7

Straddling the line between attitude verbs and necessity modals

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7.1 Introduction

What is the relationship between attitude verbs and modals? Although the analysis of attitude verbs as modal operators has been the standard approach in semantics since Hintikka's (1969) seminal work, direct comparison of the range of meanings expressed by modals and attitude verbs has not been systematically undertaken. Understanding the differences and similarities between these predicates is important for several reasons. Theoretically, this understanding is a prerequisite for a theory of modality that aspires to predict the range of modal meanings that languages can express. It also has applications in the acquisition of modality, in typology, and in language change.

In this chapter, I approach the question of the relationship between attitude verbs and modals by looking at representative lexical items from these two categories, which seem to express meanings that are closely related and have to do with what follows from one's desires or goals: the verb *want* as a prototypical attitude of desire (1a), and the adjective *necessary* as a prototypical modal expressing goal-oriented necessity (1b).

(1) a. Sue **wants** to teach Tuesdays-Thursdays.
b. It is **necessary** that Sue teach Tuesdays-Thursdays.

I begin with an evaluation of recent developments in the semantics of desire predicates, focusing on comparative and modal accounts stemming from Heim (1992). I show that Heim's original approach, which compares the desirability of a proposition to the desirability of its negation, is capable of dealing with a type of supposed counterexample that has motivated the introduction of sets of alternatives to recent semantic analyses of desire predicates. This paves the way for a more unified analysis of desire verbs and goal-oriented modals, updating the Heimian analysis with insights from the recent literature.

Modality Across Syntactic Categories. First edition. Ana Arregui, María Luisa Rivero, and Andrés Salanova (eds.).

The second part of the chapter concerns *necessary*. Contrary to widespread assumptions, I argue that this modal receives only goal-oriented interpretations in the configuration in (1b); other types (or "flavors") of modality are ruled out, even in supporting contexts.

I propose a modal analysis of *want* and *necessary* and end with a comparison of these predicates with prototypical modal verbs that express necessity, in particular *have to* and *ought to*. The subtle differences between members of this family of predicates paint an intricate picture of how expressions of modal necessity may vary.

7.2 Attitude verbs of desire

Attitude verbs of desire intuitively have a preference-based meaning: what we want, long for, desire, wish, or hope to do reflects the preferences we have regarding different states of affairs. Wanting to go on vacation, for example, reflects a preference for going on vacation, which in turn can be modeled in a number of ways: (i) comparing the options of going on vacation to not doing so and preferring the former (a comparative analysis), (ii) singling out vacation as the best possible outcome (a modal analysis), or (iii) evaluating the expected gain of going on vacation as the highest among the available options (a utilitarian analysis). All three analytical options have been explored in the literature.[1] In this section, I review the well-known comparative analysis of *want* developed by Heim (1992) as well as its modal implementation (due to von Fintel 1999) in order to evaluate a range of amendments to this analysis that have been proposed by Villalta (2000, 2006, 2008).

Villalta's work addresses two key aspects of the Heimian analysis: the idea that desires are related to (and restricted by) beliefs, and the idea that wanting is a comparative attitude. Villalta (2008) argues convincingly that the relationship between desire and belief is rather loose, since even if one believes that two propositions are equivalent, one may still desire one of them more than the other. Second, she argues that a two-way comparison between the prejacent proposition and its negation is insufficient to capture the meaning of desire predicates. Instead, the prejacent is said to be compared in the general case not just to its negation, but to a set of contextually determined alternatives.

In this section, I evaluate the evidence that has been brought to bear on the mechanics of comparison in desire statements, contending that in fact there is no theoretical motivation for complicating the original Heimian analysis by introducing sets of alternatives to the semantics. I then propose a comparative-modal analysis of *want* that incorporates Villalta's (2006, 2008) insight about a relaxed reliance of belief in desire statements.

[1] The utilitarian approach to the semantics of desire predicates will not be discussed in detail here, but see van Rooij (1999), Levinson (2003), Lassiter (2011).

One important issue I set aside here concerns the monotonicity properties of desire predicates. The question of whether or not, or under what conditions, verbs of desire give rise to monotonic inferences has played a central role in motivating the different analyses of *want* that will be discussed here. See Crnič (2011) for an overview and the most recent word in this debate.

7.2.1 Comparison of alternatives

The comparative approach to desire predicates originates in Stalnaker's (1984) diagnosis of wanting as an attitude that involves comparison of alternatives.

> [. . .] wanting something is preferring it to certain relevant alternatives, the relevant alternatives being those possibilities that the agent believes will be realized if he does not get what he wants. (Stalnaker 1984: 89)

Heim (1992) uses this characterization as motivation for a conditional comparative semantics for desire verbs. According to her proposal, every desire statement is implicitly conditional. In her words:

> An important feature of this analysis is that it sees a hidden conditional in every desire report. A little more explicitly, the leading intuition is that *John wants you to leave* means that John thinks that if you leave he will be in a more desirable world than if you don't leave. (Heim 1992: 193)

Both the comparative and the belief-related aspects of Heim's analysis are present in this informal description. Within the realm of what the subject (John) believes is the case, the prejacent (that you leave) is required to represent a better possibility for the subject than its negation (that you don't leave). The idea that desires are evaluated in light of one's beliefs, not in light of what is actually the case, is motivated by examples like (2). Patrick may have a desire to sell a cello which is not in fact in his possession, but which he thinks is.

(2) Patrick is under the misconception that he owns a cello, and he **wants** to sell his cello. (Heim 1992: 183(2))

More formally, the conditional paraphrase is used to implement a semantics for desire verbs using a version of the semantics proposed for conditionals (indicative and counterfactual) by Stalnaker (1968) and Lewis (1973). In this tradition, a conditional sentence of the form *If* ϕ*, then* ψ is true in a world w if and only if the consequent ψ is true, not necessarily in w, but in the worlds most similar to w in which the antecedent ϕ is true. For any proposition p and world w, the p-worlds most similar to w are abbreviated as $Sim_w(p)$.

(3) $Sim_w(p) = \{w' \in W : w' \in p$ and w' resembles w no less than any other world in $p\}$. (Heim 1992: 195, 197)

According to the conditional paraphrase, *a wants p* means, roughly, that *a* considers the *p*-worlds she can think of to be better than the ¬*p*-worlds she can think of. Thus, in addition to the above comparison of possibilities based on similarity, there is a second comparison of possibilities (von Fintel 1999: 119). This comparison, defined in (4a) for worlds and in (4b) for propositions, is based on the desires or preferences of the subject.[2]

(4) a. For any $w, w', w'' \in W$,
$w' <_{a,w} w''$ *iff* w' is more desirable to *a* in *w* than w''.
b. For any $w \in W, X \subseteq W, Y \subseteq W$,
$X <_{a,w} Y$ *iff* $w' <_{a,w} w''$ for all $w' \in X, w'' \in Y$. (Heim 1992: 197)

Putting the pieces together, an informal version of Heim's (1992) analysis of *want* is given in (5). Motivation for the two additional ingredients of the analysis is discussed immediately below. The formal version is given in (7).

