A Multi-Model Modal Theory of I-Semantics
Part I: Modals
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Abstract: This paper examines restrictions on quantification into modals noted by von Fintel and Iatridou (2003), ECP effects. I show how these restrictions can be made to follow from the architecture of a theory of modality provided that that theory introduces an asymmetry in the introduction of doxastic and non-doxastic modal bases. In the analysis developed, the set of worlds in a model constitutes the modal base for all modals interpreted with respect to that model. New models, and hence new modal bases, are introduced into the semantics through operators. The analysis largely reconstructs the results of Kratzer (1991), but does without having to stipulate an otherwise unmotivated account of ECP effects.

1 Epistemic, Doxastic and Metaphysical Modality

Modal auxiliaries in English are typically associated with a multiplicity of readings. The modal must, for example, could indicate certainty, as in the prominent reading of (1a), or requirement, as in the prominent reading of (1b), while may can indicate possibility as in the prominent reading of (1c), or permission as in the prominent reading of (1d).

(1)  a. That must be Jones
     b. Jones must leave
     c. That may be Jones
     d. Jones may leave

That these are indeed separate readings is uncontroversial, the interpretations of (1a,c) typically referred to as epistemic and those of (1b,d) as deontic, circumstantial, or simply non-epistemic. The focus of this paper is on the scopal interaction between epistemic modals and quantifiers.

Lyons (1977) proposed that epistemic modals come in two different types – subjective and objective. I will argue below that the subjective use is more properly labeled doxastic, sensitive only to belief and not knowledge. The objective use clearly differs in this respect,

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1 This paper has benefited from comments and criticisms from a large number of people. First and foremost I would like to thank Janneke Huitink for closely reading and commenting on an earlier version of this paper. Her insights proved invaluable, as did her pointing out problems I had overlooked. I would also like to thank the students in my 2006 semantics seminar for their challenging me as I developed the analysis of this paper and for providing judgments of Japanese examples. I also benefited greatly from comments from participants at the Language Under Uncertainty conference as well as from audiences at the University of Tokyo Semantics Research Group, Waseda University, and Leiden University, where an earlier version of this paper was first presented. Finally I would like to thank the two anonymous reviewers for their insightful comments and thorough reviews.
involving reasoning from accepted facts rather than simple belief. Since the label *epistemic* has been used for both of these categories, however, and since they have distinct behaviors, I will simply avoid using that label as much as possible, referring to Lyons’ objective epistemic modality as metaphysical modality, as in Iatridou (1990). Since the doxastic / metaphysical distinction is an important one and failing to make it can lead to confusion, it is worth taking a moment to differentiate the two interpretations.

One of the most frustrating aspects of the subjective interpretation is that there is no clear diagnostic for it, or at least none known to me. The English word “perhaps” (as well as its Japanese counterpart “tabun”) strongly prefers a subjective use, though like all other subjectively interpretable modals this is no more than a preference. One can do somewhat better more generally by prefixing a modalized statement with *subjectively (speaking)*, or adding *for all I know* or *as far as I know*, though even these will not ensure that the modal itself is to be taken subjectively. It could as well be the case that the sentence as a whole is to be taken as a subjective statement about an objective modality, something that occurs regularly with (the far more colloquial) *in my opinion*. What differentiates a subjective modal statement from others is that it is one that cares only about the speaker’s subjective belief state. All other modals involve something additional. An objective, or metaphysical, modal statement is based on speaker-external facts or knowledge. This type of modality can be much more reliably induced. Prefixing a statement with *objectively (speaking)* forces this reading, as does addition of evidential adverbs like *apparently, clearly, allegedly* and *reportedly*.

To see the difference between the subjective and objective uses, consider first the simple case of (1c) uttered by a speaker in isolation upon hearing a knock at the door. In such a situation, one could as easily utter *That's perhaps Jones* without any awkwardness, and in both cases the preferred way of taking the utterance is as simply saying something about the speaker's beliefs, namely that it's compatible with her beliefs that the person at the door is Jones. Prefixing the utterance with *Subjectively (speaking)*, though stylistically awkward, can help to reinforce the desired reading. In contrast to the subjective reading, consider the same sentence again following a knock at the door, but this time uttered to a hearer in the following context.

(2) Jones was invited to this party, so if he isn't here yet it follows that (1c).

Here the speaker is not simply commenting on her belief state. She is rather making a statement of general fact, namely that the evidence mentioned (perhaps together with unstated background assumptions) leads to the following conclusion: that it is compatible with all known (relevant) facts that the person at the door is Jones. She is not claiming that her belief state follows from the evidence. In fact, she cannot be said to be claiming that anybody's state of mind follows from the evidence. The most she can be said to be claiming is that a rational person who understood and accepted the claim would be led to be in a belief state compatible with the person at the door being Jones.² The objective reading can be

² The fact that the conclusion in (2) does not involve any mental states suggests that the term *metaphysical modality* is perhaps to be preferred over *(objective) epistemic modality* as a label
brought out even more unambiguously by prefixing the modal statement in (2) with 
objectively (speaking).

I claimed above without argument that the subjective modality involved in the one 
interpretation of (1c) was based on belief and hence doxastic, not epistemic, i.e. not based on 
knowledge. To see that this is so, consider the case of a speaker – Alice – who knows that 
Jones was invited to the party and also knows that he has not yet arrived. Suppose that Alice 
incorrectly believes that Jones is out of the country and so cannot possibly make it to the party. 
In such a situation, (1c) would be an inappropriate thing for Alice to utter. If the modality 
were subjective epistemic, however, i.e. based solely on her knowledge and not on her other 
things, we would have to contend that it might well be not only true but appropriate as well, 
since Alice's knowledge is compatible with the person at the door being Jones. The fact that 
(1c) is false\(^3\) in the envisioned situation is strong evidence that there is no such thing as a 
subjective epistemic interpretation of the modal. The above argument presupposes, of 
course, that Alice can distinguish those of her beliefs that constitute knowledge from those 
that do not. However, challenging that assumption is of no use in trying to salvage the 
category of subjective epistemic modality. If Alice has no basis for making a distinction 
between those of her beliefs that constitute knowledge and those that do not, then she has no 
way of ever knowingly making a subjective epistemic modal statement at all based on her 
own epistemic state. This leads once again to the same conclusion, that there is no 
subjective epistemic interpretation. Instead, what has been referred to with this label is more 
appropriately called a subjective doxastic interpretation of the modal.

Based in part on the above considerations, I will eschew Lyons' term subjective 
epistemic modality and favor instead the term doxastic modality. Though this goes against 
what I take to be standard usage in the linguistic literature, continued use of an imprecisely or 
ambiguously defined term would do nothing to clear up the confusion that such usage has 
already caused.

