to the time of the matrix clause.

(iv) Pragmatic factors affect 'point' selection (exhaustification, granularity). They produce the different interpretations that we observe.

The next section carries this analysis over into the domain of comparatives.

### 4. Analysis: Partially Pragmatic Selection

We now apply the selection analysis of *before*-clauses developed in the previous section to *than*-clauses. This is motivated by the striking empirical parallels between the two, cf. sections 2.1. and 3.1. Subsection 4.1. discusses the cases that prove fairly straightforward, given what has been said above, including 'have to'-type modals and differentials. Subsection 4.2. addresses a remaining problem for the simple selection strategy, numeral NPs. We will see that a more careful theoretical analysis of the numeral NPs will allow us to reconcile their behaviour with the selection strategy. Ultimately, I will defend the selection strategy for *than*-clauses and the analogy to *before*-clauses.

### 4.1. Extending the Selection Analysis
4.1.1. Simple Cases

The selection strategy for before-clauses formed the minimal subordinate clause interval(s) and then chose the maximum 'point' from that. Application of the same idea to a than-clause with a universal NP is illustrated below. We use Heim's interpretation of the than-clause, but in a second step apply selection instead of semantic reconstruction. Selection yields the maximum in terms of informativity relative to the ordering relation linguistically given - temporal 'earlier than' in the case of before and 'larger than' on the size scale in the case of taller.

(109)  

a. John is taller than every girl is.

b. For every girl \( x \): John's height exceeds \( x \)'s height.

(109') \( [[[\text{than} [1[\text{every girl} [2[ [\text{Pi t1}] [3[ t2 is t3 tall]]]]]]]] = \) \[D'. \forall x[\text{girl}(x) \rightarrow \text{Height}(x) \in D'] \]

intervals into which the height of every girl falls

(110) John is taller than Max\( > (\min ( [\text{than-clause}])) \)

(where > is the 'larger than' ordering on the height scale)

\[ = \text{John is taller than the height of the tallest girl} \]

(111) - (113) below provide the relevant definitions, in analogy to the ones from the temporal domain.

(111) \( \min(p<,d,t>,t>) = [D.p(D) \& \sim[D'[D\in D \& p(D')]]] \) (shortest p intervals)

(112) a. ordering of degree points: \( d>d'' \)

\( d \) is larger than \( d'' \)

b. ordering of intervals: \( I>J \iff \exists d[d\in I \& \sim[d'[d'\in J -> d>d']]] \)

\( I \) extends beyond \( J \)

8 If Fox & Hackl are right that natural language scales are always dense, then we need to identify "points" on the degree scale by some extra mechanism, e.g. as it will be done here with a Cover providing the relevant level of granularity. Then, there need no longer be a difference in semantic type between degrees and intervals. The definition of 'end' below would then look as in (i).

(i) \( \text{end}>(D):= [\exists d\in D \& \sim[d'[d\in D \& d>d']] \) (dense scale)

\( d \) counts as a point at the relevant level of granularity
We straightforwardly derive the desired meaning. Other universal quantifiers and existentials can be treated in the exact same way. Note that with the existential, the nominal quantifier also takes scope over the shifter - there is no longer scope interaction.

(114) a. John is taller than I had predicted (that he would be).
    b. For every world compatible with my predictions:
       John's actual height exceeds Johns height in that world.

(114') [[[than [1[I had predicted [CP [Pi t1] [2[AP John t2 tall]]]]]]]] =
   \[D'. \forall w[wR@ -> John's height in w \[D']
   intervals into which John's height falls in all my predictions

(115) John is taller than Max$_\succ$ (min ([[than-clause]]))
    = John is taller than the height according to the tallest prediction

(116) a. Mary is taller than anyone else is.
    b. Mary's height exceeds the largest degree of tallness reached by one of the others.

(116') [[[than [1[any one else [2[ [Pi t1] [3[ t2 is t3 tall]]]]]]]]] =
   \[D'. \forall x[x\neq Mary \& max(I.d.x is d-tall) \[D']
   intervals into which the height of someone other than Mary falls

(117) Mary is taller than Max$_\succ$ (min ([[than-clause]]))
    = Mary is taller than the height of the tallest other person.
We assume that the shift (here Pi) always occurs next to the adjective, before we encounter the quantifier - in analogy to ASP above. The selection strategy predicts the right truth conditions for the 'apparent narrow scope' and the 'apparent wide scope' quantifier data without changing scope. This allows us to predict ungrammaticality of negation straightforwardly, as illustrated below.