(5) *Basic idea for want*:
Compare the desirability of the *q*-worlds most similar to *w* to the desirability of the ¬*q*-worlds most similar to *w*, for every world *w* in the subject's belief worlds.
Additional ingredients:
(i) Only compare the desirability of worlds that agree with the subject's beliefs.
(ii) Presuppose that the subject believes neither *q* nor ¬*q*.

Motivation for restricting the desirability comparison to the subject's belief worlds (as in (i)) comes from examples like (6).

(6) I **want** to teach Tuesdays and Thursdays next semester. (Heim 1992: 195(35))

Let's assume a situation in which the possibility that I don't teach at all next semester is more desirable to me than the possibility that I get a good teaching assignment. Suppose moreover that teaching next semester is a given, and that I believe that it is impossible for me not to teach. That is, in all the worlds that represent my beliefs in the evaluation world (these worlds are called my "doxastic alternatives" in the evaluation world, or the worlds "doxastically accessible" to me in the evaluation world, or simply my "belief worlds"), I teach next semester. Even though worlds in which I don't teach at all are more desirable to me, (6) is typically judged true if it is taken for granted that I will teach. Thus, it seems that the desirability comparison cannot reach out to worlds that are not doxastically accessible to the subject in a given situation.

[2] Note that Heim uses a non-standard definition for comparing the desirability of propositions here. Villalta (2008) suggests to follow Kratzer's (1991) definition of *better possibility* instead:

(i) a. For any $w, w', w'' \in W$, $w' <_{a,w} w''$ *iff* w' is more desirable to *a* in *w* than w''.
b. For any $p \subseteq W, q \subseteq W$, $p <_{\text{DES}(a,w)} q$ *iff* $\forall w'' \in q\ \exists w' \in p$ such that $w' <_{a,w} w''$, and it is not the case that $\forall w' \in p\ \exists w'' \in q$ such that $w'' <_{a,w} w'$. (Villalta 2008: 479(35), notation adapted)

The second additional ingredient, (ii), guards against the invalid inference that if an individual believes a certain proposition *p*, then they also want *p*. Clearly, even if I believe I will teach next semester, it does not follow that I want to teach next semester. According to Heim's proposal, the sentence *want p* suffers under these circumstances from presupposition failure and hence is infelicitous.[3]

Assuming that comparisons of desirability are restricted by the subject's doxastic alternatives, Heim (1992) defines the semantics of *want* as in (7). (This is a static rendering of her dynamic proposal, 1992: 197(39), following Villalta 2008: 474(22).)

(7) $[\![want]\!](q)(a)(w)$ is defined *iff* $\textsc{dox}(a, w) \cap q, \textsc{dox}(a, w) \cap \neg q \neq \emptyset$.
If defined, $[\![want]\!](q)(a)(w) = 1$ *iff*
$\forall w' \in \textsc{dox}(a, w).Sim_{w'}(\textsc{dox}(a, w) \cap q) <_{\textsc{des}(a,w)} Sim_{w'}(\textsc{dox}(a, w) \cap \neg q)$,
where:
$\textsc{dox}(a, w)$ are the worlds that match the subject *a*'s beliefs in the evaluation world (their *doxastic alternatives*);
$Sim_w(q)$ is the set of *q*-worlds most similar to *w*;
$<_{\textsc{des}(a,w)}$ defines the comparative desirability of propositions for *a* in *w*.

Heim's motivation for crafting an analysis of desire predicates is to account for Karttunen's (1974) observations about presupposition projection from complements of attitude verbs. Although the original observations have not gone uncontested,[4] Heim's (1992) analysis of *want* has become the benchmark for much subsequent work on the semantics of attitude predicates.

7.2.2 Less reliance on belief and multiple alternatives: Villalta's contribution

In more recent work, Villalta (2006, 2008) has argued for two amendments to the Heimian analysis. She proposed, first, that the desirability comparison for *want* should not be restricted to the subject's doxastic alternatives, and second, that it should be carried out between *q* and a set of contextually determined alternatives, not just between *q* and $\neg q$.

The first issue, which I will call the "Doxastic Problem", concerns conflicting desires about propositions that are believed to be equivalent. The example in (8) shows that one may desire such propositions to different degrees.

(8) a. I want to teach Tuesdays and Thursdays next semester.
b. I believe that I will teach Tuesdays and Thursdays next semester if and only if I work hard now.
c. Invalid inference:
∴ I want to work hard now. (Villalta 2008: 478)

[3] See Heim (1992: 198), von Fintel (1999: 117).

[4] See Geurts (1998), Moltmann (2006).

Intuitively, the sentence in (8c) is false if there is a possibility to get the desirable Tuesday–Thursday schedule without working hard. The inference fails in this case due to worlds that are outside the realm of what the subject believes to be the case. In other words, worlds that are not part of the subject's doxastic alternatives seem nevertheless to affect the desirability comparison. Villalta (2008) proposes to amend the Heimian analysis in (7) accordingly, to avoid the incorrect prediction in cases like this ((8c) is predicted to be true if the desirability comparison is restricted to worlds in the subject's doxastic alternatives).

A second issue Villalta raises for Heim's (1992) analysis concerns the "granularity" of the alternatives that determine the truth of desire statements. What happens, she asks, when multiple contextual alternatives seem to be compared, and those that are most similar to each other happen to be less desirable? Example (9) is a scenario of this kind.

(9) Sofía has promised to bring a dessert to the picnic. Victoria believes that there are three possibilities for what she may actually do. She could prepare a chocolate cake, even though Victoria considers that extremely unlikely because it represents far too much work. She might bring an apple pie, which Victoria considers very likely since she can just buy it at the bakery nearby. Or Sofía might bring ice cream, which seems most likely to Victoria, since she usually has some in her freezer. Victoria prefers the chocolate cake over the apple pie and the apple pie over the ice cream. (Villalta 2008: 476)

The picnic scenario introduces three alternatives that have different likelihoods of materializing and different degrees of desirability for the subject:

i. Most likely, least desirable: the guest brings ice cream.
ii. Very likely, somewhat desirable: the guest brings apple pie.
iii. Extremely unlikely, highly desirable: the guest brings chocolate cake.

It is clear that (10) is false in this scenario.[5]

(10) $^{\text{False}}$Victoria **wants** Sofía to bring an apple pie.

The claim is that a similarity-based analysis following Heim incorrectly predicts the sentence to be true in the given context (Villalta 2008: 477), if the option of the guest bringing apple pie is only compared to its negation. The crux of the argument, which I will challenge shortly, is that apple-pie worlds are compared in terms of desirability only to ice-cream worlds (since it is highly unlikely that the guest will bring chocolate cake). Of the two alternatives, worlds in which the guest brings apple pie are more desirable.

[5] Villalta (2008) uses a version of this sentence with *wish* instead of *want* (her example: 477(30)), but it is clear that she is making an argument about *want*.

