

# The grammatical category of modality\*

Valentine Hacquard

University of Maryland, College Park, Maryland, United States  
hacquard@umd.edu

## Abstract

In many languages, the same words are used to express epistemic and root modality. These modals further tend to interact with tense and aspect in systematic ways, based on their interpretation. Is this pattern accidental, or a consequence of grammar or meaning? I address this question by: (i) comparing ‘grammatical’ modals to verbs/adjectives that share meanings with modals, but not the same scope constraints; (ii) examining patterns of grammaticalization from ‘lexical’ to ‘grammatical’ modality; (iii) comparing scope interactions in languages where modals are ‘polysemous’ and in those where they are not.

## 1 Introduction

In many languages, the same modal words are used to express a variety of ‘root’ and ‘epistemic’ meanings. English *may*, for instance, can express deontic or epistemic possibility. About half of the 200+ languages in [vdAA05] have a single form that is used to express both kinds of modality. Yet, in many other languages, modal markers are unambiguously determined for meaning. In the Kratzerian tradition ([Kra81, Kra91, Kra12]), modals are lexically specified only for force (as existential or universal quantifiers over worlds), and the various meanings a ‘polysemous’<sup>1</sup> modal expresses arise from the modal combining with various modal bases and ordering sources. This account, based on the case of polysemous languages, easily extends to non-polysemous ones: a modal can further lexically specify the kind of modal base and ordering source it allows, restricting its meaning to a single epistemic or root meaning. An alternative account based on *non*-polysemous cases would provide separate lexical entries for the various modals, and extend to polysemous cases by postulating ambiguity. All else equal, such an account seems lacking in treating as synchronically accidental the fact that the same ambiguity is found in unrelated languages such as French, Arabic or Malay.

Interestingly, in languages that show modal polysemy, the different modal meanings a modal expresses interact differently with elements of the sentence it appears in, notably tense and aspect. A modal with an *epistemic* meaning scopes above tense and aspect, but the same modal with a root (*deontic, bouletic...*) meaning scopes below tense and aspect ([Pic90], [Sto04], [Hac06], [BC07], [Lac08], a.o.). In (1), French *pouvoir* can either express an epistemic or a root possibility. When epistemic, the modal is interpreted *above* tense and aspect: it describes a *current* possibility for a past event. When root, it is interpreted *below* tense and aspect, and yields an ‘actuality entailment’ with perfective ([Bha99]): it describes an (actualized) *past* possibility.

- (1) Jean a pu prendre le train.  
Jean has could take the train

**Epis:** It is possible given what we *now* know that Jean took the train at some past time.

**Root:** At some past time, given Jean’s circumstances *then*, it was possible for him to take the train [and he did].

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\*Many thanks to Pranav Anand, Thomas Grano, Aynat Rubinstein, Alexander Williams, and the audience at the *TRAIT* workshop for discussion and suggestions, and to Sayaka Funakoshi for Japanese judgments.

<sup>1</sup>I use the term polysemous as a shorthand: under a Kratzerian account, each modal is strictly monosemous.

Assuming that the differences in interaction with tense and aspect between flavors of modality can be reduced to scope (cf. [Hac06, Hac10] for arguments)<sup>2</sup>, one can ask why modal flavor should correlate with modal scope: why should a modal like *pouvoir* scope ‘high’ (above tense and aspect) when it receives an epistemic interpretation, but ‘low’ (below tense and aspect) with a root interpretation? In my attempts at answering this question, I have largely ignored the many non-polysemous languages. However, the fact that languages differ in whether their modal markers are polysemous or not matters to this question. If all modals, of both the polysemous and the non-polysemous kind, show the same constraints, then we might be able to explain the interactions with tense and aspect purely in terms of meaning.<sup>3</sup> If, however, polysemous languages do not show the same constraints, then we need to explain why polysemy should correlate with flavor/scope interactions.

[Cin99] proposes that the ordering of functional heads is fixed universally (as shown in (2)). If that is true, *all* modals, polysemous or not, should scope below or above tense and aspect as a function of their meaning. Does this ordering truly hold universally, and if so, does it follow from meaning considerations only?