2 Doxastic Modals and Quantifiers

The interaction between doxastic modals and quantifiers was observed in von Fintel and 
Iatridou (2003), who show that in a wide range of cases, when a doxastic modal and a 
quantifier occur in the same clause in English, the modal takes obligatory wide scope over the 
quantifier.\(^4\) They also note that this behavior is limited to doxastic modals, with deontic 

\(^3\) I follow Papafragou (200?) in assuming that all modal statements, subjective as well as 
objective, are formally either true or false. While intuitions are unclear on this issue, the 
arguments she gives are persuasive. For present purposes, however, the argument only 
requires that (1c) be found unacceptable in the context in question.

\(^4\) Von Fintel and Iatridou refer to the modals in question as epistemic. They do not explicitly 
distinguish between subjective and objective epistemic modality as Lyons does, though the 
claims they make and the arguments they give only go through for subjective modality. 
Based on this observation plus the fact that Iatridou (1991) explicitly equates Lyons’ category
modals giving rise to clear scope ambiguities where their doxastic counterparts do not. The absence of quantifiers scoping over doxastics in a simple clause can be illustrated with a wide range of quantifiers, and is at least as robust in Japanese as it is in English. In (3) we give English examples and in (4) corresponding Japanese examples for which the quantificational expression cannot take scope over the modal when the modal is interpreted doxastically.\(^5\)

(3) a. (As far as I know) Every student may be Jones
   b. (As far as I know) Most students may be Jones

(4) a. Subete-no gakusei-ga Jones de aru kamoshirenai
   Every-GEN student-NOM Jones COP may
   Every student may be Jones
   b. Hotondo-no gakusei-ga Jones de aru kamoshirenai
   Most-GEN student-NOM Jones COP may
   Most students may be Jones

To illustrate the unavailable readings, consider the situation of a teacher at the beginning of a new semester looking over a list of students enrolled in her class and matching up as many names as possible with faces. If the teacher sees the name Jones occurring once on the class list but has no idea who any of the students are in her class, then for all she knows any one of the students in front of her might be Jones. If a wide scope interpretation for the quantifiers in the (a) sentences were possible these sentences would be predicted to be true in this situation as a comment (perhaps made only to herself) on the teacher’s state of mind. However, the sentences are not true in this way. Indeed, the only doxastic interpretation available for them is the nonsensical one in which the teacher leaves open the possibility that all of her students are Jones. Absence of a wide scope QP interpretation in (b) can be illustrated with a similar situation in which the teacher already recognizes just under half of the students, Jones not among them. If a QP>modal scope were possible, then once again the sentence would be predicted to be true in this situation since for more than half of the students the teacher leaves open the possibility of their being Jones. And as with the (a) example, the only doxastic interpretation found is the nonsensical one in which the teacher leaves open the possibility that more than half of her students are Jones.

In section 1 we made a distinction between subjective, doxastic modals and objective, metaphysical modals. It is worth noting here that under the latter mode of interpretation the sentences in (3) – with objectively speaking in place of as far as I know – and (4) are in fact acceptable with the quantifier taking wide scope. To see this, consider once again the

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\(^5\) The modals in the Japanese examples in (4) allow both a doxastic and a metaphysical interpretation but do not allow for the deontic interpretations that their English counterparts in (3) exhibit. I will address the scope interaction with metaphysical modals below.
situation of a teacher in a classroom at the beginning of the semester, having a conversation with her TA about the students. They have heard about a certain Jones who is known to be exceptional, and they wonder who this Jones might be. They notice that his name is on the student list, but neither of them knows any of the students. The teacher concludes: *objectively / apparently / clearly every student may be Jones.* The TA can then deny the teacher's claim, a denial that does not call into question the teacher's beliefs but rather the extent of her knowledge compared to the TA's. Imagine that before the teacher arrived, the TA heard a small group of the students talking about Jones, and it was clear from what he heard that Jones was not in the group. The TA can correct the teacher, saying *objectively most students may be Jones, but clearly not every student may be Jones.* In all of the relevant occurrences of the sentences in (3), the quantifier is very naturally taken as having wide scope over the modal. The modal, however, is no longer doxastic. It is forced, rather, to be metaphysical by the adverbs employed.

Iatridou and von Fintel (2003) account for the absence of a wide scope interpretation of the quantifiers in (3a-c) on their subjective, doxastic interpretation by stipulating a ban on quantification into doxastically modalized sentences, a ban they refer to as the Epistemic Containment Principle (ECP). The specific form of this principle that they favor is one that blocks a quantifier-trace chain from crossing a doxastic modal, as formalized in (5).

\[(5) \quad \text{The ECP revised as a condition on QR} \]
\[\text{At LF, a quantifier cannot bind its trace across [a doxastic] modal.} \]
\[*Q . . . [[\text{Doxastic]} \text{ Modal ( . . t . . )}] \]

They do not, however, make any comment on the difference between the behavior of doxastic (their epistemic) modals and metaphysical modals. To the extent to which the distinction between these two types of modals can be made syntactically, the analysis they give accounts for the facts they consider. The ECP directly rules out the LF representations that are presumably required in order to generate a wide scope reading for the quantifiers, given in (6).

\[(6) \quad [Q \text{ student(s)}], \text{ may/must } t_i \text{ be Jones} \]

These LF representations consist of a quantified expression binding its trace across a doxastic modal, in direct violation of the ECP.

While the facts that von Fintel and Iatridou consider are striking, the analysis they give

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6 This notion of objective interpretation is a curious one. Clearly if Jones's knowledge is also taken into account, then objectively exactly one person may be Jones, namely Jones himself. There is no requirement of taking Jones's knowledge into account when claiming to make an objective statement, however. It is enough to take into consideration the relevant knowledge and beliefs of the discourse participants. This makes the word *objective* misleading in the present context. What the word appears to highlight is that a statement is made not based on belief-independent fact but rather based on what is perceived to be the common ground of the discourse participants, itself a belief-dependent construction.
is far from convincing, for several reasons. First, there is little independent evidence for a syntactic distinction between doxastic and metaphysic modals other than the quantifier scope facts they give. What’s more, the standard semantic analysis of modals in Kratzer (1991) distinguishes the various types of modality only by the identity of two types of conversational background – a modal base and an ordering source. It is far from clear how this distinction could make its way into the syntax so that modals dependent on one set of conversational backgrounds would be syntactically distinct from those dependent on another set. Even if these objections can be overcome, however, a more crippling objection to the analysis remains, namely that it amounts to no more than a restatement of the facts. The ECP does potentially give an account of the unacceptability of quantification into a doxastically modalized statement, but the analysis makes no predictions about any phenomena other than the narrow one that they focus their attention on, and in particular fails to explain why doxastically interpreted modals and metaphysically interpreted modals should exhibit such different behavior.

