Universal Modals in Comparative Clauses

Introduction This study proposes a non-scope solution to the problem of the non-homogeneous behavior of universal modals in comparative clauses. Specifically, it deals with the modals like have to that seem to require a narrow scope interpretation with respect to the comparative/Pi operator and thus suggests a division of intensional predicates into the wide and narrow scope ones w.r.t. the comparative. We demonstrate that have to-like modals may trigger pragmatic implicatures that produce the putative scope effects in the comparative environment. We implement the analysis in the interval-based approach.

Data and Desiderata (Heim, 2001) pointed out to the apparent cases of non-trivial scope interactions between the comparative and intensional operators in English than-clauses, cf. (1).

(1) a. Peter was more cautious than he has to.
\[ \lambda w. \forall w' \in \text{Acc}_{\text{w}}: \text{P. was } d'-\text{cautious in } w' \subset \{ d \text{P. was } d'-\text{cautious in } w \} \]
= Peter was more cautious than minimally required.
b. Peter was more cautious than he should have.
\[ \lambda w. \forall w' \in \text{Acc}_{\text{w}}: \text{P. was } d'-\text{cautious in } w' \subset \{ d \text{P. was } d'-\text{cautious in } w \} \]
= Peter was more cautious than maximally allowed.

Recent interval-based approaches have managed to solve the problem of deriving the wide-scope interpretation of should in (1b) without resorting to QR out of the comparative clause, cf. (Schwarzschild 2002), (Heim 2006). However, the suggested solutions remain scope-based and will suffer under the over-generation problem as long as there are no plausible restrictions on the available scope configurations of the relevant modals. To this we add another complication: have to-like modals often trigger the apparent wide-scope interpretations in sentences with negative-pole adjectives, cf. (2). Should-like modals do not display such a switch. This makes the task of formulating scope restrictions more difficult, if possible at all.

(2) Peter is shorter than he has to be to become a pilot.
\[ \lambda w. \forall w' \in \text{Acc}_{\text{w}}: \text{P. was } \text{Height}_{w'}(P) < d \subset \{ d \text{P. was } \text{Height}_{w'}(P) < d \} \]
= Peter’s height does not reach the minimal requirement.

In general, we can identify a designated group of modals that seem to be able to pick the min or the max of the accessible interval, whereas the remaining universal modals and propositional attitude verbs always pick the max. Thus, (1a) is an example of the more-than-min reading w.r.t. the tallness scale and (2) is a more-than-max reading w.r.t. the shortness scale. This observation anticipates our program, already laid out in (Beck, 2007): explain the pattern in (1) within an interval-based approach by finding the mechanism that is responsible for the choice of the appropriate bound (min or max).

‘Only’ Test Interestingly, the reading involving comparison with the low bound of the accessible interval (w.r.t. the positive adjective scale) surfaces only with the modals that occur in the sufficiency modal construction (von Fintel and Iatridou, 2009), cf. (3d-e). The modals in (3a-c) result in the more-than-max reading under the comparative.

(3) a. *You only ought to push the button for the bomb to explode.
b. *You only must push the button for the bomb to explode.
c. *You are only supposed to push the button for the bomb to explode.
d. You only need to push the button for the bomb to explode.
e. You are only required to push the button for the bomb to explode.
f. It is only have to to push the button for the bomb to explode.

It has been argued in (Krasikova and Zhechev, 2006) that the sufficiency meaning of (3d-e) is the result of the scalar character of only operative in these cases that gets associated with the likelihood/effort scale and produces the effect that the alternatives less likely/requiring more effort than the uttered one (“push the button”) are unnecessary, whereas the anything involving less effort is required. Hence the sufficiency of “pushing the button”. The choice of the lower bound in comparatives is reminiscent of this effect, cf. (4).

(4) Assume a scenario for (2) in which the requirement for becoming a pilot is as below:

\[ \text{necessary} \quad \sim \text{necessary} \]

\[ \text{1.75} \quad \text{1.85} \quad \text{>1.95} \]

\[ \sim \text{necessary} \quad \text{necessary} \]

1 We adopt Heim’s negation theory of antonymy.
Note that if the modal is not under the comparative, we don’t get this effect:

(9) Peter has to be between 1.75 and 1.85 to become a pilot. He is taller than that.

= Peter is taller than 1.85

**Analysis** We assume that *have to*-like modals trigger the insertion of the exhaustivity operator of the kind introduced in (Fox, 2006) at the LF, whereas the *should*-like modals do not. We show that the combination of the exhaustification step in the spirit of Fox with the interval semantics for comparatives (Heim 2006) derives the correct semantics. (6) is the analysis of the comparative clause with *should*.