- (2) **Cinque’s Hierarchy** (simplified):  $\text{Mod}_{\text{epis}} > \text{Tense} > \text{Aspect} > \text{Mod}_{\text{root}} > \dots$

It seems clear that the flavor/scope correlation cannot be based on meaning alone, since *lexical* verbs and adjectives that express the same flavors of modality do not show the same constraints. Adjectives (*possible*, *likely*) and verbs (*seem*, *know*, *think*) that express *epistemic* meanings can be interpreted under a past tense (3). Nouns like *permission* and verbs like *want* that express root meanings do not yield actuality entailments with perfective (4):

- (3) a. It **seemed** to John/It was **possible/likely** that Mary was home.  
b. John **thought/knew** that Mary was home.
- (4) a. Jean **a voulu** s’enfuir, mais il n’est pas parti.  
Jean **has wanted** escape, but he didn’t leave.  
b. Jean **a eu la permission** de partir, mais il n’est pas parti.  
Jean **has had** the permission to leave, but he didn’t leave.

We thus need to explain why modal auxiliaries show aspectual and temporal restrictions that are unexpected from their meaning alone, and what sets “grammatical” modality (expressed by modal auxiliaries) apart from “lexical” modality (expressed by verbs and adjectives). We will then be in a position to address the question of why languages differ in the polysemy status of their modal markers, and the implications of such a dichotomy for acquisition and diachrony. In section 2, I review the account I proposed for ‘polysemous’ modals. Section 3 contrasts lexical and grammatical modality. Section 4 discusses grammaticalization, section 5 non-polysemous languages, and section 6 implications for acquisition and diachrony.

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<sup>2</sup>In a nutshell, having epistemics scope above tense, and roots below, explains why the modals’ time of evaluation is the speech time (in matrix context) for the former, and the time provided by tense for the latter ([Pic90], [Sto04]). The presence/absence of actuality entailments can also be explained in terms of scope: An actuality entailment arises when the aspect that quantifies over the VP event scopes above a modal, as happens with root modals. In such a configuration, given that aspect scopes *above* the modal, its world of evaluation has to be the matrix world of evaluation, forcing the VP event to occur in the actual world. Since an epistemic modal scopes *above* aspect, it determines the world of evaluation of aspect, thereby forcing the VP event to occur in the modal worlds, but not necessarily in the actual world, as sketched below.

- (1) **Asp** > **Mod<sub>root</sub>**: There is an event in **w\*** which in some **w** is an event of John taking the train.  
**Mod<sub>epis</sub>** > **Asp**: In some world **w**, there is an event in **w** of John taking the train.

<sup>3</sup>For reasons of space, I will simply assume that the generalizations with tense, aspect and modal flavors hold. For further data and discussion of counterexamples, cf. [Hac13] and references therein.

## 2 Scope/flavor correlations

In [Hac06, Hac10], I proposed an account in which modals are lexically unspecified for flavor, in Kratzerian fashion, but where they can appear in two positions (TP and VP). Modals need to combine with a proposition, which both TP and VP can provide (under certain assumptions about tense and aspect). To derive the scope/flavor constraints, I proposed that modals are event-relative: their modal bases and ordering sources are determined relative to an event, rather than a world of evaluation. I argued that this event-relativity is responsible for the association between TP-level modality and epistemic flavors, and VP-level modality and root ones. Different syntactic positions make available different events that anchor modals, and these different events make available different kinds of modal bases.

Specifically, modals are quantifiers over possible worlds, determined by a modal base  $f$ , itself relative to an event  $e$ .  $e$  is an event variable (a dependent variable in the sense of [Gia98]), which needs to be bound locally. The type of modal base the modal receives will depend on the type of event that it is anchored to. In the following lexical entries, I assume, following [Kra13], that the modal base projects from the event the modal is anchored to.<sup>4</sup>

- (5) a.  $[[\text{must}]] = \lambda q \forall w (w \in f(e) : q(w))$
- b.  $[[\text{can}]] = \lambda q \exists w (w \in f(e) : q(w))$

The position in which a modal appears makes it relative to different events. At the VP-level (i.e., right below aspect), the modal's event variable gets bound by the aspect that quantifies over the VP event. This anchors the modal to the VP event. At the TP-level, the modal's event variable cannot be bound by the aspect that scopes below the modal: in matrix contexts, it is bound by the speech event  $e_0$ ; in embedded contexts, the event variable is bound by the matrix attitude event (more specifically, by the aspect that quantifies over that attitude event):