3 Background on Doxastic and Circumstantial modality

As noted above, the availability of a wide scope reading for a DP quantifier in English sentences like (3) depends on whether or not the modal is interpreted doxastically. We have already seen the contrast of doxastic and metaphysical modality in section 2. Under a deontic interpretation as well, where the sentences are taken as statements of permission or of restriction, each of these sentences easily allows the wide scope interpretation for the QP lacking with the doxastic interpretation of the modal, a fact already examined in detail by von Fintel and Iatridou. If we adopt the standard semantics for modals proposed in Kratzer (1991), however, this observation cannot be given a principled explanation.

According to Kratzer, modalized sentences are interpreted with respect to a modal base and an ordering source. Modals come in two main types: epistemic and circumstantial. The distinction between the two derives under her analysis from a difference in the modal base, epistemic vs. circumstantial. Here is what she has to say about the two:

Epistemic and circumstantial modal bases are both realistic modal bases. That is, both … assign to every possible world a set of propositions which are true in that world. Yet circumstantial and epistemic conversational backgrounds involve different kinds of facts. In using an epistemic modal, we are interested in what

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7 The particular examples used are perhaps not the best for bringing this reading out, as they were chosen specifically to make the doxastic and metaphysical readings the most salient. However, if interpreted as a statement of permission made to actors wishing to play the part of Jones in a play that is being performed many times, the wide scope reading of the quantifier in (3a) becomes readily available. The narrow scope reading is also available, though pragmatically it will be dispreferred except in those rare circumstances in which multiple actors simultaneously all play (perhaps different aspects of) the same character in a single play. The Japanese modals in (4) lack a deontic interpretation, and so the scope variation found with deontic modals (in other Japanese examples as well as in English) cannot be seen in these examples.
else may or must be the case in our world given all the evidence available.

Using a circumstantial modal, we are interested in the necessities implied by or the possibilities opened up by certain sorts of facts.

The modal base is taken to be determined by the conversational background, and is not lexically specified in a modal expression. Modal expressions themselves are given a uniform interpretation. In the case of must this would yield necessity, and in the case of may, possibility. The two most basic interpretations for a modalized proposition are given as follows:

(7) **Kratzer's Modal Semantics (excerpts)**

A proposition p is a *necessity* in a world w with respect to a modal base f and an ordering source g iff the following condition is satisfied:

For all u ∈ \( f(w) \) there is a v ∈ \( f(w) \) such that

\( v \leq_{g(w)} u \) and for all z ∈ \( f(w) \): if \( z \leq_{g(w)} v \), then \( z \in p \).

A proposition p is a *possibility* in a world w with respect to a modal base f and an ordering source g iff \( \neg p \) is not a necessity in w with respect to f and g.

The modal base f and the ordering source g are both functions from worlds to sets of propositions, with propositions analyzed as sets of worlds. The choices for f and g determine the type of modal interpretation a proposition is given. An epistemic modal base f picks out the set of all propositions that constitute a speaker’s epistemic state, while a circumstantial f picks out the set of propositions denoting a certain set of facts. This gives us our main distinction between epistemic and circumstantial modals.⁸ Within each of these broad categories, the ordering source determines the fine interpretation, e.g. whether a circumstantial statement of necessity is taken to be required by custom, law, mother-in-law, etc. The ordering source g determines a set of propositions in the world of evaluation w, and these propositions in turn determine a set of most ideal worlds, those in which the number of relevant requirements satisfied is at a local maximum. There may or may not be worlds in which every proposition picked out by the ordering source is satisfied. If there are, then the set of such worlds constitutes the sole ideal. If there are not, two cases can be distinguished. If the failure derives from a proposition in the ordering source being incompatible with a proposition in the modal base, there can still be a single set of most ideal worlds. If, on the other hand, failure derives from two propositions p and q picked out by the ordering source being mutually incompatible, then there will be at least two separate sets of most ideal worlds. In one of the sets in this case p will be satisfied, and in another one q will be satisfied. If all

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⁸ Note that for Kratzer, an epistemic modal base is realistic. That means that Kratzer is using the term *epistemic* in its original philosophical sense as based on knowledge and not just on belief. It would thus be a mistake to equate doxastic modality in our sense with epistemic modality in Kratzer’s. This leaves open the question of how doxastic modality can be analyzed within Kratzer’s account. I presume that the analysis consists of an epistemic modal base with a set of beliefs as ordering source. The problem of distinguishing beliefs from knowledge for a given speaker, of course, remains.
other propositions $P$ picked out by the ordering source are compatible with $p$ and with $q$, then there will be exactly two sets of most ideal worlds, those in which all the propositions in $P$ are satisfied in addition to $p$, and those in which all the propositions in $P$ are satisfied in addition to $q$. These are most ideal worlds with respect to the propositions picked out by the ordering source in the sense that no additional such propositions can be satisfied in these worlds.

The ordering source $g(w)$ lines worlds up depending on how close they come to approaching one of the sets of most ideal worlds. A world $v$ is closer to such an ideal than another world $u$ if the propositions in $g(w)$ that are true in $v$ form a superset of those true in $u$. Note that the number of propositions satisfied in $u$ and $v$ is not directly relevant since the actual propositions satisfied could well form non-embedding sets. The definition of necessity, then, says that a proposition $p$ is a necessity if for every world $u$ compatible with the modal base there is another world $v$ that is at least as close to the ideal determined by the ordering source such that $p$ is true in every world $z$ that is at least as close to the ideal as $v$. This determines that given a possibly inconsistent ordering source $g$ that determines a set of sets of most ideal worlds $\{I_1, I_2, ..., I_n\}$ within the modal base, $p$ is true in every world in $I_i$ for every value of $i$ from 1 to $n$.

What is most important for our purposes in these definitions is that they provide no basis for distinguishing between modals that can be quantified over within a simple clause and those that cannot. This is because epistemic and circumstantial modal bases are formally the same in kind, as are doxastic and deontic ordering sources. Indeed, all four are functions from worlds to sets of propositions. They differ only in their identity, but within Kratzer’s theory this difference has no scopal consequences. As we have seen already, however, the scopal possibilities observed in (3) depend on whether the modal is analyzed as doxastic or not. With a doxastic modal it is not possible for a quantifier to take scope over the modal, while with all other modals it is. Since Kratzer does not give the semantics of lexical modal items or show how to derive the desired interpretations in (7) compositionally, this observation does not yet argue against her theory. However, it does show that her theory does not by itself explain the phenomenon that we are interested in. The best that could be achieved within her theory would be to tack an ad hoc explanation of the ECP effects onto it, which is in essence what von Fintel and Iatridou’s ECP does. A more principled account would be one in which the ECP effects follow from the theory of modality itself, but that is a goal that cannot be attained without making major modifications to Kratzer’s theory.