(118) * John is taller than no girl is.

(118') [[than [1[no girl [2[ [Pi t1] [3[ t2 is t3 tall]]]]]]]] =
\[D'. \text{ for no girl } x: \max(\[d.x \text{ is } d\text{-tall}] \[D']

intervals into which the height of no girl falls

There may not be minimal such intervals - min may be undefined (depending on the nature of the scale). At any rate, Max is undefined; hence negation in the than-clause leads to undefinedness. We no longer face the problem of when to expect which scope interpretation.

4.1.2. 'Have to'-type Modals

The analysis extends to the puzzling case of 'have to'-type modals if we adopt Krasikova's analysis of them. Remember from sections 2 and 3 that modals like have to appeared to trigger a minimum interpretation rather than a maximum interpretation, in than-clauses as well as before-clauses.

(119) a. Mary is taller than she has to be.
   b. Mary's actual height exceeds the degree of tallness which she has in all worlds compatible with the school rules;
   i.e. Mary's actual height exceeds the required minimum.

(119') [[than [1[have to [XP [Pi t1] [2[AP Mary t2 tall]]]]]]]] =
\[D'. \[w[wR@ -> Mary's height in w \[D']

intervals into which Mary's height falls in all worlds compatible with the rules

the \textbf{beginning} of this interval is below Mary's actual height

Krasikova explains this interpretive effect by claiming that internal to the subordinate clause, exhaustification occurs. The subordinate clause interval is thus reduced to a point. The 'point' that
exhaustification yields the minimum compliance height. Selection is then trivial. This is demonstrated for our example below. (120) is the Logical Form with exhaustification. The relevant alternatives are given in (121) along with their difficulty scale. Just like the alternatives varied regarding the time interval in the case of before-clauses, they vary with respect to the degree interval in the case of than-clauses.

(120) \[ [\text{[than [1[Exh have to [XP [Pi t1] [2[AP Mary t2 tall]]]]]]] } = \[\emptyset'\text{.nothing more difficult is required than for Mary's height to fall within D'}] \]

(121) \{\emptyset w.\text{Mary's height in w[D1}, \emptyset w.\text{Mary's height in w[D2}, \emptyset w.\text{Mary's height in w[D3},...\}
If the ordering in terms of height is D1<D2<D3 ... then:
\emptyset w.\text{Mary's height in w[D1} < \emptyset w.\text{Mary's height in w[D2} < \emptyset w.\text{Mary's height in w[D3} < ...
(where < means: is easier; it is easier to be shorter rather than taller.)

This yields the meaning below for the subordinate clause, the minimum 'point' as desired. Selection with Max$>$ is trivial; the resulting meaning is that Mary's actual height exceeds the minimum compliance height.

(122) \( \text{min(}{\emptyset D.\text{nothing more difficult is required than for Mary's height to fall within D})} \)
\( = \{\text{the minimum compliance height}\} \)

In sum, transferring the analysis from before-clauses to than-clauses leads to a pleasingly homogenous picture for the than- and before-data. We select a point from an interval via Max$R$; with have to, we apply Max$R$ after exhaustification. R is given by -er or before. That this is the relevant ordering relation may be derived from informativity. We keep Schwarzschild & Wilkinson's intervals and we keep Heim's shift idea, but the shifter always takes local scope. The interpretive behaviour of our operators including ungrammaticality of negation is predicted.

4.1.3. Differentials

Data like (123) below appear to cast a shadow on this pretty picture.