- (6) Low (VP-level) modal: anchored to VP event  
 $[_{CP} e_0 \lambda e_0 [_{TP} T [_{AspP} \mathbf{Asp}_1 \lambda e_1 \mathbf{Mod-e}_1 [_{VP} \mathbf{VP}(e_1)]]]]$
- (7) High (TP-level) modal: anchored to speech event (matrix), or attitude event (embedded)  
 $[_{CP} e_0 \lambda e_0 \mathbf{Mod-e}_0 [_{TP} T [_{AspP} \mathbf{Asp}_1 \lambda e_1 [_{VP} \mathbf{VP}(e_1) ]]]]$   
 $[_{CP} e_0 \lambda e_0 [_{TP} T \mathbf{Asp}_2 \lambda e_2 \mathbf{Att}(e_2) [_{CP} \mathbf{Mod-e}_2 [_{TP} T \mathbf{Asp}_1 \lambda e_1 [_{VP} \mathbf{VP}(e_1) ]]]]]]$

There are two types of modal bases: factual vs. content-based [Kra12, Kra13], responsible for root and epistemic meanings, respectively:

- (8) a.  $f_{\text{content}}(e) = \{w : w \text{ is compatible with the content of } e\}$
- b.  $f_{\text{fact}}(e) = \{w : w \text{ is compatible with the circumstances of } e\}$

A content-based modal base will be projected from an event that has ‘content’ (i.e., describes an information state), which speech and attitude (but not VP) events do. We obtain that only modals relative to speech and attitude events (‘high modals’, i.e., merged above tense and aspect) receive epistemic interpretations, while modals relative to VP events (‘low modals’, i.e., merged below tense and aspect) do not. When *pouvoir* scopes above tense, it gets anchored to the speech event, a contentful event: the modal base is *content-based*, and the modal quantifies over the information state associated with that event (the speaker's commitments). When it scopes below aspect, it is anchored to the VP event. The modal base that projects from that event is *factual*: hence, the modal receives a root interpretation. Actuality entailments arise by having the aspect that quantifies over the VP event scope above the modal, forcing the event to occur in the actual world, and not merely in the worlds provided by the modal.

- (9) Jean a pu prendre le train

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<sup>4</sup>In [Kra13], a modal takes an argument, e.g., an event or situation, which uniquely determines a *domain fixing function*, which provides the set of worlds quantified over by the modal.

- a.  $[_{CP} e_0 \lambda e_0 \text{ can-}e_0 [_{TP} \text{ Past } [_{AspP} \text{ Perf}_1 \lambda e_1 [_{VP} \text{ J. take-train}(e_1)]]]]$  ‘high’ = *epistemic*  
 In some world compatible with the content of the speech event [i.e., speaker’s commitments],  
 Jean took the train
- b.  $[_{CP} e_0 \lambda e_0 [_{TP} \text{ Past } [_{AspP} \text{ Perf}_1 \lambda e_1 \text{ can-}e_1 [_{VP} \text{ J. take-train}(e_1)]]]]$  ‘low’ = *root*  
 There is an actual past event  $e$ , which in some world compatible with the circumstances of  
 $e$  is an event of John taking the train.

To sum up, ‘polysemous’ modals come in single lexical entries. The interpretation they can receive is however constrained by the position in which they appear. This is because modals are relative to an event. Different events project different modal bases: only speech and attitude events are contentful, hence only modals relative to speech and attitude events (i.e., modals that scope above tense and aspect) are epistemic. In this framework, then, the modal meaning/modal scope correlations are due to modals’ anaphoric nature.

### 3 Lexical vs. grammatical modality

As the examples in (3) and (4) show, the aspectual/temporal constraints that modal flavors exhibit cannot be blamed on meaning alone. Indeed, lexical items like *seem* or *probable* scope below past tense, despite expressing epistemic meanings. Similarly, lexical items like *want* or *permission* do not yield actuality entailments, despite expressing root meanings. Why should ‘lexical’ modals differ from ‘grammatical’ modals in this way?

As argued in section 2, grammatical modals interact the way they do with tense and aspect because of their anaphoric nature. Epistemic modals scope above tense not because they express epistemic meanings, but the other way around: modals that scope above tense and aspect happen to have epistemic meanings because they are relative to events that happen to be contentful. Similarly, actuality entailments arise when aspect scopes over a modal within its clause. This happens when modals are anchored to VP events, which happen to yield root meanings.