In response to the Doxastic Problem and the problem of multiple alternatives, Villalta (2008) proposes the lexical entry for *want* in (11). The desirability comparison invoked by this lexical entry is carried out between the prejacent p and a set of contextually available alternatives. In addition, the dependency of desire on belief is relaxed. The subject's beliefs are relegated to a definedness condition and no longer restrict the desirability comparison. Wanting p requires that p and its alternatives be represented in the subject's doxastic alternatives, but the desirability comparison is not restricted to worlds in this set.[6, 7]

(11) $[\![want_C]\!]^g(p)(a)(w)$ is defined *iff* $\forall q \in g(C) \,.\, \textsc{dox}(a, w) \cap q \neq \emptyset$.
If defined, $[\![want_C]\!]^g(p)(a)(w) = 1$ *iff* $\forall q \,.\, q \neq p \,\&\, q \in g(C)\colon p <_{\textsc{des}(a,w)} q$.
where:
C is a variable that is anaphoric to a contextually determined set of propositions (and receives its value from the variable assignment g).
(Villalta 2008: 480(37))

Assuming that the three alternatives in the picnic scenario are directly compared to each other (i.e. $g(C) = \{[\![S.\ brings\ chocolate\ cake]\!], [\![S.\ brings\ apple\ pie]\!], [\![S.\ brings\ ice\ cream]\!]\}$), this proposal predicts the falsity of (10). It also accounts for the invalidity of the reasoning in (8); that is, it avoids the Doxastic Problem.

7.2.3 Evaluation

The picnic scenario is presented as a central piece of evidence for introducing sets of alternatives into the semantics of desire predicates. Upon reviewing the argument more closely, however, it is clear that the crucial judgment in the scenario can be explained equally well by the simpler version of Heim's (1992) comparative semantics.

The argument, recall, is that Heim (1992) predicts the sentence in (10) to be true because apple-pie worlds (q worlds) are compared to ice-cream worlds (*not* q worlds), and the former are more desirable than the latter for Victoria, the subject. The important point to note is that there are also certain worlds, compatible with the subject's beliefs, in which the most desirable thing happens—as if against all odds. In these worlds, the guest brings chocolate cake to the picnic. Crucially, if this is a viable option, the universal quantification over doxastic alternatives in (7) ensures that the sentence is (correctly) predicted to be false. This chain of reasoning is presented in more detail below.

[6] For present purposes I limit myself to discussion of the pre-final version of Villalta's proposal, ignoring the compositional degree-based refinement she introduces (see Villalta 2006, 2008: §8.3).

[7] A further virtue of this analysis is that it avoids the universal quantification over belief worlds in Heim's proposal. Concerns about this aspect of the original comparative desire semantics have been voiced in the literature. E.g. Levinson (2003: 230) argues that according to an analysis like (7), "a person wants something only if he/she believes that it will necessarily improve the situation in any possible case. . . . this excludes many actual cases of wanting."

(12) According to (7), *Victoria wants Sofía to bring an apple pie* is true *iff*:
$\forall w' \in \textsc{dox}(a, w).Sim_{w'}(\textsc{dox}(a, w) \cap q) <_{\textsc{des}(a,w)} Sim_{w'}(\textsc{dox}(a, w) \cap \neg q)$,
where q is the proposition that Sofía brings apple pie, and a is Victoria.
- Consider some world w'' in $\textsc{dox}(V, w)$ such that $w'' \in [\![\textit{Sofía brings chocolate cake}]\!]$.
- $Sim_{w''}(\textsc{dox}(V, w) \cap \neg[\![\textit{Sofía brings apple pie}]\!])$ equals $\{w''\}$, since a world is always most similar to itself.
- w'' is more desirable than any minimally different world w''' in $\textsc{dox}(V, w) \cap [\![\textit{Sofía brings apple pie}]\!]$.

(10) is false in the picnic scenario.

In conclusion, scenarios of this type do not support introducing more complicated machinery into the semantics of desire predicates.

Villalta's approach nevertheless provides a solution to the Doxastic Problem, raising the question of whether the dependency of desire on belief can be relaxed while prejacents of desire predicates, as on a Heimian analysis, are compared simply to their negations.

7.2.4 Simple contextually restricted comparison, based on desires

At this juncture, it is useful to introduce a modal implementation of Heim's (1992) semantics for desire predicates. Originally developed by von Fintel (1999) in an effort to endow *want* with a monotonic semantics, the lexical entry in (13) utilizes standard modal parameters to interpret desire statements, namely a "modal base" and an "ordering source" (Kratzer 1981, 1991, 2012). The modal base, f, is a function from individual–world pairs to sets of worlds. It is lexically restricted by the verb to be doxastic, thereby mapping a pair (a, w) to the worlds doxastically accessible for a in w. The ordering source, h, is a function from individual–world pairs to sets of propositions representing relevant ideals. It is restricted by the verb to be bouletic, hence maps a pair (a, w) to the set of propositions representing a's preferences or desires in w.[8]

(13) $[\![want]\!]^{f,h}(q)(a)(w)$ is defined *iff* $f(a, w) = \textsc{dox}(a, w)$, $h(a, w) = \textsc{des}(a, w)$, and $f(a, w) \cap q, f(a, w) \cap \neg q \neq \emptyset$.
If defined, $[\![want]\!]^{f,h}(q)(a)(w) = 1$ *iff* $\forall w' \in max_{h(a,w)}(f(a, w)) \,.\, w' \in q$,
where $max_A(X)$ selects the set of $<_A$-best worlds in X.

An important lesson learned from Villalta's (2008) proposals concerns the nature of the possibilities compared in desire statements. These possibilities are contextually

[8] This is an adapted version of the modal analysis developed by von Fintel (1999: 115–118). The function *max* is defined as follows: for any $X \subseteq W$ and strict partial order $<_A$ on worlds (induced by a set of propositions A in the method proposed by Kratzer 1981), $max_A(X) = \{w \in X : \neg\exists w' \in X : w' <_A w\}$.

determined and they stand in a particular relationship to the subject's doxastic alternatives. Context-dependency, which is captured by $g(C)$ in Villalta's (2008) analysis above, can also be modeled by a modal base function in a standard modal analysis.[9] However, following Villalta, this modal base should not be identified with the subject's belief worlds (contra (13)),[10] but it should overlap with a subset of the subject's belief worlds that is diverse with respect to the prejacent.

A comparative-modal semantics for *want* that incorporates Villalta's (2008) solution for the Doxastic Problem is given in (14). The semantics is Heimian in the sense that it only compares the prejacent to one alternative—its negation—and not to a set of alternatives (following the discussion in the previous section). Crucially, the comparison of desirability is not semantically confined to the subject's doxastic alternatives.

