

Modality and attitude verbs

Contribution to *Cambridge Handbook of Natural Language Modality*

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March 2026

1 Introduction

This chapter concerns the semantics of two distinct syntactic classes of expressions: MODAL AUXILIARIES/VERBS—which I sometimes shorten as just MODALS—and ATTITUDE VERBS. In English, modal auxiliaries include *must*, *may*, *should*, *might*, *could* and (semi)modal verbs include *have (to)*, *ought (to)*, and *need (to)*. Attitude verbs in English include a variety of items including *believe*, *know*, *doubt*, *want*, and *fear*. In the discussion below, I will mostly employ English examples to illustrate main theoretical points. This said, in a number of places, I will heavily draw on non-English data that bear on the overarching theoretical questions regarding these items.

There is an intuitive parallel between the semantics of modal auxiliaries and the semantics of attitude verbs. The parallel is perhaps easiest to see between the epistemic use of a necessity modal and an epistemic/doxastic verb. The following pair of examples seem to convey similar meanings regarding the speaker's information state, i.e., that they are at least fairly certain that Aadith has won his chess game.

- (1) a. Aadith **must** have won the chess game.
- b. I **believe** that Aadith has won the chess game.

This example illustrates an interpretative parallel between modalized statements and attitude reports. We might not always find a near-equivalent attitude report for a given modalized statement, as in the case of (1). However, we can take (1) and similar examples to provide good reasons to try to assimilate the analysis of attitude verbs to that of modals. In addition to the intuitive empirical motivation, there is a conceptual motivation for pursuing a unified analysis of modals and attitude verbs. If a unified analysis is possible, it would be more parsimonious than assuming entirely different mechanisms for the two categories.

Specifically, in this chapter, we consider the possibility that the semantics of the two categories can be given a unified analysis in terms of **quantifica-**

tion over possible worlds, originated by Hintikka (1962). According to this analysis, roughly, the pair of sentences in (1) can be paraphrased as follows:

- (1') In all the possible worlds compatible with what I believe, Aadith won the game.

More generally, under the baseline Hintikkan possible-world semantics for attitude verbs, an attitude report is true iff for all possible worlds in a certain domain relative to the beliefs/knowledge/desire etc. of the attitude holder, the complement proposition is true. That is, we have the analysis of attitude verbs along the following lines:

- (2) a. $\llbracket x \text{ believes that } p \rrbracket^w = 1$
iff for all worlds w' compatible with x 's beliefs in w , $p(w') = 1$
b. $\llbracket x \text{ knows that } p \rrbracket^w = 1$
iff for all worlds w' compatible with x 's knowledge in w , $p(w') = 1$
c. $\llbracket x \text{ hopes that } p \rrbracket^w = 1$
iff for all worlds w' compatible with x 's hopes in w , $p(w') = 1$

Here, we take each attitude verb to be associated with a particular accessibility relation between worlds, relative to the attitude holder. These accessibility relations provide the domain of worlds to be quantified over. For example, the accessibility relation for *believe* in (6) relates a world w and an attitude holder x to any world that x considers possible according to their beliefs in w . The analysis states that if and only if p is true in all of these worlds, then x *believes* p (in w) is true.

The analysis is a natural extension of a simple possible-world analysis of necessity modals, as exemplified below for the epistemic reading of *must*:

- (3) $\llbracket \text{must}_{epi} p \rrbracket^w = 1$ iff for all worlds w' compatible with the evidence available in w , $p(w') = 1$

This lexical entry specifies the domain of quantification in terms of the epistemic accessibility relation between worlds, i.e., one that relates a world w to any world which is compatible with what is known in w . A modalized statement *must* p is true in the given evaluation world w iff p is true in all worlds that are epistemically accessible from w . Following the literature, I will refer to the aspect of meaning provided by the accessibility relation for modals and attitude verbs as **flavors** (see Chapters 7-10 of this volume).

Modality and attitude reports have been given a unified analysis along these lines since the inception of the possible-world semantics in the modern logical tradition due to the seminal work by Hintikka (1962). Throughout the history of formal semantics in the ensuing years, the semantics of modality and attitude verbs have undergone concomitant development. A notable example is Kratzer's (1977, 1981) introduction of the notion of **ordering** in the linguistic analysis of modality and a corresponding refinement of the analysis of desire

reports by Heim (1992) (see Ch. 4 ‘The Construction of Modal Domains—the Kratzerian View’).¹

At the same time, the semantics of the two classes have evolved independently from each other to account for empirical aspects specific to one class. One such example is the analysis of **modal force**. The distinction between necessity modals, such as *must*, and possibility modals, such as *may*, is analyzed in terms of quantificational force in the standard possible-world semantics for modals—necessity involves universal quantification while possibility involves existential quantification. Following on this basic framework, theoretical innovations have been made to account for new empirical discoveries regarding cases where a modal seems to exhibit variable force (e.g., Matthewson et al. 2007, Rullmann et al. 2008, Deal 2011, Jeretič 2021) (see Ch. 6. ‘Empirical foundations of modality: expressing modality across languages’). In contrast, the traditional Hintikka analysis of attitudes only involves universal quantification. Empirical and theoretical questions regarding the quantificational force of attitudes, such as whether it is empirically plausible to postulate an existential force for some attitude verbs and whether there are attitudes that exhibit variable force, have only begun to be explored in recent years (e.g., Močnik 2019, Močnik and Abramovitz 2019, Staniszewski 2022). We will see the relevant discussion on the quantificational force of modals and attitudes in §2.3.

There are also examples of theoretical advancements that are largely confined to the semantics of attitude verbs. The phenomenon of interrogative-embedding under attitude verbs as exemplified in (4) below, where an interrogative complement is embedded under an attitude verb, has motivated deeper theoretical understanding of the semantics of interrogative clauses and the attitude verbs that embed them (e.g., Hamblin 1973, Karttunen 1977, Groenendijk and Stokhof 1984, Dayal 1996, Lahiri 2002, Theiler et al. 2018, Özyıldız 2021, Uegaki 2022).

(4) Haruo **knows** whether Aadith has won the game.

On the other hand, it is an open empirical question whether there are cases where a modal embeds an interrogative complement, and if so, what the analysis of such a case might look like. This will be a topic which we will investigate in §2.4.

Overall, even though the semantics of modals and attitude verbs have extremely tight theoretical connections, there has rarely been an overarching discussion about the differences between them from the point of view of a potentially unified analysis.² The goal of this chapter is to offer such a discussion.

¹Within philosophy and deontic logic, ordering had been used in the analysis of modality and counterfactual conditionals (e.g., von Wright 1963, Lewis 1973).

²Rubinstein (2017) has provided a detailed comparison between the bouletic attitude verb *want* and a priority modal adjective *necessary* and has concluded that they share a quantificational modal semantics and distinguished by the involvement of an individual argument. The goal of this chapter is broader in that it aims to compare the two categories in general, by focusing on specific potential differences between them.

I will provide an overview of the current understanding of the differences between modals and attitude verbs, and the extent to which they present a challenge for a unified analysis of the two classes in terms of quantification over possible worlds. Specifically, I will frame the discussion around the following hypothesis:

- (5) **Hypothesis:** Modals and attitude verbs can be given a unified analysis in terms of quantification over possible-worlds. Any difference between the semantics of the two classes can be reduced to independent differences between the two categories, such as their syntactic properties.

As we will see, the hypothesis will be immediately challenged by a number of potential differences between modals and attitude verbs. We will explore to what extent the baseline Hintikka semantics sketched in (2) and its refinements are able to deal with such challenges.

In order to maintain theoretical focus and have a constrained comparison of the two classes, I will delimit my empirical scope for both modals and attitude verbs. As what I call modals, I will only consider modal auxiliaries and modal verbs, and exclude modal adverbs such as *maybe* and *certainly*, modal adjectives such as *necessary*, *likely* and *possible* and modal nouns such as *possibility* and *likelihood* (see Ch. 16 ‘Modality in Adjectives and Adverbs’). As attitude verbs, I will only consider stative attitudinal predicates, and will exclude dynamic and change-of-state verbs as well as communication verbs from discussion, as their semantics is likely to involve fine-grained details that diverge from that of modals in significant ways that go beyond the scope of this chapter. I will also set aside the issues pertaining to the possible-world analysis of intensional operators par se (hyperintensionality), such as issues with closure properties and logical omniscience. For discussion on these issues, see Ch. 3 ‘From modal logic to modal semantics’ and Ch. 8 ‘Priority Modality’ of this volume, as well as Grano (2021: Ch.2).