Why shouldn’t a lexical verb like *seem* with an epistemic meaning scope above tense? Because such a lexical item is a predicate of events, and as such, it has to appear below tense and aspect. Why shouldn’t a lexical verb with a root (bouletic) meaning like *want* yield actuality entailments with perfective in a language like French? Again, because it is a predicate of events: as such, it requires its own aspect and tense projections, separate from those of its complement (the embedded event is quantified over by an aspect embedded under the attitude verb, anchoring it in the desire worlds, and not necessarily the actual world).<sup>5</sup>

$$(10) \quad [_{CP} e_0 [_{TP} T [_{AspP} \text{ Asp}_1 \lambda e_1 [_{VP} \text{ seem}(e_1) [_{CP} \dots ]]]]]]$$

$$(11) \quad [_{CP} e_0 [_{TP} T [_{AspP} \text{ Asp}_1 \lambda e_1 \text{ want}(e_1) [_{CP} [_{TP} T \text{ Asp}_2 \lambda e_2 [_{VP} \text{ VP}(e_2) ]]]]]]]]$$

To sum up, the main difference between lexical and grammatical modality is that lexical modals are fully specified predicates of events; grammatical modals are not, and thus they can appear in different positions. The aspectual/temporal constraints that grammatical modals are subject to are due to their anaphoric nature, rather than to the meanings they express.

Verbs and modal auxiliaries thus differ in two respects: (i) whether they are fully specified for meaning, and (ii) how they interact with tense and aspect. In the proposed account, these two differences are correlated: modal auxiliaries interact with tense and aspect the way they do due to the fact that they are not fully specified for meaning: their domain is determined by the event that they are anchored to. But what underlies the differences between ‘lexical’ and ‘functional’ modality? And could we have *grammatical* modals that are fully specified for meaning, but still obey the modal flavor/scope constraints? We turn to the first question in section 4, and the second in section 5.

<sup>5</sup>See [Hac06, Hac08] for actuality entailments with the Italian *restructuring* predicate *volere* (*want*), which differ from its French non-restructuring counterpart in involving a monoclausal structure (i.e., single tense and aspect projection).

## 4 Grammaticalization

While polysemous modal auxiliaries are relatively common, verbs<sup>6</sup>, nouns, and adjectives<sup>7</sup>, are overwhelmingly fully specified for meaning. Why should full meaning specification correlate with the functional/lexical divide, and what is this functional/lexical divide in the first place? Looking at predicates that straddle the functional/lexical line, such as restructuring verbs, and processes of grammaticalization where lexical morphemes turn into functional ones may provide useful clues.

Restructuring verbs behave like functional heads in forming a single clause with their complements, with a single tense and aspect projection ([Wur01, Cin04]). They however differ from modals in having a fixed position and meaning. [Gra12] proposes an interesting restructuring analysis of verbs like *try* and *manage*, whereby when these predicates restructure, their individual argument gets converted into a dependent variable. They are thus not predicates of individuals, but they contain a free variable over individuals, and are thus assignment-dependent. This variable gets bound when the subject raises from the VP below it, creating the illusion of control. I would like to propose that patterns of grammaticalization in which verbs turn into modal auxiliaries take this sort of functionalization one step further.

Modal auxiliaries commonly develop from lexical predicates. Processes of grammaticalization and semantic change follow ‘regular’ patterns cross-linguistically (cf. [Tra11, Nar12], and references therein), and tend to go “upwards” in the structural hierarchy of functional categories [RR03], with lexical words turning functional, and with root meanings often extending to epistemic meanings (e.g., [BPP94]). More generally, modals with an “event orientation” (i.e., having to do with the VP event and its participants) extend to modal meanings with “speech act” orientation (i.e., having to do with the speaker/hearer; [Nar12]). For instance, English *can* developed from Old English *cunnan* (‘*know (how)*’). Its meaning then extended to ability, to circumstantial, to epistemic possibility (for some speakers). Such a grammaticalization process might work as follows in our current framework. The verb’s event argument would first be converted into a dependent variable, similarly to what Grano proposes for the individual argument of restructuring verbs. This would preserve the verb’s meaning, but the verb would lose its status as predicate of events. This morpheme would still appear below aspect, and receive a root interpretation. At this point, it might allow various ordering sources, yielding different root meanings. Over time, however, being free to move, it might venture up the tree. When its event variable would get bound by the speech event, and thus be anchored to a contentful event, the modal would start yielding epistemic meanings, as sketched below.<sup>8</sup>