(123) a. John is exactly 2" taller than every girl is.
b. for every girl x: John is exactly 2" taller than x.
Compared to Heim, and also Schwarzschild & Wilkinson, we have a problem. They derive the intuitive interpretation, as shown below for Heim's analysis.

\[(123') \quad [\{\text{than }[1[\text{every girl }[2[\text{Pi t1}][3[\text{t2 is t3 tall}]]]]]]\} = \square'D'. \square x[\text{girl(x) }\rightarrow \text{Height(x) }\square'D']\]

intervals into which the height of every girl falls

\[(124) \quad [\{123a\}] = [\square'D'. \square x[\text{girl(x) }\rightarrow \text{Height(x) }\square'D'] (\square d. \text{John is 2" taller than d})]
= \text{for every girl x: John is 2" taller than x}\]

Choice of Max on the other hand makes the wrong prediction:

\[(125) \quad \text{John is 2" taller than Max}(\min([\text{than-clause}]))
= \text{John is 2" taller than the tallest girl.}\]

However, a closer look at the data reveals that there is more to say about this issue. The intuitively available reading of (123a) can be described as one in which we assume that all the girls reach the same height. I call this an assumption of equality among the individuals universally quantified over, EqAss, in analogy to SimAss above. The EqAss appears to speak in favour of a scope solution. However, the EqAss does not always arise. Below are several examples where it doesn't; (127) and (128) are collected from the internet.

\[(126) \quad \text{Ich verdiene ziemlich genau 500 Euro weniger als alle meine Kollegen.}
= \text{I make just about 500 Euros less than everyone else in my department.}
(\text{Some even earn 1000 Euros more than I do.})\]

\[------------------SB---------|\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\]
Note that while 'normal' comparatives appear to be a problem for the selection strategy (in that I have not yet demonstrated how to derive the additional EqAss meaning component), the data above are a problem for the scope strategy (since EqAss would be predicted for them too). The three examples just mentioned use MaxR as expected from the selection analysis to determine the relevant 'point' provided by the than-clause. The differential measures the distance between that and the main clause degree. This is demonstrated for (128) below.

\[(128')\]
\[
a. \quad \# \quad \text{For all } x, x \neq Z: (Z \text{ was}) \text{ almost 4 seconds faster than } x \quad \text{(wide scope)}
\]
\[
b. \quad \# \quad Z \text{ was almost 4 seconds faster than the maximum speed reached by everyone else} \quad = Z \text{ was almost 4 seconds faster than the slowest other person.} \quad \text{(narrow scope)}
\]
\[
c. \quad (Z \text{ was}) \text{ almost 4 seconds faster than } \text{Max}_{\geq}(\min(D', \text{ for all } x \neq Z: \text{Speed}(x) \in D')) \quad = Z \text{ was almost 4 seconds faster than the next fastest person.} \quad \text{(Max}_{\geq})
\]

I do not see how the scope analysis can predict the right semantics for (126)-(128). I would like to ask the reverse question of how the selection analysis might predict not only (126)-(128), but also (123). To this effect, I propose to extend our analysis of SimAss in before-clauses to EqAss in than-clauses. This amounts to the suggestion that without an informative context, there is a danger of a granularity clash. The danger is avoided by the EqAss.

Let us assume that it is (at least) not guaranteed that points can be uniquely identified on a given scale (this would follow directly from Fox & Hackl's (2007) ontology; see also Krifka (2007)). A unit on the scale then has to be identified that can count as a 'point' at the contextually relevant level of granularity (a suggestion independently developed by van Rooij (2007)).\footnote{Van Rooij also makes use of granularity in the semantics of than-clauses with quantifiers. His application of this idea, however, is rather more general, in that a whole than-clause like 'than every girl is (tall)' would always denote a 'point' in order to be comparable with the main clause degree.}

This is done here with the help of the notion of a cover. We revise the definition of an 'end' point accordingly. The level of granularity relevant for the than-clause has to make sense in relation to the differential, just as before.

\[(129)\]
\[
a. \quad \text{end}_{\geq} (D):= [d.d[D & \sim[d'[d'[D & d'>d] & d \text{ counts as a point at the relevant level of granularity}}
\]
\[
b. \quad \text{Let Cov be the set of intervals that are of the contextually relevant size.} \quad \text{end}_{\geq} (D):= [d.d[D & \sim[d'[d'[D & d'>d] & d \in \text{Cov}}
\]
Note that the \( \text{Max}_> \) data above are all of them such that we have a rather clear expectation about the kind of interval denoted by the \textit{than}-clause - the range within which the individual degrees fall is fixed. The context is rich, and no granularity panic arises. Thus a \( \text{Max}_> \) interpretation is possible. This is not so in our original example (123). We suppose that similar to the examples with \textit{before}-clauses, granularity panic leads to \text{EqAss}: to supposing that the 'points' that are in danger of being spread over too large an interval in fact collapse into one. We expect that it should depend on the amount of information available on the interval covered by the \textit{than}-clause whether we get an \text{EqAss} interpretation or a \( \text{Max}_> \) interpretation. Additional information to the effect that the points are not the same, but close enough together for the purposes of the differential, may make the \text{EqAss} unnecessary and thus make a \( \text{Max}_> \) interpretation possible for our \text{EqAss} data. This appears to me to be correct:

Background: we are running an experiment in which we vary the growth conditions of seedlings. In particular, we test different fertilizing agents (ViagraFlor, Dung\textsuperscript{TM}, ComposFix and GuanoPlus) and their effect on how fast our seedlings grow. After two weeks, it is reported that:

The ComposFix seedlings are exactly 2" taller than all the others.  \( \text{(Max}_> \) possible)
We see that minimal pairs can be found that have essentially the same comparative (differential plus comparative adjective plus than-clause) but differ as to informativity of background context regarding the than-clause interval. An uninformative context makes us assume that the interval is small, so that MaxR will be well defined and suitable - EqAss. If we have enough background information to be sure that the MaxR unit in the than-clause interval is suitable, we do not panic, make no extra assumptions, and can get a normal MaxR interpretation as expected.

I conclude that the selection strategy is superior to the scope strategy in dealing with differential comparatives. The scope strategy would invariably expect the interpretation that we call EqAss. But it depends on context whether this is the interpretation that we get, and the selection strategy can explain this.

### 4.2. Indefinites and Numeral NPs

Another important apparent problem for the selection strategy is illustrated by the example below.

(134) John is taller than exactly five of his classmates are.

= exactly five of John's classmates are shorter than he is.

≠ John is taller than the tallest of his 5 or more classmates.

The intuitively available interpretation looks once more like a straightforward wide scope reading of the numeral quantifier. Application of the selection strategy predicts an interpretation that is unavailable. We face the combined challenge of (i) predicting the right interpretation and (ii) not predicting the non-existing one.

(135)  D'. for exactly 5 x: max( [d.x is d-tall] D')

intervals into which the height of exactly 5 classmates falls

Max>(min([D'. for exactly 5 x: max( [d.x is d-tall] D')])) =

the height of John's tallest classmate, as long as there are at least 5

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I propose to tackle this problem through a more thorough analysis of numeral NPs. We will first consider indefinite NPs in the context of than-clauses and then move on to numerals and example (134).

4.2.1. Singular and Plural Indefinites

Singular indefinites allow in principle two interpretations in than-clauses: an apparent wide scope and an apparent narrow scope reading. Which reading(s) is/are possible depends on the indefinite as well as the sentence context. We have seen examples with NPIs in which the narrow scope reading is available. An example that has a wide scope reading is given in (136), (137) and (138) provide two examples which I take to be genuinely ambiguous.

(136)  a. John is taller than one of the girls is.
    b. There is a girl x such that John is taller than x.

(137)  Annett hat lauter gesungen als eine Sopranistin.
        Annett has louder sung than a soprano
        Annett sang more loudly than a soprano did.

(137') a. There is a soprano x such that Annett sang more loudly than x.
    b. Annett sang more loudly than any soprano did.

(138)  Sveta solved this problem faster than some undergrad.

(138') a. There is an undergrad x such that Sveta solved this problem faster than x.
    b. Sveta solved this problem faster than any undergrad did.

For NPI examples it was demonstrated how the selection analysis can derive an appropriate interpretation corresponding to the apparent narrow scope reading. What about the apparent wide scope reading? One option open to us is to acknowledge that indefinites quite often give rise to apparent wide scope readings - so-called specific readings - and to adopt whatever mechanism is available for the analysis of specific readings in general for apparent wide scope indefinites in than-clauses. This is what I will do, and I use the choice function mechanism (e.g. Reinhart (1992), Kratzer (1998)). Furthermore, I will assume that indefinite NPs e.g. with English some (and
German *ein ('a')*) are ambiguous between the 'normal' interpretation \( \exists x \) (existential quantification over individuals) and the 'specific' interpretation \( \exists f \) (existential quantification over choice functions). Below I provide a selection analysis of the two readings of (138) under those assumptions. I further assume that the usual factors (in particular, the nature of the indefinite and what readings the sentence context permits) decide when we can get which reading(s) of a singular indefinite.