To account for the ECP effects that von Fintel and Iatridou uncovered, I propose to introduce an asymmetry in the introduction of modal bases that makes it possible to derive the ECP effects as a consequence of the architecture of the theory. In particular, I argue that a doxastic modal base must be available prior to a circumstantial modal base (and to an epistemic modal base if there is such a thing), in a sense to be made precise below. This minimal addition to the theory makes it possible to maintain all of the main insights from Kratzer’s analysis while also giving a principled account of the uniqueness of doxastic modality.
4 Multi-Model Theory

The central proposal of this paper that will make possible an account of the desired kind is that model theoretic semantics is a theory of the semantic component of an I-language in the sense of Chomsky (1986). Since I-languages differ from individual to individual, it follows that in order to interpret other people it is necessary to be able to translate among I-languages. For semantics, I take this to require introduction of separate models for separate speakers together with a way of translating among them.\(^9\) Significantly, this means that interpretation of others requires relating a model of one’s own beliefs to a model of another speaker’s beliefs, and hence that each individual speaker needs to be able to manipulate multiple models. This view differs from the standard model-theoretic semantic view in which a single model used for all interpretation is assumed to be given from the start. On the present view, no designated model is given prior to interpretation of an utterance. If we take models to be speaker relative, this makes it most natural to assume that models are introduced through utterances. More specifically, I will assume that every utterance by a speaker comes with a claim that there is a model compatible with the speaker’s beliefs within which the content of the utterance is true.

To formalize these ideas, I distinguish between interpretation of an utterance and interpretation of what was uttered. The former involves attribution of a model of beliefs to the utterer, while the latter employs this model to calculate truth conditions. To distinguish between these two very different aspects of interpretation, I employ triple brackets for the first and the standard double brackets for the second. Since the identity of the utterer is essential in determining the model to be used for interpretation, I will take the utterer to be identified through a parameter on the utterance. For utterance \(U_s\) of a sentence \(S\) by a speaker \(a\) in world \(w\), the beginning of the interpretation will go as follows:

\[
(8) \quad \llbracket U_s \rrbracket^M = \text{true iff } \exists M \text{ M is compatible with the beliefs of } a \text{ in } w \text{ and } \llbracket S \rrbracket^M = 1
\]

Of relevance here, the model \(M\) will contain a set of worlds \(W_M\) compatible with the

\(^9\) This idea can be justified in several ways. In the present paper, I argue for the need for distinct sets of worlds as model parameters for distinct types of modal interpretation. An additional argument can be made from the semantics of propositional attitude attribution for the need to have distinct domains of individuals accessible at different points in the interpretation, where a domain of individuals is assumed to come from a model. The basic idea of this argument is that \emph{de re} and \emph{de dicto} interpretations of names cannot be adequately represented in a single model if names are taken to be rigid designators and the speaker and attitude holder have irreconcilable differences in their ontology of individuals (real and/or imaginary). A multi-model analysis that takes attitude attribution to always involve a translation between two models has no problem handling this kind of situation without having to abandon the rigid designator analysis of names within a model. The full analysis can be seen as a synthesis of a Lewis-style appeal to counterparts, needed to relate individuals and worlds across models, and a Kripke-style appeal to rigid designation within a model. (cf. Lewis 19?? and Kripke 19??).
speaker’s beliefs and hence equivalent to the doxastic modal base of the speaker.\textsuperscript{10} I propose that doxastic interpretation consists simply of a modal interpreted using this $W_M$ as a modal base.

The beginnings of the analysis given so far already contain the essentials of an account of ECP effects. By taking all utterances to introduce a model compatible with the speaker’s beliefs, a doxastic modal base has a privileged position in the theory that sets it apart from any other modal bases introduced later. This introduces the asymmetry into the theory needed to account for the differential behavior of doxastics and other modals.

Note that the world parameter in (8), present in interpreting the utterance, only serves to identify the utterer’s beliefs, and is not added as a parameter used to interpret the sentence $S$ that was uttered. Intuitively, this aspect of the analysis reflects the fact that although we make statements within the actual world, our beliefs do not themselves suffice to isolate this world and may well in fact be incompatible with it. Introduction of a model compatible with beliefs thus should not simultaneously introduce a world parameter for interpreting world-sensitive expressions. It is the absence of this world parameter that gives us our account of ECP effects. Quantifiers are world sensitive. Under standard interpretations, this means that they need to be interpreted with respect to a world parameter in order to determine the extension of their restriction. The quantified expression every detective, for example, will range over a very different set of individuals within the context of a Columbo show, a Sherlock Holmes novel or a real-world crime investigation. If quantifiers are not given a single world for this purpose, their interpretation becomes undefined. With respect to (8), since $S$ is interpreted only with respect to a model and not with respect to a world, it follows that $S$ cannot have the form $[Q P S’]$; the QP would be undefined if it did. I take this to be the essence of ECP effects. Quantification is only possible at all with respect to a previously introduced world parameter, but doxastic interpretation occurs at a level prior to their introduction.

On the analysis sketched above, doxastic modal statements do not require introduction

\textsuperscript{10} Strictly speaking this statement is false under Kratzer’s analysis in two ways. First, Kratzer takes the modal base to be a function from worlds to sets of propositions, while the set of worlds $W_M$ implicitly contained in the model M in (8) is a mere set of worlds. This is a harmless difference since we have already incorporated the relativity to worlds in the fact that the utterance was made in world w, and that w helped to fix the beliefs of the speaker and hence the possible values of M. Second, the propositions that result from applying a modal base to a world under Kratzer’s analysis are not recoverable from the set of worlds in which those propositions are true. This would be problematic if Kratzer ever made essential use of these propositions. However, in her analysis these propositions play no ineliminable role. Only the intersection of that set of propositions, i.e. the set of all worlds compatible with each of the propositions, is made use of in defining the various degrees of necessity and possibility. In this respect, modal bases and ordering sources differ. With ordering sources, the propositions themselves need to remain accessible since ordering between two worlds is dependent on the sets of propositions satisfied in those worlds. I will use the term modal base loosely in this respect. Since modal bases are not introduced in the present theory as primitives, the term itself becomes no more than a useful mnemonic for one of the ways in which the set of worlds within a given model are put to use.
of any further models. They represent the simplest possible case in this respect. The modal expression simply quantifies over the set of worlds \( W_M \) contained in the model \( M \). Since doxastic interpretation does not come in different flavors depending on ordering sources the way deontic interpretation does, we will need to prevent modification of a doxastic modal with an ordering source. However, since ordering sources within Kratzer’s framework are functions from worlds to propositions, we can exclude the possibility of doxastics combining with ordering sources by analyzing the latter as a function of the former. Under such an analysis, the absence of an ordering source for doxastics would be given the exact same explanation as the absence of quantification into doxastics – there is no accessible world parameter at a point where one is needed to avoid undefinedness. This analysis will be spelled out in more explicit detail below after introducing ordering sources formally.