(14) $[\![want]\!]^{f,h}(q)(a)(w)$ is defined *iff* $h(a,w) = \textsc{des}(a,w)$, $\bigcap f(w) \cap \textsc{dox}(a,w) \cap q \neq \emptyset$, and $\bigcap f(w) \cap \textsc{dox}(a,w) \cap \neg q \neq \emptyset$.
If defined, $[\![want]\!]^{f,h}(q)(a)(w) = 1$ *iff* $\bigcap f(w) \cap q <_{h(a,w)} \bigcap f(w) \cap \neg q$.

According to (14), context circumscribes the possibilities invoked for comparison through the modal base f (here, the modal base is a function from worlds to sets of propositions).[11] Among these possibilities, q is required to be more desirable for the subject than its single alternative, $\neg q$. In addition, the prejacent and its negation are both presupposed to be represented among the subject's doxastic alternatives, specifically in those worlds that are both doxastically and contextually accessible.[12]

The crucial cases discussed by Villalta (2008) are accounted for by this analysis. If $f(w)$ includes the proposition that I teach next semester, worlds in which I do not teach at all cannot influence the desirability comparison; hence, *I want to teach Tuesdays and Thursdays next semester* ((6) above) is correctly predicted to be true, even if not teaching at at all is what I would like the most. Second, concerning the Doxastic Problem of (8), if the worlds determined by the modal base include ones in which my desires are realized without working hard, *I want to work hard now* is correctly predicted to be false, even if I believe that hard work is the only way for me

[9] Villalta (2008: 491) comments explicitly on this connection with the modal analysis: "One of my main goals has exactly been to show this last point, namely, that for different examples, different contextual alternatives are relevant. At the core of my proposal is the idea that contextual alternatives are an important ingredient of the semantics of these predicates."

[10] Or the superset of the doxastic alternatives arrived at by ignoring beliefs the subject has about their own future actions, which is what Heim (1992) ends up proposing.

[11] This is a true Kratzerian modal base, which in contrast to f in (13) is not directly dependent on the subject. Anchoring the modality to the subject can nevertheless be achieved with an event-relative approach to modality, along the lines proposed by Hacquard (2006, 2010).

[12] The explicitly comparative semantics of (14) is only superficially distinct from the quantificational one in the modal analysis above; under certain theoretical assumptions such comparison of a proposition and its negation is indistinguishable from universal quantification along the lines of (13). See von Fintel and Iatridou (2008) for details.

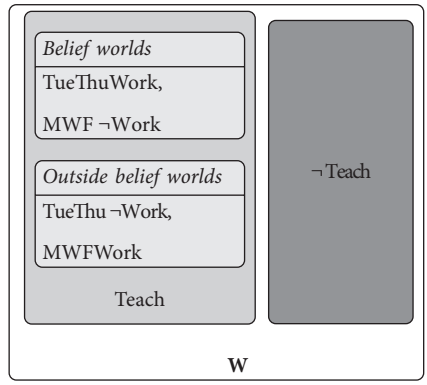

Fig. 7.1 Accessible worlds for *want* in the teaching scenario

to get the teaching schedule I want. Figure 7.1 depicts the relation between modal base and doxastic alternatives that is relevant in this scenario.

The idea behind the proposed (14) is that an individual's belief worlds may be a subset of the worlds determined by the modal base. In the teaching scenario, for example, the modal-base worlds are circumstantially accessible worlds in which I teach next semester (left-hand panel, "Teach," comprising "Belief Worlds" and "Outside belief worlds"). Only a proper subset of these are the belief worlds of the subject. The larger set is relevant for evaluating *I want to (not) work hard*. This captures the intuition that the sentence *I want to work hard now* is false in the teaching scenario of (8c) if there is a conceivable possibility of getting the desirable Tuesday–Thursday schedule without working hard.

Note that the larger set of contextually accessible worlds may also be relevant for evaluating the basic desire statement in the scenario *I want to teach Tuesdays and Thursdays next semester*, although focusing just on the doxastic alternatives would also predict the truth of the sentence since the MWF schedule is less desirable than the TueThu schedule in general. The analysis proposed does not force us to assume that the value of the contextual parameters changes from the premises to the conclusion in (8).

What can be said about the relation between the subject's doxastic alternatives and the contextually accessible worlds (i.e., $\textsc{dox}(a, w)$ and $\bigcap f(w)$) in the general case? The teaching scenario suggests that the relation may be one of inclusion, such that the accessible worlds are a superset of the doxastic alternatives, arrived at by potentially suspending some of the subject's beliefs. The doxastic alternatives also play a role in the picnic scenario, as discussed above: it is true that Victoria wants Sofía to bring chocolate cake to the picnic partly because she considers this to be a viable, if somewhat unlikely, option. The context is set up in such a way that it makes

relevant Victoria's beliefs about what Sofía might bring, and these possibilities cannot be ignored.

Given a modal analysis like (14), in which the domain of relevant possibilities for any given *want* statement is determined by context, one might go a step further and challenge the very assumption that beliefs semantically restrict desire statements at some level. This possibility is raised by examples like (15), which are a lingering loose end for the Heimian analysis and its descendants (see Heim 1992: 199(42)). The analysis proposed in (14), in particular, predicts the sentence to be infelicitous due to presupposition failure (since, presumably, my beliefs rule out the possibility of an endless weekend).

(15) I **want** this weekend to last forever. (But I know, of course, that it will be over in a few hours.) (Heim 1992)

It seems worthwhile to explore an alternative explanation of those examples that originally motivated Karttunen and Heim to posit a link between desire and belief (e.g. (2)). Heim (1992) herself suggests two paths of exploration: anaphoric accommodation of the modal base as in modal subordination, and revision of the modal base as in a counterfactual conditional. I leave a detailed investigation of these options for another occasion.

7.3 Extending the analysis to modals

Not only do certain attitude verbs and modals contribute similar meanings, e.g. a desire- or goal-oriented necessity in (16), there are also more tangible grammatical properties that single them out as a natural class.

(16) a. I **want** you to see the pyramids.
b. You **have** to see the pyramids.
c. It's **necessary** for you to see the pyramids.

In Spanish, for example, both *es necesario* 'it is necessary' and *querer* 'want' select subjunctive-marked verbs in their embedded clauses. This shared morphosyntactic property leads Villalta (2008) to extend a comparison-based semantics like that of 'want' to the modal adjective 'necessary.'

The goal of this section is to examine the type of modality expressed by *necessary* and to characterize the comparison it invokes. I argue contra existing claims in the literature that *necessary*, at least in English, does not contribute likelihood-based comparison, and neither is it a general purpose necessity operator. Instead, I expose the inherently teleological nature of this modal as a clausal operator and describe how it differs from a modal like *have to*, which is more the polyfunctional necessity modal *necessary* is often assumed to be. The semantic profile of *necessary* is supported with a small corpus study in section 7.3.2.

7.3.1 Necessary that there be a goal

The first contender for a comparative analysis of *necessary* is the one proposed by Villalta (2008) in (17), following Krasikova (2008). According to this analysis, the main difference between *necessary* and *want* is that the former compares propositions according to likelihood—implemented as closeness to the actual world—while the latter compares propositions according to how desirable they are for an attitude holder. Two ancillary differences are that the modal, unlike the verb, does not have an individual argument, and that the alternatives it compares are not required to overlap with any particular set of beliefs.