(139) \[ [\text{than [I some undergrad did solve this problem t1 fast]]} ] \]
\[ = [D', \exists x[\text{undergrad(x) & max( d.x solved P d-fast) D}']] \]
intervals that cover the speeds of problem-solving undergars

Sveta solved P faster than
\[ \text{Max}_{>}(\min([D', \exists x[\text{undergrad(x) & max( d.x solved P d-fast) D}']])) \]
= Sveta solved P faster than the fastest undergrad.
= Sveta solved this problem faster than any undergrad did.

(140) \[ [\text{than [I some undergrad did solve this problem t1 fast]]} ] \]
\[ = [D', \max( d. f(\text{undergrad) solved P d-fast) D}] \]
intervals that include the speed of the problem-solving undergrad selected by f

\[ f: \text{CH(f) & Sveta solved P faster than} \]
\[ \text{Max}_{>}(\min([D', \max( d. f(\text{undergrad) solved P d-fast) D}']))) \]
= Sveta solved P faster than the undergrad selected by f (f a choice function).
= There is an undergrad x such that Sveta solved this problem faster than x.

Matters are different with plural indefinites. In (141) we only get an apparent wide scope reading - in our terms: only the \( \exists f \) interpretation seems available. We can confirm this with the German example (142), where the obligatorily weak *lauter (several/many)* sounds very strange. Only *einige (several)* is acceptable, under an apparent wide scope reading.

(141) a. John is taller than some girls.
    b. There are some girls X such that John is taller than each member of X.

(142) Annett hat *lauter* gesungen als *einige/lauter* Sopranistinnen.
Annett has sung louder than several sopranos.
Annett sang more loudly than several sopranos.

Why should the normal $\Box X$ interpretation of (141) be unavailable? Careful consideration as to what it would mean, (143a), reveals that (given that there is more than one girl) it would be true iff the sentence with the singular $\Box x'$ (‘some/any girl’) would be true. I suggest that this makes the interpretation (143a) somehow inappropriate for the example. Perhaps this can be seen as a matter of economy: the plural has no purpose, hence cannot be used gratuitously. (144) is a first shot at what the relevant constraint might effect. The reading that survives, (143b), is one in which, compared to the corresponding singular indefinite, the plural serves a purpose.

(143) a. # John is taller than

$$\text{Max}\rangle (\min(\Box D'. \Box X[*\text{girl}(X) \& \Box x\Box X: \text{max}(\Box d.x \text{ is } \text{d-tall}) \Box D')))$$

= John is taller than any girl.

b. $\Box f$: CH(f) & John is taller than

$$\text{Max}\rangle (\min(\Box D'. \Box x f(*\text{girl}): \text{max}(\Box d. x \text{ is } \text{d-tall}) \Box D')))$$

= John is taller than each of the girls selected by f (f a choice function)

(144) Ban on Un-Motivated Pluralization (BUMP):

Pluralization of a noun, $^*N$, in a structure S is not permitted if there is no truth conditional difference to the non-pluralized N in S.

To sum up: indefinites are semantically ambiguous, and this shows up in than-clauses just like it does elsewhere. Apparent wide scope of indefinites is analysed as pseudoscope. Sometimes one interpretation is excluded by independent factors. For example an economy constraint like the BUMP rules out $\Box X'$ for plural indefinites in than-clauses. Conversely, NPIs in than-clauses will only be licensed on the apparent narrow scope reading $\Box x'$ (perhaps they have no $\Box f'$ interpretation, or perhaps that interpretation would fail to satisfy their requirements on their context, cf. Lahiri (1998)). This makes the interesting prediction that plural NPIs should be odd in than-clauses, and indeed they are. (145b) is degraded compared to (145a) and (145c).

(145) a. John solved this problem faster than any girl did.

b. ?? John solved this problem faster than any girls did.

c. John solved this problem faster than any of the girls did.
4.2.2. Numerals

With these results regarding indefinites in mind, let us next be somewhat more precise in our semantic analysis of 'exactly n' (compare Hackl (2000, 2001), Krifka (1999) on the semantics of such NPs). A simple example is discussed in (146). 'Exactly n N' comes apart into an indefinite 'n N' and an independent operator 'exactly'.