This chapter is structured as follows. In §2, I will explore four potential differences between modals and attitude verbs and examine the empirical robustness of these differences and the extent to which they challenge the baseline possible-world analysis of modals and attitude verbs. The four potential differences concern (i) sensitivity to an individual argument; (ii) lexical specification regarding the domain/flavor; (iii) quantificational force; and (iv) question-orientedness. In §3, I discuss an alternative analysis of attitude verbs, according to which the compositional contribution of the attitude verb is separated from the modal quantificational component. In §4, I will provide a quick survey of other issues that are relevant for the unified semantics of modals and attitude verbs. These issues will be set aside from the main discussion as they concern aspects of meanings that potentially go beyond the possible-world analysis. §5 concludes.

To preview, I will draw two main conclusions from my survey. Firstly, some of the apparent differences between modals and attitude verbs are not as empirically robust as they initially appear. Specifically, modals and attitude verbs are

similar in that they both in principle allow varying domains/flavors and quantificational forces. Secondly, there are other differences that appear to be empirically robust, as far as the available empirical evidence is concerned. These include the sensitivity to an individual argument, the presence/absence of a (lexically-encoded) strength distinction, and the presence/absence of question-orientedness. Maintaining the unified analysis in light of these differences may not be impossible, but doing so will likely impose significant constraint on the shape of the eventual theoretical analysis.

2 Potential dimensions of difference

In this chapter, we will consider a number of potential dimensions of difference between modals and attitude verbs that pose challenges for our Hypothesis in (5) above.

I will critically consider the following four potential differences:

1. **Sensitivity to an individual argument:** Modals only take a propositional argument while attitude verbs take an individual argument in addition to a propositional argument.
2. **Lexical specification of the flavor:** Modals do not lexically encode a specific flavor i.e., a domain of quantification over worlds. That is, they exhibit context sensitivity. Meanwhile, attitude verbs lexically specify a domain.
3. **Quantificational force:** Modals can have universal and existential forces while attitude verbs only have a universal force.
4. **Question orientedness:** Modals do not take questions as an argument while attitude verbs can.

For each of the above points, I will outline why it can—at least at first sight—be viewed as a candidate for a genuine difference between the two categories, and thus a challenge for a unified analysis. At the same time, recent advancements in the modal and attitudinal semantics make the arguments about the differences more nuanced than they initially seem.

2.1 Sensitivity to an individual argument

The first difference we consider concerns the involvement of the individual argument in the specification of the domain of quantification over worlds. As one can easily see by consulting the truth conditions below (repeated from §1 above), the interpretations of an attitude verb in (6) differ from that of a modal in (7) in that the domain of quantification over worlds in the former is sensitive to the attitude holder argument (represented with the variable x).

- (6) $\llbracket x \text{ believes that } p \rrbracket^w = 1$
iff for all worlds w' compatible with x 's beliefs in w , $p(w') = 1$

- (7) $\llbracket \text{must}_{epi} p \rrbracket^w = 1$ iff for all worlds w' compatible with the evidence available in w , $p(w') = 1$

There is no corresponding individual argument that ‘anchors’ the domain of quantification for *must* in (7). One might view this difference as a challenge to a truly unified analysis.

What complicates the picture here is the fact that the domain of quantification for root modals may be sensitive to the subject (See Ch. 8 ‘Priority Modality’, Ch. 9 ‘Circumstantial and Ability Modals’, Ch. 22 ‘The notional category of evidentiality’). Portner (2009: 186-8) discusses this with the teleological (goal-oriented) reading of *should*, as in the following example.

- (8) Mary **should** take the subway.

Under the possible-world analysis, the truth conditions of (8) can roughly be stated as follows:³

- (9) For all worlds compatible with **Mary’s** goals, Mary takes the subway.

What is important here is that the relevant goals are specified to be *Mary’s* goals, and not goals in general. To derive such an interpretation, we have to make *should* sensitive to the individual argument corresponding to the subject. Building on syntactic analyses that treat root modals as **control** predicates with a subject argument (e.g. Ross 1969, Jackendoff 1972, Zubizarreta 1982, Roberts 1985, Brennan 1993) (as opposed to epistemic modals which are analyzed as **raising** predicates), we can formalize the semantics of *should* sensitive to an individual argument as follows:

- (10) $\llbracket x \text{ should}_{tel} p \rrbracket^w = 1$ iff for all worlds compatible with x ’s goals in w , $p(w) = 1$

If the analysis of root modals along these lines turns out to be correct, the involvement of an individual argument will not be a defining characteristic of attitude verbs that distinguishes them from modals. Rather, what emerges is a view where the difference between those world-quantifiers that involve an individual argument and those that do not is reduced to their argument structure, which are orthogonal to the distinction between attitude verbs vs. modals. Both root modals and attitude verbs take a subject as an argument and represent it in their semantics as an anchor in the domain of quantification. On the other hand, epistemic modals are raising predicates which do not take a subject as an argument. Under this view, then, the difference does not challenge the Hypothesis as we stated in (5) as it is reduced to an independent difference between the categories.

Note that the analysis of root modals as control predicates is not universally accepted. See Bhatt (1998), Hackl (1998), Wurmbrand (1999) among

³Technically, the domain in (9) must be further restricted with respect to circumstantially accessible worlds, i.e., those worlds that conform to the laws of nature in the evaluation world. I am leaving this aside here to aid readability.

others for syntactic arguments according to which modals in general are raising predicates. Hacquard (2006, 2010) offers a way to reconcile the unified syntax of modals as raising predicates with the subject-sensitive interpretation of root modals exemplified in (10). In Hacquard (2006, 2010), all modals are semantically sensitive to an event. The event argument is syntactically represented by a covert event pronoun that is bound by a local binder, which can either be the Asp(ect) head, an attitude verb, or the speech event, depending on the syntactic configurations. In particular, following the syntactic literature on the hierarchy of functional projections (Cinque 1999), Hacquard assumes that root modals are generated below Asp while epistemic modals are generated above it. This results in the binding of root modals' event argument by Asp, which has the function of relativizing the domain to the circumstances surrounding the event, including its agent/experiencer and location etc. On the other hand, epistemic modals are relativized to the event described by the embedding attitude verb (if there is any) or to the speech event. Hence, Hacquard's analysis achieves unification of root and epistemic modals as operators sensitive to an event argument. Based on the neo-Davidsonian event semantics, this perspective allows further unification of modals and attitude verbs: both are analyzed as a quantifier over worlds sensitive to an event, through which the agent of the event can be retrieved. Thus, even under the view where all modals are syntactically raising predicates, attitude verbs' sensitivity to an individual argument can be given an analysis that is parallel to that of modals. See Hacquard (2006, 2010) and Hacquard (2013) for details of the proposal as well as interesting discussions regarding the potential grammaticalization paths from attitude verbs to modals.⁴

2.2 Lexical specification vs. context sensitivity of the domain

The second potential difference concerns the lexical specification for the domain of quantification over worlds. Attitude verbs lexically specify a domain of quantification. On the other hand, a single modal auxiliary in English are compatible with different types of domains, or MODAL FLAVORS, depending on the context. The variability of flavors for *must* can be seen in the following examples:

- (11) a. In view of the available evidence, it **must** be raining right now.
(epistemic)
b. In view of his teacher's orders, John **must** put down his phone.
(deontic)

⁴In more recent years, event relativity has been invoked for the fine-grained analysis of both modals and attitude verbs. This includes analyses of subjunctives by Portner and Rubinstein (2020) and Alons-Ovalle et al. (2024) (see also Ch. 14 'Mood and Modality') as well as analyses of the selectional properties of attitude predicates by White and Rawlins (2016), White (2021) and Özyıldız (2021).