	<i>know (how)</i> :	$\lambda p \lambda e. \text{know-how}'(e) \ \& \ \exists w(w \text{ comp. } w / \text{know-how}(\text{Exp}(e)) : q(w))$
(12)	<i>can-ability</i> :	$\lambda p \exists w(w \text{ comp. } w / \text{know-how}(\text{Exp}(e)) : q(w))$
	<i>can-root</i> :	$\lambda p \exists w(w \in f_{\text{act}}(e) : q(w))$
	<i>can</i> :	$\lambda p \exists w(w \in f(e) : q(w))$

<sup>6</sup>One interesting polysemous verb is Mandarin *xiang* [TW00, Ngu13].

<sup>7</sup>The adjective *possible* looks like a ‘polysemous’ *lexical* modal: like a grammatical modal, it seems to express both epistemic and circumstantial modality, but like a lexical modal, it is able to scope under a past tense with an epistemic interpretation. Interestingly, there seems to be some correlation between meaning and syntax: when *possible* takes a nonfinite complement, it favors a circumstantial interpretation; with a finite complement, it seems more epistemic. It is not entirely clear, however, that the ‘polysemy’ of *possible* is really of the same nature than that of a modal auxiliary. For one, it is particularly difficult to distinguish separate kinds of root possibilities (bouletic or permission). One possibility is that the ‘polysemy’ of *possible* is really a matter of generality, rather than anaphoricity. Whereas for modal auxiliaries, the domain of quantification is determined anaphorically, it would be lexically determined for *possible*, and describe a more general possibility. (Thanks to Alexander Williams for this suggestion.) I leave a fuller investigation of this interesting case for future research.

<sup>8</sup>According to the proposal just sketched, why shouldn’t an epistemic *verb* turn into an epistemic, and then circumstantial/polysemous, *modal* (a “downward” process)? Tom Grano (p.c.) suggests that a verb with a root meaning under aspect can easily be reanalyzed as a root modal in virtue of its position. However, when an epistemic verb appears below aspect, it cannot be so reanalyzed, as this would require a simultaneous shift in flavor, which would be too big of a step for reanalysis.

## 5 Polysemous vs. non polysemous languages

We see that what differentiates ‘grammatical’ modals from ‘lexical’ modals is both their polysemy and their interactions with tense and aspect. What about modal markers that are not polysemous? There are two logical possibilities. They could either lack anaphoricity altogether: their lexical entry could then hard-wire both meaning and scope. Alternatively, they could be just like their polysemous counterparts: event-relative, but with lexical restrictions on the kinds of modal bases they allow. For instance, an event-relative modal could be specified to only allow content-based modal bases. Such modals would have to appear in a position where they would be anchored to a contentful event (e.g., speech event). We would expect modals’ scope to correlate with meaning with the second option, but not necessarily with the first. How do polysemous languages actually behave?

In a language like Japanese, modals are fully specified for meaning, and they do not seem to show scope/meaning correlations. *kamosirenai* and *nitigainai*, for instance, express epistemic possibility and necessity, respectively, but unlike their French and English counterparts, they easily scope under tense:

- (13) John-ga hannin-de aru {*kamosirenakat-ta/nitigainakat-ta*}  
 John-Nom culprit-Pred be **might-past/must-past**  
 (At some point) It was possible/necessary that John was the murderer.

However, in many other languages, the scope of modals seems to be rather strict. [Nau08] argues that modals from diverse language families show the same Cinquean ordering of epistemic over root modals, regardless of whether they are fully-specified for meaning, at least with respect to one other. The epistemic enclitic *-kəɬ*, and the circumstantial circumfix *kaa* in Lilloet, for instance, are fully-specified for flavor, and only allow the epistemic to scope over the circumstantial. Whether this ordering of modals can be explained solely on conceptual grounds (and whether it really holds cross-linguistically) is not entirely settled (cf. [vFI04, Kra76, Hac11, Hac13], a.o.). But to the extent that it holds, it supports the anaphoric view. Grammatical modal markers, whether polysemous or not, would all be event-relative, and project modal bases from the event they are relative to, explaining the correlation between scope and meaning. Non-polysemous languages would differ from polysemous ones in lexically imposing restrictions on the kinds of modal bases their modals can combine with.