(146) a. Exactly three girls weigh 50lbs.
   b. \[ \text{max}(\exists n. \exists X[ \text{girl}(X) \& \text{card}(X)=n \& *\text{weigh}_{50lbs}(X)]) = 3 \]
   'the largest number of girls each of which weighs 50lbs is three.'

This step does not immediately solve our problem. If we give the than-clause in (134) the semantics in (147), nothing changes: we still compare with the tallest of John's classmates, as long as there are at least five. Notice, however, that this interpretation is just as strange as the plain plural indefinite \[ \exists X \] interpretation above, since the number information serves no real purpose for the truth conditions.

(147) \[ \text{max}(\exists n. \exists X[ \text{classmate}(X) \& \text{card}(X)=n \& *\text{Height}(X) \exists D']) = 5 \]
   Intervals into which the height of exactly five of John's classmates falls

(148) John is taller than
   \[ \text{Max}_{>}(\text{min}(\text{max}(\exists n. \exists X[ \text{classmate}(X) \& \text{card}(X)=n \& *\text{Height}(X) \exists D'])=5)) \]

(148') Psp: John has at least five classmates.
   Ass: He is taller than any of them.

Let us suppose that it is ruled out by the same constraint BUMP. We should then alternatively consider a choice function analysis of the indefinite 'n classmates'. I combine this below with the assumption that 'exactly 5' is evaluated in the matrix clause. In (149), we derive the desired interpretation.

(149) \[ \text{max}(\exists n. \exists f[ \text{CH}(f) \& \text{John is taller than} \text{Max}_{>}(\text{min}(\exists D'. \exists X[f((\exists X[ \text{classmate}(X) \& \text{card}(X)=n)]:\text{Height}(x) \exists D'])=5)) \]
'the largest number n such that John is taller than the tallest of the n classmates of his selected by some choice function f is 5.'

This interpretation could be derived from a structure like (150).

(150)  [exactly 5 [\[n. John is taller [than[ n, of his classmates are tall ]]]]

This would mean that we can interpret the nominal quantifier in the than-clause, but have to interpret 'exactly 5' in the matrix. This looks like partial progress: leaving the NP quantifier inside the subordinate clause corresponds to our goals, and this is possible when the selection analysis is combined with a choice function analysis of the indefinite. But the 'exactly' constituent must still take scope over the comparison. How is it possible for that constituent to do so? It looks like 'exactly n' must leave the than-clause and our problem of violated scope constraints resurfaces here until we remember Krifka's (1999) arguments that expressions like 'exactly', 'at least' and 'at most' are interpreted via an alternative semantics. The evaluating operator, moreover, is not the word 'exactly' itself, but a higher proposition level operator. A more proper LF representing a version of Krifka's analysis thus looks as in (151). A semantics for the operator, called ASSERT here, has to be given that derives essentially (149) above. It uses alternatives to the asserted proposition (which vary according to the numeral), as well as the asserted numeral (5 in the example). Compare Krifka (1999).

(151)  a. ASSERT  &{[John is taller [than[ n, of his classmates are tall ]]], n=5}>

b. Out of all the alternatives of the form 'John is taller than n of his classmates are, the most informative true one is 'John is taller than 5 of his classmates are'.

We know (e.g. Rooth (1985), Beck (2007)) that alternative evaluation is not sensitive to scope constraints. Thus I suggest that a proper semantic analysis of numeral NPs makes the facts compatible with a simple selection solution after all. I should note that a similar strategy for the interpretation of 'exactly n' NPs in than-clauses is pursued by Gajewski (2008). However, his goal is to improve on a Heim (2006) - style analysis of quantifiers in comparatives, which gives the quantifier semantic scope over the comparison between degrees.

4.2.3. Further Considerations
The analysis developed here for indefinite NPs in *than*-clauses needs to be extended to NPs with *many* and *most*, which show the same apparent wide scope interpretations we observed for numerals.

(152)  a. John is taller than many of his classmates are.
       b. There are many classmates of John's such that he is taller than they are.

(153)  a. John is taller than most of his classmates are.
       b. For most x, x a classmate of John's: John is taller than x.

I will make further use of the semantics developed by Hackl (2000, 2001, 2008) for these NPs, according to which 'many N' is an indefinite NP including a gradable adjective in the positive form, and 'most N' is correspondingly a superlative. This makes feasible analyses that can be paraphrased in the following way:

(152') John is taller than the tallest of the many-membered group of classmates of his selected by f (f a choice function).