- c. In view of winning the tournament, John **must** win this game.
(teleological)

In light of such context sensitivity, it is standard to analyze a modal flavor as not completely specified by the lexical semantics of the modal element, but by contextually-determined variables, or what Kratzer (1977, 1981, 2012) calls Conversational Backgrounds. Thus, at least *prima facie*, there is a difference in the degree of lexical specification in the domain of quantification between attitude verbs and modals. While attitude verbs lexically specify a domain, modals don't.

A closer look at the data reveals that this perspective is too simplistic. We have cases where attitude verbs exhibit context sensitivity in determining the domain, as well as cases where a modal element lexically specifies its flavor. Below, I will survey these cases in turn.

2.2.1 Context sensitivity of attitude verbs

An attitude verb whose domain exhibits context sensitivity can be exemplified below with *want*, inspired by a similar example by Jerzak (2019).

- (12) **Context:** *Ethan is tasked with bringing wine for a friend's party. Now at a nearby liquor store, he has narrowed down the options to a Sauvignon Blanc and a Zinfandel, considering his budget. He has no knowledge of the flavors of these wines. These wines in fact taste the same to him. However, the other guests of the party would prefer the Zinfandel over the Sauvignon Blanc. The Zinfandel costs £30 while the Sauvignon Blanc costs £25.*
 - a. To bring the best wine to the party, Ethan **wants** to choose the Zinfandel. (true)
 - b. To save money in the short term, Ethan **wants** to choose the Zinfandel. (false)

In this context, there is a true reading of the *want*-ascription *Ethan **wants** to choose the Zinfandel*, as demonstrated in (12a). But there is also a false reading, as demonstrated in (12b). What these examples show is that the domain of quantification for *want* can shift depending on context (which can be overtly manipulated with the rationale phrases), resulting in the following two distinct interpretations for the *want*-ascription.

- (13) a. Among the possible worlds compatible with what we know, the best worlds, according to the goal of bringing the best wine for the party, are those where Ethan chooses the Zinfandel.
- b. Among the possible worlds compatible with what we know, the best worlds, according to the goal of Ethan saving money in the short term, are those where Ethan chooses the Zinfandel.

Readers familiar with the Kratzerian analysis of modals (Kratzer 1977, 1981, 2012) will have noticed that the context sensitivity of *want* illustrated above

concerns the **ordering source**, i.e. the relative ordering among the worlds in the **modal base**, which determines the set of worlds based on specific accessibility relations (see Ch. 4 ‘The Construction of Modal Domains—the Kratzerian View’). In the case of (13) we have different ordering sources depending on different goals, but we have a fixed modal base, the epistemic modal base corresponding to what is known. This contrasts with *must* in (11), which can be interpreted using an epistemic modal base (11a) or a circumstantial one (11b, 11c).

We may wonder, then, whether we have cases where attitude verbs involve different modal bases depending on the context. If we cannot find such a case, lexical specification vs. context sensitivity of the modal base might turn out to be a viable point of variation between attitude verbs and modals.

While English attitude verbs rarely exhibit context sensitivity with respect to its modal base, cross-linguistic studies suggest such cases do exist. Specifically, Bogal-Allbritten’s (2016) description of the Navajo verb *nízin* suggests that it is ambiguous between a ‘believe’ sense and a ‘want’ sense, as exemplified below:

- (14) Alice [nahodoołtíł] **nízin**.
 Alice 3S.rain.FUT 3S.NIZIN
 ‘Alice thinks it will rain.’ OR ‘Alice wants it to rain.’
- (15) Hastiin [nahodoołtíł sha’shin] **nízin**.
 man 3S.rain.FUT MODAL 3S.NIZIN
 ‘The man thinks it will probably rain.’
- (16) [Níneeł laanaa] **nisin**.
 2S.tall.IMPF MODAL 1S.NIZIN
 ‘I wish you were tall.’

In (14), *nízin* is ambiguous. In (15), it is unambiguously interpreted as ‘think’/ ‘believe’ while in (16) it is interpreted as ‘wish’. As noted by Bogal-Allbritten, the modal base for (16) cannot be a simple doxastic modal base, as it involves a counterfactual wish which is incompatible with the attitude holder’s beliefs. Thus, if we were to apply the possible-world analysis along the lines of what we sketched in §1 to *nízin*, a reasonable choice is to assume context sensitivity of the modal base.

However, the situation is more nuanced. Bogal-Allbritten (2016) shows that *nízin* can have a ‘think’ interpretation with respect to a conjunct of a coordinated complement while having a ‘wish’ interpretation with respect to the other conjunct, as shown below:

- (17) **Context:** *Alice thinks Bill moved to Flagstaff. She wants to go visit him some time, but she does not have any definite plans to do so and knows it is very likely it will not happen. I’m telling you about Alice.*
- Alice [Bill Kinłánígóó ‘íiná] dóó [bich’i deeshááł]
 Alice Bill Flagstaff.to 3S.move.PERF and 3O.to 1S.go.FUT
nízin
 3S.NIZIN.IMPF

‘Alice think Bill moved to Flagstaff and she wants to go see him.’
(Bogal-Allbritten 2016: 145)

This example cannot be accounted for if we take *nízin* to contribute the domain of quantification, even if it is determined in a context-sensitive manner. Bogal-Allbritten instead argues that *nízin* itself does not contribute quantification over worlds, and that there are separate modal elements (overtly expressed as *sha’shin* and *laanaa* in (15-16); covert elsewhere). The analysis is based on Kratzer’s (2006, 2013) decomposition analysis of attitudes, according to which attitude predicates are decomposed into a predicate of contentful objects (or situations) and a covert modality. In this sense, it is unclear whether *nízin* itself exhibits a genuine case of context sensitivity with respect to the modal base. I will come back to the decomposition analysis of attitudes in §3.

Močnik and Abramovitz (2019) offer a possible case of context sensitivity in the modal base for an attitude verb in Koryak. The verb *ivək* in Koryak is compatible with several readings, including speech reports, belief reports, hope/fear-reports, as exemplified below. (We will revisit the ‘allow’ reading when we discuss the quantificational force in §2.3.)

- (18) meλλo kivəŋ, (əno) kumuqetəŋ
Melljo IVək.3SG.PRS that rain.3SG.PRS
‘Melljo {says, thinks, allows, hopes, fears} that it’s raining.’
(Močnik and Abramovitz 2019: 495)

Using a coordination similar to (17), Močnik and Abramovitz show that a single occurrence of *ivək* cannot embed a conjoined complement involving a speech content and a belief content. The following sentence, for example, is infelicitous.

- (19) #inenɣəjulevətʃʔən ivi əno əninew jeɣyutʃewŋəlʔu metʔaŋ
teacher IVək.3SG.PST that his students well
kojajyotʃawŋəlaŋ ʔam əno qekwaŋ kojajyotʃawŋəl
study.3PL.PRS but that badly study.3PL.PRS
‘The teacher said that his students are studying well but thought that they were studying badly.’ (intended)
(Močnik and Abramovitz 2019: 501)

This shows that the decomposition analysis along the lines of Bogal-Allbritten’s (2016) analysis of Navajo *nízin* is not plausible for the ‘say’/‘think’ ambiguity. Močnik and Abramovitz go on to propose a lexical entry for *ivək* which is ambiguous with respect to the modal base.⁵

⁵Interestingly, a parallel test with respect to the ‘think’/‘hope’ ambiguity results in a different outcome. The following example is felicitous:

- (i) təkivəŋ [əno tatjana kotvaŋ novosibirskək] to [əno ečyi kukəčviʔetəŋ]
ivək.1SG.PRS that Tatiana be.3SG.PRS in.Novosibirsk and that today happy.3SG.PRS
‘I think that Tatiana is in Novosibirsk and I hope that she is happy today.’
(Močnik and Abramovitz 2019: 501)

2.2.2 Modals with lexical specification

An example of a modal element which lexically specifies the flavor is English *might*. As exemplified below, *might* is only compatible with the *epistemic* flavor but not with root flavors, such as deontic, circumstantial and teleological flavors.