(6) a. Peter is taller than he should be.
   b. \( [\lambda x \text{ should } [Pi] \lambda y \text{ Peter } 2 \text{ tall}] \)
   c. \( \lambda w. \lambda I. \forall w' \in \text{ Acc} \_w. w' \in \text{ goal} \rightarrow \text{ Height}_w(\text{Peter}) \in I \), where goal = \( \lambda w. \) Peter is a pilot in w
   d. \( \lambda I. [1.75; 1.85] \in I \) (extension in the scenario (4))

The LF of the *than*-clause with *have to* features a covert exh, defined as in (8). The alternative set A, that the exoh depends on, the value in (9a) in the scenario at hand. The set of innocently excludeable alternatives is calculated in (9b) and the resulting extension of the complete comparative clause in (7a) is given in (9c).

(7) a. Peter is taller than he has to be.
   b. \([\lambda x \text{ has to } [Pi] \lambda y \text{ Peter } 2 \text{ tall}]\)
   c. \([\text{ has to } [Pi] \lambda y \text{ Peter } 2 \text{ tall}] \) = \( (6c) \)

(8) a. \( [\text{ exh}]\lambda (p)(p_o) = \lambda w. p(w) \) & \( \forall q \in I - E(p, A) : \sim q(w) \) (Fox, 2006)
   b. \( I - E(p, A) = \cap \{ A' \subseteq A | A' \text{ is a maximal set in } A, \text{s.t., } \{ -p : p \in A' \} \cup \{ p \} \text{ is consistent} \}

(9) a. \( A = [\lambda w. \forall w' \in \text{ Acc} \_w. w' \in \text{ goal} \rightarrow \text{ Height}_w(\text{Peter}) \in I | I \in [1.75; 1.85] \)
   b. \( I - E(\{ (\gamma ) \}), A) = A - \lambda w. \forall w' \in \text{ Acc} \_w. w' \in \text{ goal} \rightarrow \text{ Height}_w(\text{Peter}) \in I \) \( \in [1.75; 1.85] \)
   c. \( \lambda I. \{ \text{ exh} \} (w)(\Lambda)(\{ (\gamma ) \} \text{ goal}) = \lambda I. \{ (\gamma ) \} \text{ goal} \) & \( \forall q \in I - E(\{ (\gamma ) \} \text{ goal}) : \sim q(w) \)
   = \( \lambda I. \forall w' \in \text{ Acc} \_w. w' \in \text{ goal} \rightarrow \text{ Height}_w(\text{Peter}) \in I \) \( \cap [1.75; 1.85] \), where goal is as in (9c).
   d. \( \lambda I. 1.75 \in I \)

(6) and (9) are selected by the comparative operator, defined in (3a) to derive the desired results, cf. (3c-d).

(10) a. \( [\text{ er}] = \lambda w. \lambda I. \lambda I'. \max(I') > \max(I) \)
   b. \( [\text{ er}]\{ \text{ min[than-clause]} \} \{ \text{ min[matrix clause]} \} \)
   c. \( \{ \text{ min} \} = \lambda w. \lambda D (\text{ subj. } D \in \text{ D} \) & \( \forall D' \in \text{ D} : D < D' \}
   d. \( \lambda w. \max (\lambda D. \text{ Height}_w (\text{Peter} \in D) > \max ([1.75; 1.85]) = \text{ Height}_w (\text{Peter}) > 1.85 \)
   e. \( \lambda w. \max (\lambda D. \text{ Height}_w (\text{Peter} \in D) > \max ([1.75; 1.85]) = \text{ Height}_w (\text{Peter}) > 1.75 \)

One of the important aspects of the analysis (and its outcome) is the definition of the alternative set. Crucially, alternatives are ranked according to the effort scale that may or may not correspond to the scale associated with the adjective. In the pilot example it does. But in (2) the adjective scale (shortness) and the effort scale are not unidirectional. We can however come up with examples involving negative-pole adjectives and the unidirectionality of the corresponding scales:

(11) a. Peter arrived earlier than he had to.
   b. \( \text{ earlier - } \text{ earlier} \rightarrow \text{ more than } \text{ earlier} \text{ reading} \)
   c. \( A = [\lambda x. \text{ Peter is } t \text{ early in } w \ & \& t \in I | I \in [12 \text{ a.m.; } 11 \text{ a.m.}] \]

**Conclusion** We advocated the pragmatic solution to the problem of quantifiers in comparative clauses by showing how the differences between the apparently wide and narrow scope universal modals can be reduced to the choice of the interval that as the input to the comparative and spelling out the mechanism that determines this choice.