(153') John is taller than the tallest of the group selected by f, which comprises a majority of his classmates (f a choice function).

More detailed analysis are given below ((154) provides the two potential readings of (152) and (155)-(157) analyse (153)). Besides being able to predict the existing readings, the BUMP constraint in (144) will rule out the ones that are intuitively unavailable.

(154)  a. # John is taller than
       \[
       \operatorname{Max}_>(\min([\square D'. \square X \left[ X \left[ \text{classm}(X) \& \text{many}(X) \& \square x \square X: \max(\square d. x \text{ is d-tall}) \square D' \right]\right] = \text{John is taller than any classmate (as long as there are many).}
       \]
       b. $ f: CH(f) \& \text{John is taller than}
       \[
       \operatorname{Max}_>(\min([\square D'. \square x f[\square X. \left[ X \text{classm}(X) \& \text{many}(X)\right]: \max(\square d. x \text{ is d-tall}) \square D'\right]\right] = \text{John is taller than each of the many classmates selected by f (f a choice function)
       \]

(155)  [[ than [1[ \square x \text{most of his classmates are t1 tall}]] ]] =
\[\square D'. \square x \square d[\text{\textasteriskcentered} \text{classm}(X) \& d\text{-many}(X) \& \square Y \square C[Y \neq X \& \text{\textasteriskcentered} \text{classm}(Y) \rightarrow \neg d\text{-many}(Y)] \& \square x \square X: \text{max}(\square \square x. \text{is d-tall}) \square D']\]

intervals that contain the heights of a majority of John's classmates

\[(156) \quad [[\text{than } 1[\varnothing, \text{most of his classmates are t1 tall}]]] = \]
\[\square D'. \square x \square f(\square X. \square d[\text{\textasteriskcentered} \text{classm}(X) \& d\text{-many}(X) \& \square Y \square C[Y \neq X \& \text{\textasteriskcentered} \text{classm}(Y) \rightarrow \neg d\text{-many}(Y)]): \text{max}(\square \square x. \text{is d-tall}) \square D']\]

intervals that contain the heights of the majority of John's classmates selected by \(f\)

\[(157) \quad \# \quad \text{John is taller than Max}_{>}(\min(\square D'. \square X \square d[\text{\textasteriskcentered} \text{classm}(X) \& d\text{-many}(X) \& \square Y \square C[Y \neq X \& \text{\textasteriskcentered} \text{classm}(Y) \rightarrow \neg d\text{-many}(Y)] \& \square x \square X: \text{max}(\square \square x. \text{is d-tall}) \square D'))\]
\[= \text{John is taller than the tallest of any majority of his classmates.}\]
\[= \text{John is taller than any of his classmates.}\]

b. \[\square f: \text{CH}(f) \& \text{John is taller than Max}_{>}(\min(\square D'. \square x \square f(\square X. \square d[\text{\textasteriskcentered} \text{classm}(X) \& d\text{-many}(X) \& \square Y \square C[Y \neq X \& \text{\textasteriskcentered} \text{classm}(Y) \rightarrow \neg d\text{-many}(Y)]): \text{max}(\square \square x. \text{is d-tall}) \square D'))\]
\[= \text{John is taller than the tallest of the majority of John's classmates selected by } f\]
\[= \text{For most } x, x \text{ a classmate of John's: John is taller than } x.\]

In order to ultimately evaluate the success of my proposals, the whole approach needs to also be extended to adverbials. I will not attempt to do so now. Other considerations concern a more detailed analysis of the various modals (including \textit{might}) and an investigation of the interaction of several scope bearing elements inside a \textit{than}-clause. I give some representative data below and acknowledge the need for future work on the subject (compare Schwarzschild \& Wilkinson (2002), Heim (2006)). Finally, I admit that I have no analysis for Sauerland's (2007) example (159), for which he provides a solution in terms of Heim's theory.

\[(158) \quad \text{a. } \text{It is hotter here today than it often is in New Brunswick.}\]
\[\text{b. } \text{It is hotter today than it might be tomorrow.}\]
\[\text{c. } \text{Sveta solved this problem faster than someone else could have.}\]

\[(159) \quad \text{Ekaterina is an odd number of centimeters taller than each of her teammates.}\]
A concluding remark concerns numerals in before-clauses. They frequently sound odd, like the example below:

(160) ?? I left the room before exactly 3 presentations were given.

\[
\text{Max}_< (\min(\exists t. \text{exactly 3 presentations given}(t)))
\]

is the beginning of the first presentation.