- (20) Bill might leave.
 ≈ It possible given what we know that Bill will leave. (epistemic)
 ≠ Bill is allowed to leave. (deontic)
 ≠ Bill is capable of leaving. (circumstantial)
 ≠ It is compatible with Bill's goals that he leaves. (teleological)

Expanding our perspective beyond English, Rullmann et al. (2008) show that modals in St'át'imcets have fixed modal flavors but variable forces. For instance, the element *k'a* is consistently epistemic, while *kelh* is restricted to the future. We will revisit the phenomenon of variable force in §2.3. For now, what is most relevant to our discussion is the existence of modals with fixed flavors.

2.2.3 Interim summary

Overall, we have found cases that seem to go against the hypothesis that attitude verbs and modals are distinguished in terms of the lexical specification of the domain of quantification. In both categories, the domain of quantification can be flexible in principle, while lexical specification is also possible. This can be accounted for if we have a suitable enrichment of the baseline model that allows flexibility as well as lexical specification in the domain. Specifically, Kratzer's theory in terms of conversational backgrounds offers such a theory—The domain of quantification is determined by variables whose values are determined in the context. At the same time, lexical items can impose restrictions on the variables so it only allows certain values.

2.3 Quantificational forces

2.3.1 Existential attitudes

Another potential difference between attitude verbs and modals pertains to their quantificational force. In the baseline Hintikka analysis presented in §1, all attitude verbs involve a *universal* quantificational force. In contrast, we see variability in the quantificational force across items within modals, *must* being an example of a necessity modal with a universal force while *might* an example of a possibility modal with an existential force, as illustrated below (see also Ch. 11 'Modal Force and its realization across languages'):

Based on this type of evidence, M&A analyze the bouletic reading to arise from an embedded modal, rather than the attitude verb itself.

- (21) $\llbracket \text{must}_{epi} p \rrbracket^w = 1$ iff for **all** worlds w' compatible with the evidence available in w , $p(w') = 1$ (= (11a))
- (22) $\llbracket \text{may}_{epi} p \rrbracket^w = 1$ iff **there is some** world w' compatible with the evidence available in w such that $p(w') = 1$

One may speculate that all attitude verbs, cross-linguistically, have a universal force. The gap for existential attitude verbs would then be something a unified analysis of modals and attitude verbs would have to account for.⁶

Cross-linguistic studies on attitude verbs have again provided important data regarding this issue. Močnik (2019) has shown that Slovenian *dopuščati* ‘to allow for the possibility’ is a doxastic verb with an existential quantificational force:

- (23) Dopuščam, da utegne biti sončno.
allow.1SG that might be sunny
‘I allow for the possibility that it might be sunny.’

Močnik and Abramovitz (2019) argue that Koryak *ivək*, which we have seen already in the previous section, is in fact ambiguous between a universal force and an existential force. The existential reading for *ivək* is exemplified below:

- (24) ?ewŋəto kivəŋ əno kumuqetəŋ, ?am ?opta kivəŋ
Hewngyto ivək.3SG.PRS that rain.3SG.PRS but also ivək.3SG.PRS
əno uŋŋe emuqetke.
that NEG rain
‘Hewngyto allows that it is raining but also allows that it is not raining.’

Note that the sentence would be felt contradictory (or as attributing a contradictory belief to Hewngyto) if *ivək* only allowed a universal reading.⁷

2.3.2 Polarity-sensitive force variability

In the realm of quantificational force, a further parallel may be drawn between modals and attitude verbs in the behavior of ‘variable-force’ items. After the

⁶To my knowledge, this speculation has not been explicitly put forward in the extant literature. A pertinent discussion of the speculation as well as the potential theoretical question it entails can be found in the lecture notes by von Fintel and Heim (2011), which includes the following exercise:

[A]re there attitude predicates with such an “existential” meaning? Discuss some candidates. If you can’t find any candidates that survive scrutiny, can you speculate why there might be no existential attitude predicates? [Warning: this is unexplored territory!]
(von Fintel and Heim 2011: 21)

⁷The semantics of *doubt* and its cross-linguistic counterparts is another interesting case to consider in this context. Uegaki (2023) argues that *doubt p* has a weak semantics that roughly corresponds to the negation of the universal Hintikka analysis of *believe*. Matticchio (2024) provides an alternative analysis where *doubt* has a universal force corresponding to ‘believe $\neg p$ ’. In both cases, the analysis faces an interesting challenge when we consider the fact that both ‘doubt *p*’ and its negation ‘not doubt that *p*’ seem to license a strong reading (corresponding roughly to ‘believe not-*p*’ and ‘believe *p*’). See the discussions in the cited papers for details.

groundbreaking work by Matthewson et al. (2007), Rullmann et al. (2008) on St’át’imcets modals, a number of researchers have documented variable-force modals, i.e., modal auxiliaries that allow both possibility and necessity readings. This includes Peterson (2010), Deal (2011), Bochnak (2015), Jeretič (2021), Newkirk (2022) and Staniszewski (2022) (see also Ch. 11 ‘Modal Force and its realization across languages’). Among these authors, Deal, Jeretič and Staniszewski in particular have discussed interesting typologies regarding how the interpretations of variable-free modals are conditioned by their syntactic/semantic environments.

The basic picture is this.⁸ When a modal element has an underlying possibility semantics and does not have a ‘dual’, i.e., its necessity counterpart, it can undergo a semantic and/or pragmatic process (akin to scalar implicature; Fox 2007; Bar-Lev and Fox 2020; cf. Franke 2009) that strengthens its meaning to one that is equivalent to a necessity modal. This strengthening mechanism is independently motivated by the behavior of various phenomena involving a ‘scaleless’ item (i.e., an item that lacks a stronger scalemate), including free choice disjunction (Fox 2007), Walpiri disjunction *manu* (Bowler 2015), Hebrew quantifier *kol* (Bar-Lev and Margulis 2014), the homogeneity effect of definite plurals (Bar-Lev 2020), among others. I will schematically notate this strengthening process as follows, with $\Diamond$ representing a possibility modal and $\Box$ a necessity modal.

$$(25) \quad \Diamond p \xrightarrow[\text{strengthen}]{} \Box p$$

Crucially, this strengthening mechanism is predicted to have an effect only if the operator is unembedded or embedded under a non-downward-entailing operator. If the modal is embedded under a downward-entailing operator, such as negation, the mechanism returns the same interpretation. This is because, roughly, the negation of a possibility modal (impossibility) is already strong in the relevant sense and cannot be strengthened anymore:

$$(26) \quad \neg \Diamond p \xrightarrow[\text{strengthen}]{} \neg \Diamond p$$

Jeretič (2021) shows that the Ecuadorian Siona root modal *ba’iji* exhibits exactly this pattern. First, it has a necessity interpretation in an unembedded context, as follows:

$$(27) \quad \begin{array}{lll} \text{Ja-ë-bi} & \text{tsoa-ye} & \text{ba-’i-ji.} \\ \text{DEM.DST-CLS:ANIM.M-SBJ} & \text{wash-CLS:GEN} & \text{be-IPF-3S.M.PRS.ASRT} \\ \text{‘He has to wash something.’} & & \text{(Bruil 2014: 217)} \end{array}$$

In contrast, under a clause-mate negation, it has a possibility reading, as exemplified below:

⁸The following discussion closely follows Jeretič (2021) and Staniszewski (2022). It should be noted that Deal (2011) does not assume strengthening for her target modal, Nez Perce *o’qa*, in unembedded environments.

- (28) Sai-ye **beo-ji**.
 go-INF NEG.be-3S
Available: ‘We mustn’t go.’
Unavailable: ‘We don’t have to go.’ (Jeretič 2021: 79)

The fact that *ba’iji* has an underlying possibility semantics can be established by the observation that it can mark a felicitous answer to a question of the form ‘Is it possible that p or not?’, as follows:

- (29) *Context: A and B want to get to the other side of the river.*
 A: Tsiaya je’e-ñe **ba-’i-quë**?
 river cross-INF be-IPF-NONASRT
 ‘Can we cross the river?’
 B: (Tsiaya je’e-ñe) **ba-’i-ji**.
 river cross-INF be-IPF-ASRT
 ‘(Yes), we can cross the river.’ (Jeretič 2021: 63)

Jeretič provides a formal analysis of the pattern based on an existential semantics for *ba-’i-ji* and an obligatory grammatical strengthening mechanism.

Staniszewski (2022) argues that the quantificational force of the attitude verb *want* can be analyzed in a similar way. First, based on the data like the following (originally due to Homer 2015), he motivates the existential semantics for *want*.