(17) $[\![be\ necessary_C]\!]^g(p)(w) = 1$ *iff* $\forall q : q \neq p \,\&\, q \in g(C) \,.\, p <_{\text{LIKELY}_w} q$,
where:
For any $p \subseteq W, q \subseteq W, p <_{\text{LIKELY}_w} q$ *iff* $\forall w'' \in q\ \exists w' \in p$ such that $w' <_w w''$, and it is not the case that $\forall w' \in p\ \exists w'' \in q$ such that $w'' <_w w'$;
For any $w, w', w'' \in W, w' <_w w''$ *iff* w' is closer to w than w''.
(Villalta 2008: 482(42))

A likelihood-based analysis of *necessary* is problematic for at least two reasons. It predicts an entailment relation between *necessary* and *likely* that does not exist in ordinary uses of the adjective. More importantly, it misses a generalization about the modality type that the adjective expresses.

First, consider the pair *necessary* and *likely*. Assuming, as Villalta does, that the scale of likelihood associated with both predicates is the same,[13] an analysis like (17) predicts an entailment relation between *necessary q* and *likely q*. Consider the proposal that for a proposition to be likely, it must be at least as likely as its negation, or exceed a contextual standard for likelihood (see e.g. Yalcin 2010, Lassiter 2011). If *necessary q* is true, it follows from (17) that *q* is more likely than any of its contextual alternatives, hence that *q* is likely. In certain logical jargon, *necessary q* does seem to entail *likely q*. For example, one might conclude from a set of premises that *It is necessary that x is prime*, from which it follows that *It is likely that x is prime*. However, in everyday English this entailment does not exist. What is necessary may be unlikely, as in (18a), and what is likely may not be necessary (18b).

(18) a. Marijuana reform **necessary**, but **unlikely**.[14]
b. [In the picnic scenario of (9)]
It is **necessary** that Sofía bring ice cream.
It is **necessary** for Sofía to bring ice cream.

[13] "Other predicates from this class such as *es probable* ('it is likely'), *es posible* ('it is possible') and *dudar* ('doubt') can also be analyzed as contributing the scale of likelihood" (Villalta 2008: 483).

[14] Opinion, http://www.thecorsaironline.com/opinion/marijuana-reform-necessary-but-unlikely-1.1374244

Independently of the meaning of *necessary*, the definition of likelihood in (17) is problematic because it equates likelihood with greater similarity to the evaluation world. This is problematic because, as we know from good detective stories, the real world can be host to highly unlikely events (Kratzer 1981). Since a world is most similar to itself, (17) predicts that if *q* is actually the case, then it is necessary.

Turning to modality types, there is a connection between *necessary* and teleological (goal-oriented) modality that is not acknowledged by a likelihood-based analysis. Likelihood is an epistemic or circumstantial type of modality that pertains to what is projected to be the case based on certain facts or circumstances, potentially taking into account additional considerations such as the normal course of events. It contrasts with what may be called "priority" modalities (a term from Portner 2009), in which ideals such as desires, goals, or rules are relevant for reasoning about possible states of affairs. Priority modalities include teleological (goal-oriented) modalities, bouletic (desire-based) modalities, and deontic (rule-based) modalities. In addition to epistemic and priority modalities, a third category of modality will be relevant in this discussion: the alethic modality of what is necessarily or possibly true.

The main claims of this section are that *necessary* is a priority-type necessity modal and that it is primarily teleological as a clausal operator. My focus will therefore be on sentences such as (18b), in which *necessary* is complemented by an untensed *that*-clause or a *(for) to* infinitive. Note that the necessity of the embedded event in this example, Sofía bringing ice cream, can only be determined with respect to a contextually provided goal or priority. Was it necessary that Sofía bring ice cream in the picnic scenario? Without further information about the context, we simply don't know. This intuitive judgment will be supported with corpus data in section 7.3.2. Additional support for the modal's specialized interpretation comes from contrasts in felicity between *necessary* and other necessity modals in non-teleological contexts, and from the semantic nature of the modal's synonyms.

A rough guide to the semantics of *necessary* are its synonyms, a cohort that includes the modal adjectives *essential* and *crucial*. Tracing the diachronic development of *essential* and *crucial* in English, Van linden et al. (2008) describe how over time these adjectives have developed what we would call teleological or goal-oriented interpretations.[15] The fact that *necessary* is often provided in definitions of these two modals and is offered as their synonym (especially *essential*—see the *Oxford English Dictionary*) suggests that it too is a teleological modal at least in some of its uses.

Necessary with an untensed complement is odd in alethic contexts. Alethic contexts are by nature uncommon in non-philosophical everyday discourse, but even within the genre, whether or not *necessary* can be felicitously used to describe an alethic necessity depends on the type of complement it takes. In the trio of sentences below,

[15] They also conclude that the adjectives have undergone a further semantic change and are able to express deontic modality as well. This conclusion is not warranted, as will be shown.

inspired by an example in a scholarly philosophical paper,[16] the variant with an untensed embedded CP (19a) is notably degraded in comparison to variants with a tensed complement, regardless of whether the embedding modal is an adjective (19b) or an adverb (19c).

(19) If this particle is Helium, then . . .
  a. . . . [?] it is **necessary** that it have atomic number 2.
  b. . . . it is **necessary** that it has atomic number 2.
  c. . . . **necessarily** it has atomic number 2.

Similarly, Brennan (1993: 88, n. 19) notes that epistemic interpretations of *necessary that* are found only when the modal's complement is tensed. It is tempting to relate this finding to observations about the epistemic/root distinction, especially the claim that modals take scope over tense when they are interpreted epistemically (Groenendijk and Stokhof 1975; Cinque 1999; Hacquard 2006, 2010, 2011). (Alethic modals would be treated as members of the same semantic category as epistemics; see Portner 2009: 135.) From this perspective, what is surprising is that *necessary* has a limited interpretation when complemented by a smaller phrase—in other words, that it does not exhibit the full range of non-epistemic, root interpretations when its complement is untensed.

Necessary is goal-oriented where a more polyfunctional necessity modal like *have to* can be purely circumstantial. *Have to* can be used to express the circumstantial necessity that non-parallel lines intersect (20a), or that I can't help sneezing when I'm out in the sun (21a).

(20) a. If these lines are not parallel, they **have** to intersect at some point.
  b. If these lines are not parallel, it is **necessary** that they intersect at some point.

(21) a. I **have** to sneeze.
  b. It is **necessary** for me to sneeze.

The corresponding sentences with *necessary* express a type of modality that is goal-oriented; they invite a *What for?* follow-up. Example (21b), for example, cannot be used to express an uncontrollable urge to sneeze. Rather, it suggests that sneezing is a necessity in light of achieving some goal or priority—for example, making it difficult to hear what someone next to me is about to say.