The analysis of doxastic modality just presented takes the set of worlds of the current model to act as the modal base that the modal expression quantifies over. In order to avoid unnecessary ambiguity, I propose to generalize this analysis of modals to all cases: modals uniformly quantify over the worlds of the local model. I give two examples in (9) of such modals, where \( W_M \) represents the set of worlds in the model \( M \).

\[
\begin{align*}
\text{[[must]]}^M &= \lambda c \lambda p. [\forall u: u \in W_M \& c(u)] (p(u)) \\
\text{[[may]]}^M &= \lambda c \lambda p. [\exists u: u \in W_M \& c(u)] (p(u))
\end{align*}
\]

The inclusion of an additional proposition in the restrictive clause serves two purposes. The first is to allow if-clauses to serve as restrictors on modals, something that occurs with all types of modals but won’t be examined here. The second is to facilitate incorporation of an ordering source in non-doxastic modals. In cases containing neither an overt if-clause nor a covert ordering source, I assume that the first argument applies to a default if-clause denoting a proposition true of all worlds. This makes it possible for these modal expressions to be used directly without any ordering source, applying to a proposition in their scope, which is just what is wanted in the doxastic case.

We are now ready to deal with non-doxastic modals. Given that modals in the present framework quantify over the worlds \( W_M \) of the local model \( M \), a change in modal base requires a change in models. A means of introducing a new model is thus required, together with rules for relating the new model to the current one. There are many potential operators that can do this, including most prominently those associated with propositional attitude predicates. For our purposes the most important such operator is the circumstantial operator that introduces a model \( M' \) whose set of worlds \( W_{M'} \) consists of all worlds consistent with some salient set of facts.\(^{11}\) Since the new model introduces its own domain of individuals as well as its own set of worlds, there is no automatic correspondence between these new

\(^{11}\) It is conceivable that this set should further be restricted to those worlds already contained in the worlds of the current model, \( W_M \). I do not make this assumption in order to allow for the possibility of reasoning on the basis of supposed facts that are accepted by others but not by the speaker as well as reasoning on the basis of counterfactual assumptions.
individuals and worlds and those of the original model. This means that in order for any interpretation given within a circumstantial model \( M' \) to have any significance for the speaker whose beliefs were modeled by \( M \) it is necessary to set up a relation between the individuals and worlds of \( M \) and those of \( M' \). The relation needed could be seen as an extended version of Lewis’s (19??) counterpart relation, extended to apply to worlds as well as to individuals. In the semantics for the circumstantial operator given in (10), this counterpart relation is introduced through a variable \( R \).

\[(10) \quad [\text{Op}_{\text{circ}}]^{M} = \lambda p. \text{circumstantial}(M') \& R(M, M') \& [p]^{M} = 1\]

Note that the circumstantial operator is a metalinguistic operator that applies to expressions, not to their interpretations. In positing such an operator I am implicitly following Potts (200?) and Sudo (2006) in taking all expressions to have a dual semantic type, one a normal semantic type and the other the type of expressions.

It is worth asking at this point what other modal operators there are that can be used to introduce new models. In particular, given that doxastic interpretation is already secured, is there any further need for introducing an epistemic operator? I take no stand on this issue. The question turns on whether deontic modals can be interpreted relative to an epistemic modal base, and if so whether such an interpretation would be any different from interpretation relative to a circumstantial modal base. I confess that I do not see what such a distinction might be at this point and continue to remain skeptical about the usefulness of the notion of speaker’s knowledge as opposed to beliefs in the analysis of modality, though I will remain neutral on this issue here. What’s important to the analysis being developed is only that whatever modal base operators there are, they will operate in a way parallel to the circumstantial operator in (10), identifying a new model as being of a particular kind and relating that model to the model within which the operator is interpreted.

We are now ready to incorporate ordering sources into our compositional treatment of modality. Following Kratzer, I assume that an ordering source is a function from worlds to propositions. The world I take to come from a parameter specified together with the model used for interpretation. The only difference is that whereas Kratzer takes all modals to involve an ordering source I assume that ordering sources are optional. The difference is crucial since without it we would not be able to account for the irrelevance of ordering sources for doxastic modals.

To facilitate computation, I will assume that for any set of worlds \( W \) and any ordering source \( os \), there will be a set of sets of worlds \( \{\text{Max}(os)_1, \ldots, \text{Max}(os)_n\} \) such that each set of worlds \( \text{Max}(os) \) counts as maximally close to the ideal set up by \( os \). In order to introduce an ordering source where wanted, I employ the operator \( \text{Op}_{os} \) in (11).

\[(11) \quad [\text{Op}_{os}]^{M,w} = \lambda \varphi \lambda c. \varphi (\lambda u. \exists i u \in \text{Max}(os(w)), & c(u))\]

This operator applies directly to a lexical modal expression like the ones defined in (10). Combined with most as in (12a) this operator will yield an interpretation that directly
generates a necessity, and combined with may as in (12b) one that generates a possibility.

(12) a. \[[\text{Op}_{\text{os}} \text{ must}]]^{M,w} = \lambda c \lambda p. [\forall u: u \in W_M \& \exists i u \in \text{Max}(os(w)), \& c(u)] (u \in p)

b. \[[\text{Op}_{\text{os}} \text{ may}]]^{M,w} = \lambda c \lambda p. [\exists u: u \in W_M \& \exists i u \in \text{Max}(os(w)), \& c(u)] (u \in p)

These interpretations are equivalent to Kratzer’s notions of necessity and possibility in those cases in which maximally ideal sets of worlds can be assumed to exist, as the reader can verify. The fact that the ordering source operator is only defined when a world parameter is specified precludes applying the operator to a doxastically interpreted modal as desired.

Before the analysis can count as a full-fledged account of the behavior of modals vis-à-vis quantifiers, one thing is still required: to specify how world parameters get introduced so that quantification becomes possible quite generally. I will follow von Fintel and Heim (2005) in taking worlds to be introduced through application of an intensional version of functional application. The definition I give below deviates somewhat from theirs since I do not assume that a world parameter is always present.

(13) Intensional Functional Application (IFA)

If \( \alpha \) is a branching node and \( \{\beta, \gamma\} \) the set of its daughters, then, for any interpretation parameters \( \pi \): if \( [[\beta]]^{\pi} \) is a function whose domain contains \( \lambda w. [[\gamma]]^{w,\pi} \), then \( [[\alpha]]^{\pi} = [[\beta]]^{\pi} (\lambda w. [[\gamma]]^{w,\pi}) \).