- (30) I no longer want to be called an idiot.

In the most salient reading of (30), the speaker of (30) never had the desire to be called an idiot. Rather, Staniszewski argues, it has the reading that can be paraphrased as follows:

- (31) I used to tolerate/acquiesce to being called an idiot, but now, I don’t want to be (called an idiot).

Assuming that *no longer* presupposes that the content of its scope used to hold, the data suggest that *want* expresses tolerance/acquiescence, which can be modeled in terms of existential quantification over worlds that are ideal with respect to the attitude holder’s preferences.⁹

⁹Staniszewski (2022) argues that *want* in (30) is in the scope of *no longer*, pace Homer (2015) who analyzes *want* in (30) as covertly scoping over *no longer*. The argument is based on a pair such as the following (Staniszewski 2022: 202):

- (i) *(Uttered by a speaker who has never found it acceptable that Trump would be president)*
 a. #I no longer want Trump to be president.
 b. I want Trump to no longer be president.

Under the view where *want* takes scope over *no longer* in (ia), it is difficult to account for the fact that (ia) is infelicitous in the given context, unlike (ib), which can be assumed to have the *want* > *no longer* scope configuration. The contrast in (i) can however be accounted for if *no longer* takes scope over *want* in (ia), but not in (iib), once we have the existential semantics for *want* and the presupposition for *no longer* that its scope used to hold. Under such a view, (ia) has the presupposition that the speaker used to find it acceptable that Trump would be president, which is not satisfied in the given context.

This existential interpretation is strengthened in unembedded contexts to a universal interpretation in the same way Siona *ba'iji* is strengthened in Jereti'vc's analysis. In addition, under downward-entailing contexts, the existential interpretation arises, again in a way parallel to the case of *ba'iji*. This accounts for the neg-raising interpretation of *want* under negation. For example, the assertive meanings of (30) and the second clause of (31) convey the speaker's desire not to be called an idiot. Jeretič and Steniszewski furthermore discuss how modals and attitude verbs having an underlyingly universal semantics undergo the strengthening mechanism under negation, giving rise to a neg-raising effect via a different route. See also Mirrazi and Zeijlstra (2021) for a similar analysis of the neg-raising effect for attitude verbs.

2.3.3 Strength distinction

An issue related to the quantificational force concerns the **strength** distinction between **strong** and **weak necessity**. In the following example, we have a strong necessity deontic modal *must* in contrast with the weak necessity modal *ought to*.

- (32) Employees **must** wash their hands. Non-employees really **ought to** wash their hands, too. (von Fintel and Matthewson 2008: 115)¹⁰

In a number of languages, the strength distinction within necessity modals is morpho-syntactically marked in the paradigm of modal auxiliaries, either in terms of a lexical distinction or in terms of an additional morphology on the necessity modal. In Uegaki, Mucha et al.'s (2024) database of modal paradigms with the sample of 24 languages, the following languages involve (a) a lexical encoding and (b) a morphological encoding of the strength distinction:¹¹

- (33) a. Akan, Cantonese, Hausa, Hindi, Igbo, Japanese, Khmer, Mandarin, Russian, Thai, Vietnamese
b. Dutch, Greek, Hungarian, Mapudungun, Spanish, Vietnamese

We can add English to the list of languages with the lexical distinction, as exemplified with the *must* and *ought to* in (32). A paradigmatic example of a language with the morphological encoding is Greek, where weak necessity corresponds to the past form of strong necessity. This is exemplified below:

- (34) Tha eprepe na plinis ta piata ala dhen ise ipexreomenos na
FUT must.PAST NA wash the dishes but NEG are obliged NA
to kanis
it do
'You ought to do the dishes but you are not obliged to do it.'
(von Fintel and Iatridou 2023: 1492)

¹⁰From a cartoon appearing in the July 31, 2006 issue of the *New Yorker*.

¹¹The lists are not exclusive as different necessity items in a languages can have different encoding patterns.

Turning to attitude verbs, to the best of my knowledge, there is no widespread pattern with respect to lexical distinctions between attitude verbs with a strong necessity meaning and a weak necessity meaning. In fact, it is interesting to note that, in many European languages, the same morphology that creates a weak necessity modal out of a strong necessity modal, the so-called X-marking (after von Fintel and Iatridou 2023) turns ‘want’ into a ‘wish’, a counterfactual desire verb. This is exemplified below for Greek:

- (35) *tha ithele na ixe makritero krevati*
 fut want.PST.IMP NA had longer bed
 ‘He wishes he had a longer bed.’ (von Fintel and Iatridou 2023: 1495)

Under a naive parallelism view on modals and attitudes, we might expect the morphological marking to turn ‘want’ into a weaker desire verb, rather than a counterfactual desire. Thus, the apparent lack of the distinct lexical marking for ‘weak necessity attitudes’ as well as the unexpected effect of the X-marking on desire verbs call for an explanation under the unified semantics of modals and attitude predicates.

2.3.4 Interim summary

In this section, we have explored potential dimensions of difference between modals and attitude verbs in the realm of quantificational force. We have seen that both modals and attitude verbs exhibit universal and existential forces. We have specifically examined cases of existential attitudes as well as the phenomenon of polarity-sensitive force variability. Thus, if we just focus on existential and universal forces, it seems plausible that we can maintain uniformity between modals and attitude verbs. On the other hand, the strength distinction between strong and weak necessity presents a challenge for the uniform analysis, as we are not aware of the lexically/morpho-syntactically encoded strength distinction in the domain of attitudes.

2.4 Question-orientedness

Another dimension that may present a genuine variation between modals and attitudes concerns **question orientedness**. Although there are cases of question-oriented attitude verbs, such as *wonder* and *care* as we will see below, we do not seem to find clear cases of question-oriented modals.

Certain attitude verbs are question-oriented in the sense that they take questions, rather than propositions, as a semantic argument. A primary example of such a question-oriented attitude is *wonder*, as follows:

- (36) Haruo **wondered** whether Aadith had won his game.

Intuitively, the wondering attitude in (36) relates the attitude holder to the **question** of whether Aadith has won his game expressed by the interrogative

complement. The attitude does not target any **proposition** which would correspond to the possible answers of the question. In fact, *wonder* is incompatible with a declarative complement, which I assume to express a proposition:¹²

(37) ??Haruo **wondered** that Aadith had won his game.

Given these data, one might argue that *wonder* decomposes into ‘want/wish to know’, and hence, to the extent that *know* is proposition-oriented and *not* question-oriented, we do not have to posit a question-oriented attitude predicate in our semantic analysis. The intuition that *wonder* can be paraphrased as ‘want/wish to know’ has been suggested by many semanticists and philosophers, including Karttunen (1977), Boër (1978), Ginzburg (1995), Guerzoni and Sharvit (2007), Xiang (2021) and Deigan (????). At the same time, arguments against such a paraphrase has been made by Friedman (2013, 2019) and Uegaki (2022). Regardless of the outcome of this debate, however, the fact still stands that *wonder* lexicalizes a question-oriented attitudinal relation, whether or not that relation is decomposed in terms of a proposition-oriented attitude. An important piece of data to appreciate this point is that the combination *want to know* is compatible with interrogative complements but not with declarative complements:

(38) Haruo **wants/wishes to know** {whether/??that} Aadith had won his game.

Thus, even if one assumes a decomposition according to which *wonder* = *want/wish to know*, *wonder* lexicalizes an attitudinal relation that is compatible with a question, but not with a proposition.

Elliott et al. (2017) and Uegaki (2022) furthermore argue that certain attitude verbs that are syntactically compatible with declarative and interrogative complements are semantically question-oriented. The argument with *care* goes as follows: When *care* takes a declarative complement, it presupposes and entails that the attitude holder believes the content of the complement, as exemplified below:

- (39) a. Haruo **cares** that Aadith won. $\Rightarrow$ Haruo believes that Aadith won.
 b. Haruo does not **care** that Aadith won. $\Rightarrow$ Haruo believes that Aadith won.