Not only is *necessary* incapable of expressing pure circumstantial modality, the range of priority modalities it can express is also limited. A surprising finding is that deontic interpretations of the modal are ruled out in the relevant complementation configuration. This is surprising on the traditional view, where all non-epistemic

[16] See Halbach and Welch (2009: 72). These authors argue that from a formal logical perspective, there are reasons to treat phrases in which the adjective *necessary* is interpreted in an alethic sense as standing in for (perhaps as a shorthand for) phrases including the adverb *necessarily* and a predicate of truth.

modalities are grouped together in one natural class, generating the expectation that a polyfunctional modal will allow different interpretations of this class in different contexts of utterance.

Consider (22). Rationing food is a teleological necessity if one's priority is to survive a famine. It can also be a deontic necessity if there are rules mandating the rationing. Both (22b) and (22a) would be true in a famine scenario of this kind, but they would be true for different reasons. Example (22a) describes the content of a law, whereas (22b) describes survival during difficult times.

(22) During the famine, . . .
  a. . . . it was **mandated by law** that food be rationed.
  b. . . . it was **necessary** that food be rationed (and retired laboratory animals eaten).

Next, consider the necessities that characterize the post-famine era, a time in which a famine ended but the rationing law was still in place. This context supports food rationing as a deontic necessity, and therefore (23a) is clearly true. However, since an abundance of food means that there are multiple ways for people to survive without rationing, a teleological claim oriented toward the priority of survival is false. *Necessary that q* in (23b) does not receive the same interpretation as *mandated by law that q* does; there is a sense in which it does not accurately describe the scenario.

(23) [After the famine ended there was plenty of food again for everybody, but the law hadn't changed for a while.]
During that interim period, . . .
  a. . . . it was **mandated by law** that food be rationed.
  b. . . . it was **necessary** that food be rationed.

Why are we still hesitant to say that (23b) is false—full stop—in this context? The reason is that *necessary* depends on a priority, and a different priority could make the sentence true. In particular, since the prejacent to the modal matches what is deontically necessary in the scenario, the preference for abiding by the law would do the trick. Imagine that (23b) is uttered by a lawmaker who is an adamant believer in upholding and enforcing the law. Example (23b) is true in the context of (23) if *necessary* means 'necessary in order to behave in accordance with the law.' To the extent that we are willing to judge (22b)/(23b) as deontic, it is not because the modal describes the content of the law in these examples (arguably, this *necessary* cannot do), but rather because it is restricted by a priority that exists *because* the law exists.

7.3.2 Corpus study

The judgments presented in the section 7.3.1 are subtle. To test their validity and to answer the more general question of whether syntactic configuration might influence

the meaning of *necessary*, a corpus study was carried out on the interpretation of the modal in naturally occurring texts. The study addressed two questions:

i. What is the range of modality types expressed by *necessary*?
ii. Is the modal's interpretation constrained by the syntactic structures it appears in?

To answer these questions, examples of *necessary* in different syntactic configurations were extracted from a large corpus (COCA, the Corpus of Contemporary American English 1990–2012; Davies 2008). The search was limited to the years 2000–2012 in order to yield a manageable dataset for annotation. It consisted of three search queries (a substitute for a structural search, since the corpus is not syntactically parsed): *necessary* immediately preceding the complementizer *that* (24a), *necessary for* separated by up to five words from a following *to* (24b), and *necessary to* followed by a verb and separated by up to three words from a preceding *it* (24c). Examples of relevant sentences that matched these queries are given in (24). There were 109 relevant sentences that matched the pattern in (24a) in the section of the corpus from 2000-2012; the same number of examples were sampled randomly from matches to each of the other two patterns.

(24) a. *necessary that*:
The rapid change of society has outdated some of the statutes in the law and it is **necessary that** it be revised.

b. *necessary for . . . to*:
I know many of you have been farming for many years but it will be **necessary for** all farmers **to** become certified.

c. *It . . . necessary to V*:
"Yes, that would have certainly been more convenient," he said, "but I felt **it** was **necessary to** talk to you in person."

Among the 109 sentences with *that*-clause complements, the vast majority had untensed complements (100/109 = 91.7%). The connection between finiteness and modal interpretation in the data is discussed in more detail below.

The overall picture that emerges from the annotation of modality types (Table 7.1) is that *necessary* is primarily used as a teleological or bouletic modal. This is true regardless of the syntactic configuration that the adjective appears in (98/109 = 89.9%, 96/109 = 88.1%, 94/109 = 86.2% of occurrences in the three configurations that were examined). Only a small fraction of these sentences were determined to have a bouletic flavor (7/98, 0/96, 7/94), but all of them could be interpreted teleologically as well.[17] Since conceptually an individual's desire can always be construed

[17] Example (24c) is an example of a sentence in the *necessary to V* configuration annotated as having both flavors. An example in the configuration *necessary that* is given in (ii).

(ii) With Sugarloaf and The River Club only six miles apart, it was **necessary that** each luxury community have different atmospheres and architecture.

Table 7.1 The interpretation of *necessary* in the corpus (COCA, 2000–2012; Davies 2008).

	Epistemic	Deontic	Teleological/bouletic	Other	Total
necessary that	3	0	98	8 (T/E?)	109
necessary for . . . to	0	13 (T/D)	96	0	109
it . . . necessary to V	0	14 (T/D?)	94	1 (T/E?)	109

as their goal, teleological and bouletic modalities are treated as one category in the summary.

The first configuration, *necessary that*, stands out in two ways from the other configurations that were examined: it was the only one to allow non-ambiguous epistemic uses of the modal, and it showed no trace of deontic interpretations.

Evidence of the epistemic (alethic) interpretation of *necessary* was found in the corpus, but only when the modal was complemented with a *that* clause. In addition to three examples that were annotated as exclusively epistemic (one is given in (25)), eight were annotated as being ambiguous (26) or potentially ambiguous (27) between teleological and epistemic interpretations.

(25) [Following Saddam Hussein's capture, the speaker lists a number of groups that pose a threat to coalition forces in Iraq.] And it's not **necessary**$_{E}$ **that** each of these groups is connected or will be impacted by this man's capture.

(26) 'I don't think that's a be-all and end-all. I don't think it's **necessary**$_{T/E}$ **that** that happens because ultimately I'm going to make the call on it with a lot of input from my staff,' he said.

(27) . . . because it was **necessary**$_{T/E?}$ **that** Christ suffer only once.

This is the only complement type in the study that can potentially be tensed, and based on the discussion in the previous section one would expect to find a correlation between tense and non-priority interpretations in precisely this configuration. I argued above that epistemic interpretations require a tensed *that* complement. The actual findings are not so categorical. Of the three epistemic examples of *necessary that*, one ((25) above) had a tensed complement and one had an untensed predicate of truth (*But it is not necessary that these hypotheses should be true, nor even probable*, from a translation of Copernicus; see n. 16). Of the five examples annotated as ambiguous between teleological and epistemic interpretations, only one had a tensed complement ((26) above). Two of the remaining four examples, with untensed complements, were from articles in an academic journal on theology. The three potentially ambiguous examples in which the epistemic overtone was unclear were also all found in this journal and arguably do not represent everyday English.