Clearly, much more empirical work is needed before a definite answer can be provided, as much more is known about the interaction between modals, tense and aspect in polysemous languages than in non-polysemous ones. What gets classified as modal markers in grammars do not necessarily form a uniform grammatical class. Thus, the answer may vary based on the functional vs. lexical status of such markers. As for the Japanese modals in (13), one might argue that they are in fact lexical, based on their adjectival morphology, the relative temporal independence of their complement, and the fact that epistemics can scope below deontics, as shown in (14) (translated from [vFI04] English example by S. Funakoshi, p.c.):

- (14) Kensa hiyoo-no harai-modosi-no tameni-wa, kanja-wa arutuhaimaa(-ni  
 Test cost-Gen reimbursement-Gen for-Top, patient-Top Alzheimer’s(-Dat  
 kakattei-ru) kamosirenake rebanaranai.  
 be.taken.with-present) possible must  
 ‘For reimbursement of the test costs, it must be possible that the patient has Alzheimer’s.’

## 6 Acquisition and diachrony

Let’s take stock by taking the point of view of a learner, trying to figure out how modality works in her language. The child has to figure out whether modals in her language are polysemous or not, and has to associate certain modal meanings with certain scope positions: modals with epistemic meanings scope high, modals with root meanings scope low. Such a mapping should be particularly difficult when the *same* words are used to express both epistemic and root modality. Hence, the hope is that

the meaning/scope association is principled—if indirect—as I have argued here. If the association were arbitrary, we would expect incorrect meaning/scope mappings, and the ordering of modals and tense and aspect to flip over time. However, diachronic patterns show that this is not the case: modals develop in systematic ways.

Languages may differ in whether modality is expressed by functional morphemes or solely by lexical ones. They further differ in whether their modals show polysemy or not. The first choice point for the child then will be whether modality in her language is expressed by functional or only lexical vocabulary. Hopefully the clues for such a distinction (morphological and other) will be clear enough. If modals are functional, the second choice point will be to figure out whether they are polysemous or not. If the child figures out that the same modal can scope in two positions (which should be easy at least in languages where syntactic scope transparently reflects semantic scope), knowing that this modal is anaphoric (because functional) should help her figure out the correct flavor/scope mappings.

As for why root modals tend to extend to epistemic meanings in some languages (Romance and Germanic), but not others (Japanese), it may largely be due to historical idiosyncracies. [Nar12] proposes that while both types of languages faced at some point a need for new morphemes to express epistemic modality, the items available for meaning extensions were not the same. English and German used verbs that already had a deontic meaning, but such verbs did not (and still do not) exist in Japanese. Japanese’s epistemics thus evolved from various other lexical items (e.g., *nitigaina* derives from a construction meaning ‘there is no mistake that’).

Thus, *whether* modals in a given language show polysemy or not may be largely idiosyncratic. However, *the way* polysemy develops and how the resulting modal meanings scopally interact is principled. Languages may not all necessarily have grammatical modals, let alone polysemous ones. Yet, given the way polysemy arises diachronically, and works synchronically (if this account is on the right track), the correct scope/flavor correlations should be recoverable by the learner.<sup>9</sup>

## 7 Conclusion

Modal markers are unique in language in exhibiting systematic polysemy in many languages, and having their meanings further correlate with scope. I have argued that modals’ ‘polysemy’ and their associated temporal and aspectual restrictions follow from their anaphoric dependency. That lexical verbs/adjectives do not show the same temporal and aspectual constraints support this fact: the correlations are not purely meaning-based. I have argued that the main difference between ‘lexical’ and ‘grammatical’ modals is whether they are predicates of events or merely event-dependent, and suggested that patterns of grammaticalization support this view: lexical modals turn functional when they lose their event argument. This loss, or rather conversion, leads to anaphoricity, which leads to scope/flavor constraints. Finally, while modals in some non-polysemous languages show similar scope/meaning constraints as in polysemous languages, they do not in others. Ultimately, the answer to the universality of scope and meaning of modal markers will depend on the grammatical category and status of such markers in their respective language.

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<sup>9</sup>Cross-linguistically, modals also differ in whether they encode *force* of quantification (cf. e.g., [RM08]). This variability raises important further questions about acquisition, diachrony ([Yan13]), and universal properties of modality ([Nau08] proposes the tentative universal that modals can either express variability in flavor or force, but not both). I leave the integration of these questions for future research.

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