Minimal sufficiency readings of necessity modals

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The problem The combination of *have to* with an infinitive purpose clause (known as *teleological* or *goal-oriented have to*), as in (1), can be analysed as in (2).

(1) To get a driving license, you have to be an adult.

(2) In all the best worlds w.r.t. getting a driving license, you are an adult.

As von Fintel and Iatridou (2007, henceforth vF&I) point out, an analysis along these lines is incorrect for (3a). Adopting the analysis of *only* by Horn (1969), (3a) should presuppose the truth of (3b). (3b) would in turn have a paraphrase similar to (2). Yet, if we know that there are many places in Boston where you can get good cheese, (3b) is not true, but (3a) might be. The analysis we just sketched predicts (3b) to be false, but also predicts that (3a) should be a presupposition failure.

(3) a. To get good cheese, you only have to go to the North End [a part of Boston].
b. To get good cheese, you have to go to the North End.

vF&I propose a solution based on decomposing *only*. Informally, they give to (3a) a meaning paraphrasable as *"you do not have to do anything other than go to the North End to get good cheese"*. However, we observe that similar examples may be constructed that do not feature *only*. (4) fails to imply that you cannot get into the next stage with gold (it implies the opposite), and (5) (where capital letters indicate the intended prosody) fails to imply that you cannot be over the limit after drinking wine.

(4) To get into the next stage, you have to get a silver medal.

(5) To be over the legal limit, you have to drink TWO beers.

(3a), (4) and (5) pattern together in that they express *Minimal Sufficiency* (MS). MS presupposes *scalarity*: it only makes sense when a scale of pragmatically- or logically-ranked alternatives is salient. Given a ranking, MS conjoins *sufficiency* (higher alternatives are unnecessary) and *minimality* (lower alternatives are insufficient). In particular, (3a) is not a felicitous utterance in a context where minimality is violated, e.g. if you can get good cheese in the North End, but also across the street from the speaker's home. The analysis of vF&I, as it is (they discuss variants that do not have this problem), predicts (3a) to be true in that context. This is because it does not involve scales: there is no way to predict a different status for "you can get good cheese across the street" (which is incompatible with (3a)) and "you can get good cheese in the South End" (which is compatible) if there is no ranking to distinguish them.

Alonso-Ovalle and Hirsch's analysis An account of (3a) that doesn't rely on *only* and therefore can be extended to other examples is found in Alonso-Ovalle and Hirsch 2018 (henceforth AO&H), with unrelated motivations. The idea is that a weakening operator AT-LEAST is available. AT-LEAST acts upon propositions that lie on a scale, and returns the disjunction of its argument and all its higher scalemates.

(6) $[\![\text{AT-LEAST } p]\!](w) = \exists q \in \text{alt}(p), [q \succeq p \wedge q(w) = 1]$

If AT-LEAST occurs below the modal, we predict a meaning that is roughly right for (3a): it presupposes that you have to go to the North End or somewhere less accessible (minimality), and asserts you don't have to go to anywhere less accessible (sufficiency). Extending the account to (4) yields minimality (as an assertion) but not sufficiency: we predict the sentence to be true if you in fact have to get a gold medal to qualify. Since this seems incorrect, we have to assume that MS examples without *only* obligatorily receive an *exhaustive* interpretation, whereby the stronger alternative *"you have to get (at least) a gold medal"* is negated. For (5), assuming numerals already have "at least" semantics, we derive a meaning isomorphic to that of (4) whether AT-LEAST is present or not. We submit that the reason exhaustivity is obligatory in (4) and (5) is that there is no uncertainty over what the formal alternatives are, due to the presence of a highly conventional scale. Finally, the fact that (3b), in contrast with both (3a) and (4) and (5), does not receive an MS reading, can be explained (following Krasikova (2010)) as follows: in (3b), unlike in (4) and (5), there is no conventional scale available. However, the addition of *only* in (3a) leads the listener to accommodate an appropriate context, because *only* has to associate with scalar elements.

This analysis has limitations: what we derive for minimality is too strong. We wrongly predict that possibilities not expressed by a scale member are ruled out. Most clearly, we predict (5) to assert that

you have to drink some amount of beer to be over the limit, even though world knowledge lets us know that you can also drink wine, and we may judge (5) true nonetheless. In general terms, the minimality we want only rules out lower scalemates (drinking one beer, going across the street), and nothing else.

A degree-based solution A potential solution is to make AT-LEAST even more of a weakening. We consider an implementation of this idea relying on the notion of *degrees*. AT-LEAST is replaced by an operator DO-AS-MUCH-AS paraphrasable as "something at least as high as the argument is true", where "high" corresponds to a contextually-supplied gradable property μ.

(7) $[\![\text{DO-AS-MUCH-AS } p]\!](w) = \exists q \in D_\mu,\, \mu(q) \geq \mu(p) \wedge q(w) = 1$

Assuming that the intuitive ranking of alternatives and their ranking by μ are the same, we derive a sufficiently weak notion of minimality. As we do not assume that the ranking by μ of non-scalemates (such as wine-drinking) is recoverable, nothing is implied as to whether these let you attain the goal or not. Sufficiency, however, might have become too weak: we predict (3a) to be true if you cannot get good cheese in the North End, but you can get some through some equivalent effort. One would then have to say that the inference that you can specifically get good cheese in the North End is perhaps some kind of Manner implicature rather than an entailment or presupposition of (3a).

A solution based on alternative-sensitive modal semantics We offer another account of MS that avoids this problem. Keeping AT-LEAST as it is, we adopt the proposal of Villalta (2008) and Krasikova (2010) that teleological *have to* has alternative-sensitive semantics based on the notion of *better possibility* due to Kratzer (1981). Ignoring any complications related to remote possibilities, our proposed semantics is equivalent to (8).

(8) "To p, have-to q" is true iff q is compatible with p, and for any alternative q' to q such that q' entails $\neg q$, q' is incompatible with p.

It can be shown that in order to not derive contradictions, it is crucial that we adopt the "q' entails $\neg q$" clause (which is not present in Villalta 2008 and Krasikova 2010). We also have to assume that an operator EXH, that delivers exhaustive interpretations, may be inserted in alternatives, so that the set of alternatives for (5) has the structure exemplified in (9).

(9) $A' = \{\text{you drink } n \text{ beers} \mid n\} (= A) \cup \{\text{exh}_A[\text{you drink } n \text{ beers}] \mid n\}$

Our assumptions deliver exactly the right notions of minimality and sufficiency, without implying anything about non-scalemates (e.g. wine-drinking), and without running into the potential issue of overly weak sufficiency. We also make straightforward, and apparently correct predictions as to the interaction between prosody and readings of *have to*, and we can account for the fact that MS is not a possible reading of (10b), in contrast to (10a).

(10) a. To be over the limit, you have to drink TWO beers. You can also drink wine.
b. # To be over the limit, you HAVE to drink two beers. You can also drink wine.

Both the alternative-sensitive analysis and the degree analysis extend straightforwardly to *disjunctive* cases of MS where minimality and sufficiency are expressed along two dimensions at once, as in (11). We correctly predict that (11) doesn't specify whether drinking one beer and two glasses of wine puts you over the limit or not, a fact that doesn't fall out easily from AO&H's analysis or from variants of vF&I's that derive minimality. Note that within the alternative-sensitive analysis, we need to adopt the *minimal world* definition of EXH for this result to hold.

(11) To be over the legal limit, you have to drink TWO beers or THREE glasses of wine.

References

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