Zooming in on the nine examples with tensed *that* clauses in the annotated corpus, many of them (7/9 = 77.7%) express priority modality and only two are epistemic or partly epistemic. This may also seem to challenge a theory that predicts a modal to be interpreted epistemically if it takes scope over tense. However, some of these examples occur in texts that appear to have been written by non-native speakers (e.g. (28)). In others (e.g. (29)), tense marking in the embedded clause may be affected by the tense of a parallel sentence in the surrounding context.

(28) . . . it is **necessary that** internet is used to get information and make project on studies about school . . .

(29) Yes, some motorcycles are too loud, but from a rider's standpoint, it is **necessary that** motorcycles are not too quiet.

Due to these considerations and the small number of examples, I will not attempt to draw conclusions about the connection between tense and epistemic interpretation based on this data.

Turning to the question of deontic interpretation, the corpus gives us some evidence that complements with infinitives are able to express this type of modality. Thirteen examples of *necessary* complemented by a *for to* infinitive were ambiguous between a teleological and a deontic interpretation (13/109 = 11.9%; for example, (30)). In the infinitival complement construction, nine examples were ambiguous between a teleological and a deontic interpretation (as in (31)), and in five cases the deontic interpretation was not clearly intended, but also not ruled out by the context (see (32)).

(30) The goal is to engage clients, not coerce. It is not **necessary**$_{T/D}$ **for** every client **to** present a story.

(31) A Serenitatis newslogger asked why some deputies weren't working on the case, and she explained that the department had other normal duties it was **necessary**$_{T/D}$ **to** fulfill.

(32) In Strauss's view, it was **necessary**$_{T/D?}$ **to** reaffirm the dignity of the political by returning to a natural, or prescientific, understanding of the political.

The evidence for deontic interpretations of *necessary* is weak, however, because the deontic examples were all annotated as ambiguous or potentially ambiguous between deontic and teleological meaning. None were in the type of context that is capable of distinguishing the two modality types, a context like the post-famine scenario in (23), where the relevant rules are in conflict with the goals. A larger sample of examples may have helped in this respect, although the finiteness of any corpus places a limitation on the conclusions one can draw using this methodology.

Summing up, an examination of all the examples of *necessary that* in COCA between 2000 and 2012 suggests that the modal is interpreted primarily as a teleological modal when complemented by a *that*-clause. Epistemic/alethic

interpretations are rare, and a larger body of examples would be needed to investigate whether, as suggested in the literature, the modality expressed is correlated with the tense in the complement (or other features of interest). Although the results show no difference in the interpretation of *necessary* with *for to* infinitives and with simple infinitival complements, they suggest that there is no simple correlation between the (syntactic) size of *necessary*'s complement and the range of modality types it can express. Given that corpus research is inherently limited by the finiteness of corpora, an experimental study might be necessary in order to probe the subtle contrast in judgments reported in the previous section between *(for) to* and *that*-CP configurations of the modal.[18]

Finally, the uneven distribution of interpretations found in the corpus for *necessary*—all essentially clustered around teleological modality— is different from the profile of interpretations one would expect a general-purpose modal to have. A comprehensive corpus study would confirm this conclusion by comparing *necessary* to more flexible modals of necessity, such as *need to* or *have to* (see (20), (21)). Evidence that *need*, in particular, has a wider range of meanings is found in recent corpus studies of English modals (e.g., Leech et al. 2009: 109ff.). Crowdsourcing experiments with non-expert annotators show that bouletic, deontic, circumstantial, and epistemic uses of the modal are attested alongside a majority of teleological examples (Rubinstein et al. 2012).

I conclude on the basis of the results of this initial corpus study that in its most natural uses, *necessary* depends on a goal or priority to get its domain of quantification. In certain syntactic configurations (in particular, with *that*-clause complements that tend to be untensed), it primarily expresses shades of goal-oriented necessity. This claim is new and surprising. It contradicts what seems to be a common, if mostly silent, assumption that *necessary* is a general-purpose necessity modal that can be used deontically and even non-circumstantially in appropriate contexts.

7.3.3 Proposal: a requirement for a contextually provided goal

A lexical entry for *necessary* should capture the observation that the modal is teleological, and thereby different from a general purpose-necessity modal like *have to* or *must*. The proposal I pursue in this section is that the modal requires the application of a (teleological) ordering source, and that this ordering source operates on top of other contextually determined modal backgrounds to determine the modal's quantification domain. I couch the proposal within Kratzer's doubly relative semantics of modality, the framework adopted for the meaning of desire predicates in section 7.2.4. This will enable a direct comparison of the two types of displacement operators in what follows.

To explain the inability of *necessary* to receive pure circumstantial interpretations (as observed in (20), (21) and suggested in the corpus study), I propose that the modal

[18] See Rubinstein (2012: 142ff.) for a relevant experimental setup.

places a condition on the context, requiring it to supply a quantification domain that is a subset of the worlds determined by the modal base alone. This boils down, roughly, to a requirement that the context provide the modal with a non-empty ordering source. If *have to* contrasts with *necessary* in placing no restrictions on the contextual parameters it draws on, we can explain why the former is able to express necessities that characterize the set of modal base worlds in its entirety, as in the case of pure circumstantial modalities.

It is clear, however, that the condition placed by *necessary* cannot be as simple as requiring a domain of quantification that is a proper subset of the accessible (modal base) worlds. This is so because deontic modals as well as epistemics are typically analyzed as having access to ordering sources, hence they too quantify over a select subset of the accessible worlds. For epistemics, the ordering source describes the stereotypical or normal course of events in the world of evaluation; for deontics, the ordering source describes relevant laws and regulations (Kratzer 1981, 2012). But even when such considerations are salient, we have seen that *necessary* is interpreted in relation to a goal, not the rules, and that it goes beyond what the stereotypical ordering source provides. Example (18a), repeated here, shows this last point.

(18a) Marijuana reform **necessary**, but unlikely.

The author of this sentence, who claims that marijuana reform is necessary yet unlikely, is clearly attuned not just to the possibilities opened up by the relevant circumstances, but also to what is likely and unlikely to take place. His necessity claim is thus sensitive to a modal base, a stereotypical ordering source, and some additional priorities that further restrict the possibilities that count as "best." (In all of these, there is marijuana reform.) *Necessary* requires these additional priorities, in addition to the norms represented by the stereotypical ordering source. It also requires that the priorities be of the teleological type, as shown by the interpretation of the modal in the sentence describing the post-famine situation:

(23b) During the interim period, it was **necessary** that food be rationed.

The salient deontic norms in this scenario are not able to satisfy the needs of the modal, which cannot receive a simple deontic interpretation in the context. A different kind of priority is responsible for the teleological interpretation it receives.