In contrast, when *care* takes an interrogative complement, as in (40a), the sentence can be true even when there is no answer *p* such that the attitude holder believes *p*, i.e., when the attitude holder is totally ignorant. This can be seen by the fact that (40b) is coherent. This means that (40a) can be true even if there is no answer *p* such that *Haruo cares that p* is true (since *Haruo cares that p* entails Haruo believes *p*).

¹²Here, we set aside the use of *wonder* that has the sense of admiration or amazement. I consider this sense of *wonder* to be close to emotive factive predicates like *surprise* which are compatible with declarative complements. The question-directed sense of *wonder* in (36) has a distinct sense from this use.

- (40) a. Haruo cares which player won.
 b. Haruo cares which player won and wonders which player won.

If one were to analyze *care* as a proposition-oriented predicate and derive both its declarative-embedding (such as (39a)) and interrogative-embedding uses (such as (40a)) based on it, the fact above poses a challenge. This is so because, roughly speaking, the data show that the interpretation of (40a) cannot be paraphrased in term of the proposition-oriented *care* and answers to the question expressed by the interrogative complement. Instead, Uegaki (2022) (following Elliott et al. 2017 and Theiler et al. 2018) analyze *care* as a question-oriented predicate, as follows:

- (41) $\llbracket x \text{ cares } \varphi \rrbracket$
- presupposes that x believes that φ contains a true answer; and
 - if the presupposition is met, asserts that there is an answer $p \in \llbracket \varphi \rrbracket$ such that x prefers p or x prefers $\neg p$.

Here, φ can either be a declarative or an interrogative complement. The semantic content of an interrogative clause is its Hamblin denotation (i.e., the set of its possible propositional answers, Hamblin 1973) while that of a declarative clause is a singleton set consisting of its classical propositional value. Thus, informally, $\llbracket \text{which player won} \rrbracket = \{\text{'Player A won'}, \text{'Player B won'}, \text{'Player C won'}, \dots\}$ while $\llbracket \text{that A won} \rrbracket = \{\text{'A won'}\}$. This analysis captures the inference regarding the presupposition of belief in (39) and (40). The analysis predicts that (39) presupposes that Haruo believes that $\{\text{'Aadith won'}\}$ contains a true answer while (40a) presupposes that Haruo believes that $\{\text{'Player A won'}, \text{'Player B won'}, \text{'Player C won'}, \dots\}$ has a true answer (i.e., that some player won). What is crucial here is that the analysis in (41) treats *care* as targeting the proposition set represented by $\llbracket \varphi \rrbracket$ as a whole, rather than specific members of it. In this sense, the analysis treats *care* as question-oriented. Elliott et al. (2017) have argued that the class of predicates called Predicates of Relevance, which contains *matter* and *be relevant* along with *care* show a similar pattern. See Roberts (2018) for an argument that Estonian contemplative predicates, such as *mõtleva*, are question-oriented. Qing et al. (2025) furthermore maintain that certain non-veridical preferential predicates, such as *worry* and Mandarin *qidai* 'look forward to' are question-oriented.

Thus, there seem to be abundant cases of question-oriented attitude verbs. In contrast, question-oriented *modals* are scarcely attested, if at all. The only examples the author is aware of concern Japanese sentence-final particles *daroo* and *na* (Uegaki and Roelofsen 2018, Roelofsen and Uegaki 2021, Uegaki 2022). These are exemplified below:

Based on an argument parallel to the one above regarding *care*, Uegaki & Roelofsen argue that these particles are question-oriented. Below are examples of *na* from Uegaki (2022):

- (42) a. Ken-wa utau **na**.
 Ken-TOP sing NA

- ‘I think/suppose that Ken will sing.’
 b. Dare-ga utau ka-**na**.
 who-TOP sing Q-NA
 ‘I wonder who will sing.’

The particle *na* expresses a doxastic modality when it combines with a declarative clause, as in (42a), while it expresses the ‘wonder’ attitude when it combines with an interrogative clause, as in (42b).¹³ The interrogative-embedding sentence *Q-na* can be true when no proposition of the form *p-na* (where *p* is a possible answer to *Q*) is true. Thus, just like in the case of *care*, the semantics of *Q-na* is hard to paraphrase in terms of proposition-oriented semantics. Following an earlier proposal by Uegaki and Roelofsen (2018) and Hara (2024) for *daroo*, Uegaki (2022) proposes a question-oriented semantics for *na* implemented within Inquisitive Semantics, which treats clausal meanings to be proposition sets, regardless of whether they are declarative or interrogative, just as in the analysis of *care* in (41) above.

However, the status of these examples as genuine cases of question-oriented modal is questionable for two reasons. Firstly, there are several discourse-functional properties for these particles that seem to go beyond the type of modal semantics proposed in the works cited above. For example, Moriyama (1998) argues that *na* has the discourse function of ‘confirming’ information already existing in the common ground, similar to what has been argued for Japanese *ne* (see McCready and Davis 2020 for an survey of the semantics and pragmatics of these particles, as well as Ch. 28 ‘Modality and discourse particles’ for relations between modals and discourse particles in general). Thus, the characterization of the semantics of these particles as modal operators might have to be reconsidered in the first place. Secondly, the syntactic status of these particles are likely different from the modal auxiliaries we have focused on so far in this chapter. In the standard assumption about the syntax of Japanese sentence-final particles (e.g., Endo 2012), they are located in a syntactic projection above ForceP (where e.g., the question-operator is located and the clause type is specified) whereas modal auxiliaries are located below it, as follows:¹⁴

- (43) [_{SpActP} ... [_{ForceP} ... [_{ModP} TP **modal**] Q] **SFP**]

Given these considerations, one may maintain that there is genuine variation between modals and attitude verbs with respect to the possibility of question-oriented operators. At the same time, the syntactic consideration outlined above also paves a way for a possible syntactic explanation of the variation. If we follow the standard assumptions in syntax (e.g., Rizzi 1997) regarding the left periphery, the Force head that determines the clause type is specified in a projection above a modal:

- (44) [_{ForceP} Force ... [_{Mod_{epi}P} Mod_{epi} [_{TP} T [_{AspP} Asp [_{Mod_{root}P} Mod_{root} vP]]]]]]

¹³More precisely, Uegaki (2022) claims that (42b) is in fact compatible with the speaker believing that a specific person will sing, and thus the relevant question-oriented sense does not entail ignorance, unlike *wonder*.

¹⁴The structure is represented with the head finality of the Japanese syntax.

If we combine the syntax with the compositional semantic assumption that sentential meanings up to $\text{Mod}_{\text{epi}}P$ is propositional, which can be converted to a question type (e.g., a set of propositions) if there is a question operator at Force, it follows that modals never embed a question. On the other hand, something that can embed a constituent larger than $\text{Force}P$, such as a sentence final particle or an embedding attitude verb, may syntactically embed a constituent that denotes a question. In this sense, although the variation with respect to question orientedness may turn out to be a genuine difference between modals and attitude verbs, it may be reduced to a syntactic difference between the two categories.

2.5 Taking stock

To take stock, we have surveyed four potential differences between the semantics of modal auxiliaries and attitude verbs listed below, and questioned whether they pose challenges for the unified semantics of modals and attitude verbs:

1. **Sensitivity to an individual argument:** Modals only take a propositional argument while attitude verbs take an individual argument in addition to a propositional argument.
2. **Lexical specification of the domain of quantification:** Modals do not lexically encode a specific domain of quantification over worlds—they exhibit context sensitivity—while attitude verbs lexically specify the domain.
3. **Quantificational force:** Modals can have universal and existential forces while attitude verbs only have a universal force.
4. **Question orientedness:** Modals do not take questions as an argument while attitude verbs can.

Regarding Difference 1, its assessment depends on syntactic assumptions about the control/raising status of root modals. If root modals are control predicates, they are like attitude verbs in being sensitive to an individual argument. The difference between root modals and attitude verbs on the one hand the epistemic modals on the other will then be reduced to a syntactic difference. If root modals are raising predicates, on the other hand, Hacquard's event-relative approach to modals will provide a refined unified analysis of attitudes and modals: they are all sensitive to an event, which can be substantiated differently depending on the syntactic configurations they appear in.