Since both bare modals and \( \text{Op}_{\text{os}} \)-modal combinations require an intensional argument of type \(<s,t>\), IFA will require this argument to be raised to the appropriate intensional type prior to combination with the modal, introducing the world parameter needed for interpretation of quantified expressions in the scope of a modal. This account does not automatically extend to non-modalized cases as it stands, however. In order to make quantification possible in non-modalized cases, I assume a default operator semantically equivalent to must that obligatorily selects for a circumstantial model.\(^{12}\) This will introduce the necessary world parameter for all non-doXastic interpretation, making possible not only quantification but also introduction of an ordering source.

\(^{12}\) Introducing the equivalent of a null must raises the question of why the doxastic modal statement That must be John is interpreted any differently from the declarative statement That is John. I take this distinction to follow from general blocking principles that operate in grammar to block true synonymy. Whenever a systematic synonymy is introduced into grammar, one of the synonyms invariably picks up a meaning or use that differs from that of its original synonym. In the case of modals, I take this general blocking effect to be the source of the requirement that null must select for a circumstantial model. A possibly preferable alternative would be to allow for a separate non-modal operator to introduce a world parameter into the interpretation, perhaps an evidential operator (see Faller 2002 for an in-depth analysis of evidentials). I will put investigation of this question off for a future occasion.
5  Doxastic, Metaphysical and Deontic Modality Revisited

With our analysis in place, we are now ready to consider how to model the distinctions described earlier between doxastic modality, metaphysical modality and deontic modality. The first we have already adequately examined: a doxastic modal statement is one in which the modal quantifies over the worlds of a model that models the belief state of a speaker. Since all statements within the current framework involve such quantification either explicitly or implicitly, in that respect all statements count as doxastic modal statements. Those statements more standardly identified as doxastic would within this framework be those which do not in addition introduce a circumstantial operator in the matrix clause. Metaphysical modality we can now define as modality involving quantification over a set of worlds introduced by a circumstantial operator. Pure metaphysical modality does not involve identification of an ideal in any sense, and so does not involve an ordering source either. It only involves quantification over a modal base, and in this respect is similar to doxastic modals. The most important difference between pure doxastic modals and pure metaphysical modals lies in the identity of the modal base. Finally, deontic modality as well as all remaining cases of circumstantial modality can be characterized as involving quantification over a set of worlds introduced by a circumstantial operator in combination with an ordering source. Since our analysis is fully compositional, these distinctions reduce to the following syntactic representations for necessity, where Must represents the phonetically null doxastic operator that selects for the circumstantial operator.

\[
\begin{align*}
\text{doxastic} & \quad \text{[must p]} \\
\text{metaphysical} & \quad \text{[Must [Op_{circ} [must p]]]} \\
\text{deontic} & \quad \text{[Must [Op_{circ} [Op_{on} \text{must} p]]]}
\end{align*}
\]

6  Quantifier Modal Interactions

We are at last ready to show how the analysis laid out above accounts for the observations regarding modals, quantifiers and their interaction made at the beginning of this paper. The first observation regarding modality was that it is very difficult to isolate and force a doxastic interpretation – it is always possible to interpret what looks like a plausible candidate for a doxastic modal as a metaphysical modal instead. Within the present framework this is expected since metaphysical modality is a sub-instance of doxastic modality (in its broadest sense). Metaphysical interpretation involves addition of a circumstantial operator combined with quantification by the modal over the set of worlds introduced by that operator, but the interpretation of a metaphysical modal is identical with that of a pure doxastic modal in all other respects. In particular, it does not require any contextually determined ordering source. What’s more, introduction of the null doxastic operator and its accompanying circumstantial operator is universally available – there is nothing in the theory to block it. It is thus expected that a shift from doxastic to metaphysical modality should be possible any time, restricted only by pragmatic considerations. It is also expected that any diagnostic for doxastic interpretation will be satisfied both by a pure doxastic modal and by a metaphysical modal, since in fact both do involve a doxastic quantification over worlds.

The second observation made was that quantifiers cannot scope over pure doxastic
modals, but that they can scope over metaphysical and deontic modals. These facts too follow from the model without need of further stipulation. The absence of quantification over doxastics follows from the fact that a doxastically interpreted modal is interpreted with respect to a set of parameters that does not include a specified world. QPs require access to a world parameter for their interpretation, and so it follows that they cannot be interpreted at the same point at which doxastic modals are interpreted. Doxastic modals, however, including the default operator Must, introduce a world parameter (through IFA) into the interpretation, which will provide the necessary world parameter for interpretation of a quantifier in metaphysical and deontic modal statements as well as in declarative statements. Since the circumstantial operator relates all worlds of a higher model with worlds of the circumstantial model it introduces, this world parameter will be taken care of by that same relation, making it possible for quantification to be over individuals in the worlds of the circumstantial model, not only over individuals in the speaker’s belief model. Crucially, the introduction of the world parameter logically precedes quantification over worlds by a modal expression in these latter types of modality, making it possible for a standard QP to be interpreted above the modal and hence to take scope over the modal. The particular positions semantically allowed for a quantifier are illustrated in (15).

(15)  

<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>doxastic</td>
<td>[must [&lt;QP&gt; p]]</td>
</tr>
<tr>
<td>metaphysical</td>
<td>[Must [&lt;QP&gt; [Op_circ [&lt;QP&gt; [must [&lt;QP&gt; p]]]]]]</td>
</tr>
<tr>
<td>deontic</td>
<td>[Must [&lt;QP&gt; [Op_circ [&lt;QP&gt; [Op_os must] [&lt;QP&gt; p]]]]]</td>
</tr>
</tbody>
</table>

7 Predictions of the Analysis:

The analysis presented in the preceding section makes a clear prediction regarding embedability of modals. Since circumstantially interpreted modals all involve quantification over a circumstantial modal base, it should be possible for a circumstantially interpreted modal to be within the scope of any other modal. While we can’t show this with multiple modal auxiliaries, which presumably must be tensed, we can show this with the help of modal verbs like have to. As we can see in (16) below, the prediction is borne out straightforwardly for deontic modals.

(16)  

a. John has to_deon go to prison  
b. John may_deon (for all I know) have to_deon go to prison  
c. Objectively speaking, John may_meta have to_deon go to prison  
d. (To build a safe society,) criminals must_deon have to_deon go to prison

For metaphysical modals the intuition is more subtle, though the following examples show that metaphysical modals as well can occur within the scope of any other modal.\(^\text{13}\)

\(^{13}\) In an earlier version of this paper I made no distinction between doxastic and metaphysical modals, implicitly taking epistemic modality to be what I am here calling doxastic modality. I claimed in that paper that epistemic modals cannot occur in the immediate scope of another
(17) a. John, (objectively speaking,) has to\textsubscript{meta} be guilty
   b. John may\textsubscript{dox} (as far as I know) (objectively speaking) have to\textsubscript{meta} be guilty
   c. (Objectively speaking,) John may\textsubscript{meta} (objectively speaking,) have to\textsubscript{meta} be guilty
   d. (By law,) criminals must\textsubscript{deon} (objectively speaking) have to\textsubscript{meta} be guilty.