The interpretation we expect under the normal interpretation is that I left before any presentations were given, as long as there were at least three. This can be expected to violate the now familiar constraint BUMP on vacuous number marking. But what about an apparent wide scope reading?

(161)# Mary was born before exactly two of her classmates were born

\[
\begin{align*}
\neq & \text{she is the thirdyoungest} & \text{(apparent wide scope of 'exactly 2')} \\
\neq & \text{she is the oldest} & \text{(apparent narrow scope)}
\end{align*}
\]

In contrast to than-clauses, before clauses do not easily give rise to apparent wide scope readings of numeral NPs. I do not know why that is.\(^{10}\) Other than that, the obvious strangeness of these data support the constraint on gratuitous number marking I have relied on. I do not know whether the formulation of the BUMP in (144) will stand up to closer scrutiny; what we want to derive is that it is strange to say 'John is taller than exactly three girls are' when we might as well have said 'John is taller than any girl is'. Since this seems eminently reasonable, I am hopeful that a good way of stating the relevant constraint exists.

5. Conclusion

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\(^{10}\) One possibility one might pursue is that there is a difference between before-clauses and than-clauses in terms of discourse status. If before-clauses constitute their own assertive speech act while than-clauses do not, we expect that Krifka's ASSERT occurs below before, but at matrix clause level in comparatives. This would explain the data and support Krifka's analysis of exactly. I must leave this for another occasion.
Building on work by Schwarzschild & Wilkinson and Heim, I propose an analysis of quantifiers in than-clauses in which the quantifier is uniformly interpreted inside the than-clause. A shift from degrees to intervals of degrees makes this possible. Despite appearances, there is no scope interaction between quantifier and shifter or quantifier and comparison operator. Instead, there is uniformly selection of a point from the subordinate clause interval. Apparent scope effects like the interpretation of 'have to'-type modals and 'exactly n' NPs have been explained away via recourse to alternative interpretational strategies, which have been argued for independently of than-clauses. The strategy is motivated by the lack of clear scope interaction in than-clauses. It is further supported by the parallel behaviour of before-clauses, which are given a parallel analysis.

The analysis relies on the idea that comparison is ultimately reduced to comparison of points. It is not possible to compare intervals. One consequence of the proposal is that the semantics of the comparative operator is very simple. It is the same semantics that one needs for data like (162a), namely one in which the first argument of the comparative operator is a degree, perhaps (162c). Maximaly is still used in clausal comparatives like the ones we have discussed, but it is independent of the comparative operator.

(162) a. John is taller than 1.70m.
   b. [ [ -er [than 1.70m]] [2[ John is t2 tall ]]]
   c. [-er] = [d1.\[d2.\(d2>d1\)]

A price we pay for the simplicity is that the semantics is no longer completely determined by compositional semantics. Data with differentials could only be analysed by enriching the classical semantics with pragmatic notions (covers, contextual background). However, this aspect of the proposal is supported by contextual variability of the judgements and thus has to be part of a successful analysis.

A question raised by the analysis is whether we need the shifter Pi at all, or whether we should instead change the meaning of adjectives like 'tall'. This step would be possible here because Pi never takes scope and is always combined directly with the adjective. If we pursue further the analogy to the domain of tense, perhaps it was a mistake to think of degrees as points in the first place; the basic degrees used in natural language might be intervals.

(163) a. tall <d,<e,>>: \[d.\[x. x is d-tall]\] = \[d.\[x. x's height \leq d]\]
   b. tall <<d,,><e,>>: \[D.\[x. \max(\[d.x is d-tall]) \[D]\] = \[D.\[x.x's height \[D]\]
Before this can be decided upon, we need to combine the interval analysis with an analysis of antonyms, something I haven't attempted here.

References


Fintel, Kai von & Sabine Iatridou (2005). What to do if you want to go to Harlem. Ms. MIT.


Schwarzschild, Roger. 2004. Scope Splitting in the Comparative. Ms. MIT Colloquium