With respect to Difference 2, I have surveyed recent cross-linguistic studies that suggest that attitude verbs too may exhibit underspecification/context-sensitivity with respect to the domain of quantification. In addition, we have seen examples of modals that involve a lexical specification of flavors. Thus, we can conclude that this does not constitute a categorical distinction between the two classes.

The conclusion is similar with respect to Difference 3 as far as the existential/universal distinction is concerned. Cross-linguistic studies on attitude

verbs reveal plenty of evidence that there are existential attitudes. In addition, there are attitude verbs that exhibit variable behavior in the quantificational force in a way parallel to some modal auxiliaries. However, the strength distinction remains as a puzzle for our unified Hypothesis. Although the strength distinction among necessity modals seems to be wide-spread, we do not find a parallel pattern in the domain of attitude verbs.

As for Difference 4, my conclusion is that there is so far little evidence to undermine the possibility that there is a genuine difference with respect to the possibility of question orientedness. At the same time, we have seen that it can be reduced to the difference in the size of the syntactic constituent that modals and attitude verbs embed.

So, where do we stand with respect to our hypothesis repeated below?

- (5) **Hypothesis:** Modals and attitude verbs can be given a unified analysis in terms of quantification over possible-worlds. Any difference between the semantics of the two classes can be reduced to independent differences between the two categories, such as their syntactic properties.

On the one hand, we can see that Differences 2 and 3, which seemed plausible at first glance, turned out to be untenable after further empirical scrutiny. Differences 1 and 4 may be empirically upheld. However, there may be ways to maintain a form of unified semantics despite the variation and/or ways to reduce the variation to syntax. Notably the discussion also revealed that maintaining the hypothesis in view of the differences puts a substantial constraint on the theoretical accounts. Specifically, if we are to maintain the Hypothesis, Difference 1 may call for an event-relative treatment of modals, as proposed by Hacquard. Also, reducing Difference 4 to syntax requires a specific view on the compositional semantics of questions, namely one in which the question denotation is formed by an operator at a certain syntactic height above the modal. This is at odds with a view in which the basic type of the semantic content of a sentence is a set of propositions, e.g., Inquisitive Semantics (Ciardelli et al. 2018).

Above, I have dismissed Differences 2 and 3 in light of cross-linguistic examples that go against them. However, it is still possible that the differences can be upheld as **statistical universals** that hold for a significantly large proportion of modals and attitude verbs cross-linguistically. If this is the case, such statistical tendencies will call for an explanation if one were to maintain a unified semantics of modals and attitude verbs.

All in all, we need more cross-linguistic empirical work to evaluate to what extent the hypothesized differences in 1-4 can be upheld, either as categorical universals or as statistical universals. At the same time, theoretical investigation is required to explore the theoretical ramifications of the observed differences between modals and attitude verbs, and how they may or may not challenge the unified view of the two categories.

3 A content-based analysis of attitudes

In the past two decades, a number of semanticists have developed a **content-based analysis** of attitudinal complementation which explicitly represents the modal component in the compositional semantics of attitude reports (e.g., Kratzer 2006, Moulton 2009, Kratzer 2013, Elliott 2017, Moltmann 2020, Bassi and Bondarenko 2020, Bondarenko 2022). The analysis can be taken to be a natural alternative to the baseline theory presented in §1 which still adheres to the aim of unifying the semantics of modals and attitude verbs. For this reason, it is worth discussing its basic implementation and how it fares with Differences 1-4 we discussed in the previous section.¹⁵

The basic tenet of the content-based analysis of attitudes is the separation of the attitudinal component involving a certain ‘content’ and the quantificational component with respect to this content. For example, *Haruo believes that it is raining* involves Haruo’s believing event/state, whose content is such that it is raining in all worlds compatible with it. For expository purposes, I will adopt the following event-semantic implementation of the analysis, loosely following Kratzer (2006), Elliott (2017).¹⁶

- (45) a. $\llbracket \text{believe} \rrbracket^w = \lambda e_v : e \in \text{Dom}(\text{Con}). \text{believe}_w(e)$
 b. $\llbracket \text{that}_v \rrbracket^w = \lambda p_{st} \lambda e_v. \text{ for all worlds } w' \text{ compatible with } \text{Con}_w(e),$
 $p(w') = 1$
 where $\text{Con}_w(e)$ is the content of the event e in world w .

Note that the attitude verb simply represents an event predicate true of any believing eventuality while the complementizer *that* contributes universal quantification over worlds compatible with a content of an event. (Here, I will follow Kratzer (2006) in assuming that the complementizer contributes the quantificational component. However, this is not a crucial assumption. One may also assume that the combination of the two items in (45) is spelled out as the attitude verb *believe* in English.)

An embedded proposition combines with the complementizer *that* with functional application while *believe* combines with the result of this composition with predicate modification. We then arrive at the following denotation of the VP:

¹⁵This section will require more formal backgrounds than assumed in the previous sections. Specifically, I will assume knowledge of a compositional semantic framework along the lines of Heim and Kratzer (1998) as well as the neo-Davidsonian event semantics. Readers can skip the section without missing the central claims of the chapter.

¹⁶The precise implementation of the content-based analysis in Elliott (2017) makes a substantial departure from the implementation presented in this subsection, in a way that bears on the unification of modals and attitude verbs. Instead of an analysis that yields a Hintikka analysis of attitudes, as in (45), Elliott (2017) offers an equality semantics, according to which the content of an event equals the embedded proposition. This would yield a semantics for attitudes no longer shares important properties with quantificational semantics for modals, such as closure properties. Argument for the equality semantics can be seen in Moulton (2009), Elliott (2017), Bassi and Bondarenko (2020), Bondarenko (2022) and Bondarenko and Elliott (2024).

- (46) $\lambda e_v: e \in Dom(Con). \text{believe}_w(e) \ \& \text{ for all worlds } w' \text{ compatible with } Con_w(e), p(w') = 1$

With an attitude holder argument introduced by a separate head and an existential closure, we arrive at the following truth conditions for *Haruo believes that p*.

- (47) $\exists e[\text{holder}_w(e, \text{haruo}) \ \& \text{believe}_w(e) \ \& \text{ for all worlds } w' \text{ compatible with } Con_w(e), p(w') = 1]$

Thus, with different assumptions about the compositional ingredients, the analysis arrives at the truth conditions close to the ones based on the baseline analysis given in §1. Notably, the modal component is explicitly represented in this analysis by the semantics of the complementizer.

Researchers have motivated the content-based analysis of attitudes in view of various empirical considerations, including the interpretation of nominal complements of attitude predicates (e.g. Elliott 2017) and the adjunctive syntactic behavior of complements Moulton (e.g. 2009). Since the purpose of this chapter is not to adjudicate the theory of attitude verbs, the empirical motivations for the content-based analysis will not concern us here. What is relevant is to what extent the analysis offers an account of the differences (or lack thereof) between modals and attitude verbs we have observed in §2.

I will again repeat the four (potential) differences below as a reminder:

1. **Sensitivity to an individual argument**
2. **Lexical specification of the domain of quantification**
3. **Quantificational force**
4. **Question orientedness**

If we have the content-based analysis of attitudes alongside the baseline possible-world analysis of modals in §1, how can we account for the empirical facts observed in §2 regarding Differences 1-4?

With respect to Difference 1, the analysis will follow Hacquard's insight in making both modals and attitude verbs sensitive to events. Through the event argument, information about the agent can be retrieved in the case of root modals and attitude verbs. The syntactic manifestation of the individual argument is analyzed to be distinct between the two cases. For attitude verbs, the individual argument is syntactically introduced by a separate head, and thus is syntactically represented. For root modals, the individual argument is not syntactically represented. Information about the participants of the event is only indirectly accessed through the event argument.

Turning to Difference 2, the flexibility of the domain of quantification for attitude verbs can again be accounted for in terms of context dependency with respect to conversational backgrounds. Specifically, along the lines of Močnik and Abramovitz (2019), we can assume that attitude verbs take (implicit) arguments that correspond to the conversational backgrounds, which constrain the type of content their event argument is compatible with (see also Portner and Rubinstein 2020). This context dependency can of course be constrained,

so the lexical specification with respect to the domain is also amenable to the analysis.