In contrast, since doxastic modals are interpreted above all other modals it follows that doxastically interpreted modals cannot be embedded under any other non-doxastic modal: any such embedding would require access by the intended doxastic modal to a model that is no longer an active parameter of semantic interpretation. Once again, the prediction is borne out, as seen in (18c,d).

(18) a. John has to\textsubscript{dox} be guilty.
   b. #(For all I know,) John may\textsubscript{dox} (for all I know) have to\textsubscript{dox} be guilty.
   c. #(To build a safe society,) criminals must\textsubscript{deon} (for all I know) have to\textsubscript{dox} be guilty.
   d. #(Objectively speaking,) John may\textsubscript{meta} (subjectively speaking) have to\textsubscript{dox} be guilty.

While the sentences in (18) are interpretable, it is not possible for the occurrences of have to contained therein to be given a doxastic, i.e. purely subjective interpretation. The one case of blocked embedding that doesn’t follow from the architecture of the theory is that of (18b), i.e. embedding of a doxastic modal under another doxastic modal. Since both modals in (18b) involve quantification over the same modal base, there should be no problem with accessing the required modal base as there was for the case of doxastics embedded under circumstantial.

If the present analysis is correct, it follows that the unacceptability of (18b) must be given a separate explanation. The explanation I will adopt here is that multiple quantification over the same modal base without any ordering source is redundant. (18b) comes out as saying that some world consistent with the speaker’s beliefs is such that in every world consistent with the speaker’s beliefs John is guilty. Clearly the first quantification adds nothing to the truth conditions here.

An anonymous reviewer raised an example parallel to (17d) as an objection to this claim. (The actual example is The state must have to be right). The reviewer suggested such a sentence might be used to describe a totalitarian society where thoughts are controlled. While I agree that a reading like the one the reviewer pointed out is possible, I take this to involve a metaphysical interpretation of the modal and not a doxastic one. Whether this analysis is adequate or not, making a clear distinction between metaphysical and doxastic modals and abandoning the term epistemic modal should at the very least help to clarify the question of what interpretations are possible and to avoid the unintended confusion that invariably accompanies use of a single term that has multiple and conflicting standard uses. A technical way out of this problem would be to analyze lexical modal expressions as including in their interpretation something equivalent to a circumstantial operator. This would make (18b) entirely parallel to (18c,d). While such an analysis gets the facts to come out right, however, it does so by stipulation rather than as a consequence of general properties of the theory of modality and is so to be dispreferred.
A more general prediction of the theory is that languages should be able to exist in which doxastic modals are lumped together with metaphysical modals to the exclusion of deontics, as well as languages in which metaphysical modals are lumped together with deontics to the exclusion of doxastics, but that no language should lump doxastics together with deontics to the exclusion of metaphysical modals. Allowing multiple interpretations for a single modal requires abstracting away the differences in those interpretations. Doxastic and metaphysical interpretations differ in their modal base but share an absence of relativity to an ordering source. Metaphysical and doxastic interpretations share a modal base but differ in whether they employ an ordering source. Doxastic and deontic interpretations, in contrast, differ both with respect to modal base and with respect to employment of an ordering source. Abstracting over both differences will leave a lexical item capable not only of doxastic and deontic interpretations but also of metaphysical interpretations. Abstracting over only one of the differences, in contrast, will leave a lexical item capable of two interpretations only, either metaphysical and deontic, or metaphysical and doxastic. English modal auxiliaries represent the least specific case. Whether this prediction is upheld across the various types of modal expressions across the worlds languages is a question only time will tell.

8 Extending the Analysis to Japanese

The technical analysis developed in the main section of this paper was worked out for the case of English modal verbs, where a single modal verb form can be given either a doxastic, a metaphysical or a deontic interpretation. Modal predicates in Japanese, however, generally do not exhibit this same three-way ambiguity. Kamoshirenai (may) and nichigainai (must) in the examples in (4) can be doxastic or metaphysical, while -te ii (may, for permission) and -beki da (should, of requirement) have only a deontic interpretation. The analysis we have given for English can be naturally extended to account for the Japanese facts as well. The only difference that needs to be introduced is to treat ordering sources as introduced only within the lexical specification of a sub-class of modal expressions in Japanese, and not available as a separate lexical item directly accessible by the syntax. This will leave all of the observed properties of the modals intact. Under this approach, the semantics of Japanese doxastic and metaphysical modal predicate would be modeled after (19a), and that of other modal predicate after (19b).

(19)a. $[[\text{kamoshirenai}]^{M}] = \lambda c \lambda p. [\exists u: u \in W_{M} \& c(u)] (p(u))$

b. $[[\text{-te ii}]^{M,w}] = \lambda c \lambda p.[\exists u: u \in W_{M} \& \exists i u \in \text{Max}(os(w)), \& c(u)] (u \in p)$

The definitions given above preserve the world-dependence of deontic modals and the world-independence of doxastic and metaphysical modals. They furthermore instantiate one of the patterns of lexicalization that is predicted to be available as a universal possibility. The rest of the machinery for introducing models can remain unchanged and will have the same effect in Japanese as in English. Since the same contrasts found in English held for Japanese as well, this is a desirable consequence of the interpretations given.
The analysis of Japanese modals further leads to the same prediction as the English analysis regarding embedability: non-doxastics should embed under other modals, while doxastics should not. The reason is again the same: doxastic interpretation requires access to a model of the speaker’s beliefs, but that model becomes unavailable once a circumstantial model is introduced, and in multiple doxastics one of the modals is always redundant. Indeed, to the extent that the architecture of interpretation is universal, these same facts are predicted to hold in all languages. That this prediction is upheld for Japanese can be seen in the Japanese counterparts to (16) – (18) given respectively in (20) – (22) below.

[[Check examples with doxastic metaphysical distinction.]]