Both of the above considerations are incorporated into the lexical entry in (33): the modal selects for a contextually provided teleological ordering source, h', which applies on top of any (stereotypical or other) ordering source h to determine the modal's domain of quantification.[19]

[19] A sequence of ordering sources can be thought of as a hierarchy of ranked priorities, where ordering sources toward the end of the sequence cannot change the ordering determined by ones higher up, only add to it. The formalization in the text follows the proposal for weak necessity in von Fintel and Iatridou (2008).

(33) $[\![necessary]\!]^{f,h,h'}(q)(w)$ is defined *iff* h' is teleological.
If defined, $[\![necessary]\!]^{f,h,h'}(q)(w) = 1$ *iff* $\forall w' \in max_{h'(w)}(\max_{h(w)}(\bigcap f(w)))$.
$w' \in q$, where $\max_A(X)$ selects the set of $<_A$-best worlds in X.

Goal orientation has been hard-wired into this lexical entry of the clausal operator *necessary*—a move that might seem suspect in light of the prevalent view that modality type is a feature that can be derived to some extent from the syntactic configuration a modal appears in (e.g. Cinque 1999; Hacquard 2006, 2011). While this move might be appropriate for *necessary*—perhaps this modal adjective is lexically restricted to a particular type of modality, just like we assume the verb *want* is—it is also possible that there is a more principled explanation for the emergence of teleological modality in some of the syntactic configurations that have been surveyed here.

As I have shown elsewhere, a restriction to teleological modality is characteristic of a variety of general purpose necessity modals when they take CP complements, in English and in other languages (Rubinstein 2012). Pointing in this direction is also the observation that *necessary* is somewhat more open to deontic interpretations in corpora when its prejacent includes an infinitive (recall Table 7.1). Moreover, in scenarios that are able to distinguish deontic from teleological modality, the range of interpretations that the modal receives seems to be correlated with the type of complement it takes. Thus, of the two sentences in (34), the first is somewhat more felicitous than the second if the context supports the prejacent as a deontic but not a teleological necessity (I gloss over the active/passive contrast in the sentences).

(34) [In the post-famine scenario of (23).]
a. It was **necessary** to ration food.
b. It was **necessary** that food be rationed.

It may be that these fine fluctuations in the adjective's interpretation (as well as the rare epistemic uses it has) are not idiosyncratic and should receive a grammatical explanation. Such an explanation has not yet been provided, however.

Settling on a teleological semantics for *necessary* and denying its polyfunctionality underscores the affinity between the modal adjective and a bouletic attitude verb like *want*. The net difference between the denotation proposed for the adjective in (33) and that arrived at for the verb in (14) is minimal and concerns (i) the modality type lexically encoded for each item, and (ii) the involvement of an attitude holder in the latter. These two differences are presumably not unrelated. As noted in the previous section in the context of annotation, it is difficult to deny that modal claims that are based on an attitude holder's desires can also be construed teleologically (with the desires functioning as goals). What seems to characterize prototypical bouletic

See Katz et al. (2012) for an alternative implementation, which ranks all accessible worlds, not only the "best of the best."

examples is the identifiability of an individual who is the source of the priorities that are relevant for evaluating the modal claim; when the source of a priority is unknown, it cannot be classified as a desire (or a law), merely a goal.

In the next and final section, the semantics of *necessary* and *want* is situated in the context of a larger group of necessity modals.

7.4 Concluding remarks: attitude verbs and modals compared

In this chapter, I offered detailed discussion of the interpretation of bouletic attitudes and priority modals, concluding that such predicates share a quantificational modal semantics and are principally distinguished by whether (*want*) or not (*necessary*) their modality is lexically relativized to an individual. In passing, I compared *necessary* to other necessity modals, arguing that not all such modals are created equal. *Necessary* was shown to allow only a subset of the interpretations that necessity modals like *have to* and *need to* can accommodate. On the one hand, the lexical specification of modality type proposed for *necessary* makes it similar to an attitude verb; on the other hand, not being lexically anchored to an individual is a property it shares with typical necessity operators.

In terms of the range of modality types they allow, attitude verbs and polyfunctional necessity modals seem to occupy extremes of a continuum, with *necessary* somewhere in the middle. However, considerations of modal strength group *necessary* squarely with verbs like *have to*, exposing another parameter of variation within the class of necessity modals. To appreciate this similarity, it is necessary to include "weak-necessity" modals like *ought* or *should* in the discussion. Weak-necessity modals are characterized by the scalar inferences they exhibit in relation to so-called "strong-necessity" modals. Such patterns are used to classify *have to* and *must* as both being strong (hence giving rise to a contradiction in (35a), keeping the teleological interpretation fixed throughout), in contrast to *ought to* and *should*, which are weaker and do not give rise to a contradiction in (35b) (von Fintel and Iatridou 2008). The examples with *necessary* in (35) suggest that this modal is strong rather than weak.[20]

(35) a. #You must take the train, but you don't have to (/but it's not necessary).
b. You ought to take the train, but you don't have to (/but it's not necessary).
c. #It's necessary that you take the train, but you don't have to.

[20] It is not the lack of overt specification of a goal for *necessary* that is responsible for the infelicity of (35c), as no goal is specified in (35b) and this sentence is perfectly coherent. Not surprisingly, if different goals are specified for the two modals, the two necessity statements are no longer contradictory:

(iii) It's necessary that you take the train if you want to reduce your carbon footprint, but you don't have to in order just to get to where you need to go.

Exploring the roots of the weak-strong distinction would take us too far afield,[21] so I will conclude by merely mentioning a few open issues that these data raise for a comprehensive theory of modal and attitudinal necessity. If strength is a reflection of a difference in modality type (as argued by Bybee et al. 1994 and reflected in von Fintel and Iatridou's 2008 domain-restriction approach), how is the largely priority-type interpretation of weak *ought/should* different from the priority-type interpretation of the strong modal *necessary*? Second, how can an inherently teleological modal like *necessary* be as strong as a general-purpose modal like *have to* in light of this approach? Indeed, in terms of the range of modality types it can express, *necessary* is more similar to *ought* (and to *want*) than to *have to* or *must* (and in Spanish, 'necessary' and weak necessity 'likely' both belong to the set of subjunctive-selecting predicates; Villalta 2008). It is an open question whether a more refined classification of modality types will provide answers to these questions, or whether the data are better explained by an independent property (e.g. the discourse status of the priorities that are relevant for the different modals; Rubinstein 2012).

Acknowledgments

I thank Angelika Kratzer, Rajesh Bhatt, Kai von Fintel, and Paul Portner for fruitful discussions. The material in the first part of the chapter was presented in 2011 in the seminar "Modals, attitudes, and evidentials" at the University of Maryland. I thank Valentine Hacquard and the seminar participants for their interest and feedback. The final version of the chapter benefited from comments by an anonymous reviewer and the participants of the modality workshop in Ottawa. These are gratefully acknowledged.

[21] For a taste of the approaches available, see von Fintel and Iatridou (2008), Finlay (2009), Lassiter (2011), Rubinstein (2012, 2014), Silk (2012).