As for Difference 3, the possibility of existential attitudes is not accounted for by the analysis outlined above. But, it is natural to assume that the complementizer comes with the existential version as well, as defined below, in a way parallel to what we assume for possibility modals.

$$(48) \quad \llbracket \text{that}_{\exists} \rrbracket^w = \lambda p_{st} \lambda e_v. \text{ for some world } w' \text{ compatible with } Con_w(e), p(w') = 1$$

A minor issue is how to account for the lexical specification of attitude verbs regarding the force. Aside from the Koryak *ivək* discussed by Močnik (2019), attitude verbs we have dealt with in this chapter lexically specify their underlying force. Without any kind of restriction, all attitude verbs would have variable force, a prediction we have to avoid. The lexical specification of force can be accounted for either by syntactic or semantic mechanisms. Syntactically, we may assume that attitude verbs select for a certain declarative complementizer, *that*_∃ or *that*_v. Alternatively, we may assume that the event argument of *that*_∃ is compatible with events that are true of specific attitudinal predicates, such as *dopuščati* in Slovenian and *want* in English under Staniszewski's (2022) analysis.

The apparent lack of the strength distinction for attitudes still remains as a puzzle in the content-based analysis. If we aim for a unified analysis of the modal contribution of the complementizer in attitudinal complementation and that of modal auxiliaries, the difference in the strength distinction calls for a further explanation.

Finally, the difference in the question-orientedness (Difference 4) can again be reduced to syntactic differences between attitude verbs and modal auxiliaries, depending on one's assumption about the syntax/semantics of question formation. The required assumption is that, although attitude verbs can embed a constituent that contains a question-forming operator, modal auxiliaries can't. Formally, to analyze the question-oriented interpretation of attitude verbs, we can assume that the interrogative complementizer takes a set of propositions as an argument and state that the content of its event argument is related to this question in specific ways.

To summarize, adopting the content-oriented analysis for attitudes does not change the nature of the challenges Differences 1-4 pose. In particular, the analysis can be sufficiently enriched to account for the flexibility with respect to flavor/domain and force. At the same time, cases where the differences between modals and attitude verbs may be empirically upheld (e.g., sensitivity to individual arguments and question-orientedness) will impose constraints on the possible theoretical analyses.

4 Other relevant issues

There are a number of relevant issues I am not able to touch on in this chapter, in part because they go beyond the aspects that can be analyzed in terms of the basic setup of the possible-world analysis. Here is a quick rundown of some of these issues.

Supposition/conditionality Under the unified semantics we have assumed in this chapter, the following two *if*-clauses are predicted to be equivalent, contrary to fact (Yalcin 2007):

- (49) a. ??If it is raining and it **might not** be raining, then...
b. If it is raining and I **don't know** that it is raining, then...

Yalcin (2007) analyzes the contrast by making *might* (but not *know*) quantify over worlds compatible with the epistemic information state restricted by an *if*-clause. Though see Blumberg and Holguín (2019) for cases where the interpretation of attitude verbs like *surprise* is restricted by *if*-clauses/supposition in similar ways.

Weakness of *must* Since Karttunen (1972), it has been observed that an epistemic *must*-statement feels weaker than a corresponding unembedded statement or a knowledge statement. For example, (50a) feels weaker than (50b) or (50c).

- (50) a. The keys **must** be in the drawer.
b. The keys are in the drawer.
c. I **know** that the keys are in the drawer.

This is unexpected under the view where (50a) and (50c) are treated in parallel. See e.g., Kratzer (1991) for a weaker semantics of epistemic *must* and von Stechow and Gillies (2010, 2021) for a semantics that maintains its strong quantificational force that accounts for the intuition outlined above in terms of its additional evidential component of *must* (see also Ch. 22 ‘The Notional Category of Evidentiality’).

Focus/alternative sensitivity Villalta (2008) argues that interpretations of certain attitude predicates—including but not limited to bouletic predicates like *want*—are focus-sensitive, i.e., their interpretations depend on the **alternatives** induced by the focus structure of the complement. Cariani et al. (2013) propose a semantics of *ought* that is sensitive to the decision problem, which formally resembles a set of alternatives. Similarly, sensitivity to a set of alternatives has been argued for *believe* by Yalcin (2018) and for *want* by Levinson (2003), Lassiter (2011) and Phillips-Brown (2021). It is yet to be seen how these various incarnations of alternative sensitivity supports or challenges the unified perspective on modals and attitude verbs.

Gradability Villalta (2008) notes that focus sensitivity of some attitude predicates are associated with their gradable semantics (as well as their mood licensing properties). This view is supported by the compatibility of the relevant predicates, such as *want* and *be glad*, with grammatical degree constructions, such as modification by degree adverbs, as exemplified below. (The examples are English translations of Spanish examples in Villalta (2008: 509).)

- (51) a. Marcela **enormously wants** Rafael to come.
 b. Sofia is **enormously glad** that they will visit her.

In light of the apparent lack of similar grammatical degree constructions with modal auxiliaries, one may then consider gradability as a strong candidate for the semantic distinction between modal auxiliaries and attitude predicates. That is, at least some attitude predicates involve gradability as a core component of their semantics whereas—arguably—modals always involve quantificational semantics.

The question then is whether the assumption that modals always involve quantificational semantics is a plausible one and whether modal auxiliaries can be semantically gradable. Portner and Rubinstein (2016) and Lassiter (2017: pages) argue that some are, including *ought* and *should*. Below are examples from Lassiter (2017: 233–4) involving degree modification:

- (52) a. Autonomy absolutely does not strike me as “beyond the pale” when it comes to either abortion or pornography. Indeed, there are situations in which concerns of autonomy **ought very much** to matter (as they did to Justice Brennan).
 b. If you desperately need to change an old post then PM one of the moderators... This **should very much** be considered the exception though. The normal edit window should usually be enough.

The interpretation of the example above, Lassiter argues, can only be captured under a gradable semantics for *ought* and *should*. Following their arguments, we then have a situation where both modals and attitude predicates *can* be gradable, leaving open the possibility that both classes are heterogeneous in the sense that they include both gradable items and quantificational items.

Relatedly, gradable semantics for modals and attitudes can be manifested by analyses in which probability plays a central role. Proponents of such analyses include Lassiter (2017), who offers a probabilistic semantics for epistemic modals, as well as Levinson (2003), who provides a decision-theoretic semantics for *want* where probability plays an important supporting role. See Ch. 12 ‘Modality, Gradability and Probability’ for further discussion on these topics.

In this connection, it is also worth mentioning the analysis of attitudes by Pasternak (2019), who provides a gradable semantics for attitude verbs, stated in terms of measurement of the intensity of psychological states. Assuming that a similar gradability component is not applicable to modals, Pasternak’s analysis offers a possible way to explicate the attitude-modal distinction in terms of gradability.

5 Conclusions

In this chapter, I have explored the hypothesis that modal auxiliaries and attitude verbs can be given a unified analysis in terms of quantification over possible worlds. To assess the hypothesis I have focused on four potential differences between the two categories concerning (i) sensitivity to an individual argument; (ii) lexical specification regarding the domain/flavor; (iii) quantificational force; and (iv) question-orientedness.

Based on the cross-linguistic literature on modals and attitude verbs, I have concluded that some of these differences are not as categorical as they initially appear. In particular, there is evidence that attitude verbs can have flexibility regarding the domain/flavor as well as an existential quantificational force. At the same time, we have also seen that some of the differences may be taken to be empirically robust, challenging the unified view. The development of the semantics of modals and attitude verbs in the past 50+ years have enabled refined theoretical analyses that maintain the uniformity despite some of the apparent differences. I have also explored possibilities to reduce differences to syntactic properties of modals and attitude verbs.

The possible-world semantics for modals and attitude verbs, first developed by Hintikka (1962) and further refined in subsequent literature, is undoubtedly one of the most influential and successful approaches to the formal analysis of meaning in the history of formal semantics. The pursuit of a unified analysis of modals and attitude verbs has driven numerous theoretical innovations and significant empirical discoveries. The preceding discussion has hopefully shown that both our understanding of the empirical parallels between modals and attitude verbs and the analytical tools to account for them have significantly evolved since Hintikka. This said, more work is required to assess the cross-linguistic robustness of the parallels as well as the implications the observations have on our theoretical understanding of the two categories.

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