(20)a. John-wa keimusho-ni iku-beki-da
John-TOP prison-DAT go-should-copula
*John should go to prison* (non-epistemic)

b. John-wa keimusho-ni iku-beki-kamoshirenai
John-TOP prison-DAT go-should-may
*John may have to go to prison* (epistemic may, non-epistemic have to)

c. John-wa keimusho-ni iku-beki-dearu-beki-da
John-TOP prison-DAT go-should-copula-should-copula
*John should have to go to prison* (non-epistemic)

(21) (metaphysical interpretation)

(22)a. Sagashite-iru hito-wa John-ni chigainai
Looking for person-TOP John-must
*The person you are looking for must be John* (epistemic)

b. *Sagashite-iru hito-wa John-ni chigainai kamoshirenai
Looking for person-TOP John-must (epist.) may (epistemic)

Looking for person-TOP John-must (epist.) should-copula (non-epistemic)

9 Scopal Preferences for D-linked Quantifiers
I have so far been accepting that ECP effects surface with all quantifiers blocking them from taking wide scope over a doxastic modal, and I have formulated the analysis of modality to account for that fact. D-linked quantifiers (cf. Pesetsky 1987), however, at first sight appear to counterexemplify the generalization upon which the ECP is established, as in the following examples.

(23) a. Each student may be Jones
b. Either student may be Jones
c. Which students may be Jones?
The quantifiers each and either and wh-expressions headed by which all clearly prefer a wide scope interpretation in the above examples. The wide scope readings for (23a,b) can be seen in a situation in which a teacher faces a class full of unknown faces (a) or two unknown students (b) when she has reason to believe that Jones is among them. In such a situation, the teacher need not countenance the possibility that each student is Jones or that either student is Jones for the sentences to be true.

While the examples presented clearly prefer for the quantifier to have wide scope over the modal, I maintain that this wide scope reading involves a metaphysical interpretation of the modal. Establishing the possibility of a metaphysical interpretation is straightforward – add the phrase objectively speaking and notice that the scope facts remain unchanged. More difficult is showing that a doxastic reading of the modal is impossible in the scope of a D-linked quantifier. The result of substituting perhaps for may and tabun for kamoshirenai, however, goes a good way toward establishing that a doxastic modal cannot occur under the scope of a quantifier. Recall that perhaps and tabun strongly prefer a doxastic interpretation. The examples in (25) and (26) in which these modals occur with a D-linked quantifier are decidedly awkward, clearly much more so than their counterparts in (23) and (24).

(25) a. #Each student is perhaps Jones
    b. #Either student is perhaps Jones
    c. #Which students are perhaps Jones?

(26) a. #Kaku gakusei-ga tabun Jones de aru
    Each-GEN student-NOM perhaps Jones COP
    Each student is perhaps Jones
    a'. #Gakusei-ga sorezore tabun Jones de aru
    Student-NOM each perhaps Jones COP
    The students each are perhaps Jones
    b. #Dochira-no gakusei-demo tabun Jones de aru

Which (of 2)-GEN student-ever perhaps Jones COP

Either student is perhaps Jones

c. #Dono gakusei-ga tabun Jones de aru no?

Which student-NOM perhaps Jones COP Q

Which student(s) is/are perhaps Jones?

The narrow scope reading of the quantifier is of course available, but in the declarative examples and the plural questions this scope gives rise to an absurdity. The wide scope reading of the quantifiers simply appears to be missing here.

The above observations taken by themselves might suggest that the wide scope readings derive from a lexical property of a quantifier and are independent of D-linking. However, sentence (27) shows that this is not the case.

(27) That may be two (of my) friends

In a situation in which (27) is uttered directly after hearing the doorbell, in the absence of any additional context the by far most natural reading is one in which the modal takes scope over the quantifier. The interpretation in that case is equivalent to the following is possible: that that is two (of my) friends. The opposite scope – there are two x among my friends such that it is possible that that is x – is comparatively much more difficult. However, things change when context is added. Suppose that (27) is uttered in the following context:

(28) (Context for (27))

5 of my friends visit me regularly. The doorbell just rang, and my daughter tells me that there is one person at the door, and that he has a moustache. To me, that means that (27).

In this context, it becomes fairly easy to interpret (27) with two (of my) friends taking wide scope provided that the two friends are understood to be among the 5 mentioned in the context. If the two friends in mind are taken to be identified independently of the five already mentioned, then the wide scope reading of the quantifier disappears. The partitive version of (27) is somewhat more natural than the non-partitive version, though by facilitating an anaphoric interpretation of the non-partitive version by placing emphasis on two and deaccenting friends the relevant reading is marginally available in this case as well. Changing the quantifier to two of them, where the anaphoric connection to the previously mentioned friends is made explicit, makes the wide scope QP reading impeccable. Note once again, incidentally, that replacing may with perhaps once again makes a wide scope

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15 As von Fintel and Iatridou point out, a wide scope reading for the numeral quantifier is conceivable if this expression is given a non-distributed group interpretation. However, they do not establish the existence of such an interpretation, but merely show that it would be compatible with the interpretation observed.
quantifier reading much more difficult.

The above considerations suggest that D-linking facilitates wide scope over metaphysical modals but that contrary to first appearances it does not give us a way of quantifying into doxastics. Unexplained here is why D-linking makes quantification into metaphysical modals so much easier than using non-D-linked quantifiers. While this question is an interesting one, for reasons of time and space I have to leave this question unaddressed here.

10 Conclusion
In this paper I have argued that the ECP effects uncovered by von Fintel and Iatridou (2003) are properly analyzed as involving doxastic modals and not metaphysical modals, i.e. that quantification into doxastics in a matrix context is impossible while quantification into metaphysical modals is allowed. I showed that Kratzer’s (1991) analysis of modal interpretation fails to predict this distinction because it treats all types of modality in a parallel fashion. I then showed that a revision to the analysis that treats doxastic modality as interpretively prior to all other types of modality can account for the ECP effects without giving up the advantages of Kratzer’s analysis. The revision proposed is based on the notion that models are used to represent several different things in the course of semantic interpretation, speaker’s beliefs, presumed objective circumstances and other speakers’ beliefs among them. This innovation makes it possible to use the worlds of a model as a modal base for modal interpretation, and also readily provides the asymmetry between doxastic modals and all other modals needed to account for ECP effects. From a broader perspective, the proposed multi-model theory can readily serve as a basis for investigating the semantic properties of I-language, or what I call I-semantics, something that a semantic theory based on a single model is ill equipped to do.

Under the framework of modal interpretation proposed, ECP effects fall out as a consequence of doxastic interpretation not involving specification of a world parameter. On the assumption that all quantification is world relative, this absence of a world parameter makes it impossible for a quantifier to be interpreted at the same level as a doxastic modal. I showed that the fact that doxastic modals do not come in different flavors the way deontics do also follows from this absence of a world parameter at the relevant stage of interpretation. In this way, the analysis of ECP effects proposed goes farther than that of von Fintel and Iatridou in that it has broader and testable effects on other phenomena as well as accounting for the ECP effects themselves.

In making fundamental changes to the framework of semantic interpretation, the analysis proposed is certain to have far-reaching consequences not foreseen at this stage. I hope I have at least made a plausible case that these consequences are worth pursuing.

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