Constraints on the embeddability of epistemic modals[1]

Michela IPPOLITO — *University of Toronto*

Abstract. In this paper I investigate occurrences of epistemic modals such as *must* and *might* embedded under three classes of attitude verbs: (i) doxastic and doxastic-like verbs like *believe*, (ii) desiderative verbs like *want*, and (iii) emotive doxastic and dubitative verbs like *fear*, *hope* and *doubt*. The first class allows both necessity and possibility epistemic modals; the second class allows neither necessity nor possibility epistemic modals; and finally, the third class allows possibility but not necessity epistemic modals. We begin our inquiry by reviewing Anand and Hacquard (2013)'s proposal. I present some challenges for the proposal and, in particular, for their proposal for class (iii). I show that the restrictions on embedded epistemic modals are similar to the restrictions on embedded V-to-C in German (Truckenbrodt (2006)) and argue that the two phenomena can be given similar explanations.

Keywords: epistemic modals, attitude verbs, embedded V-to-C.

1. Introduction

Epistemic modals can be sometimes embedded under propositional attitude verbs. This paper is a study of what constrains their distribution under attitude verbs, starting from the broad observation that there seem to exist three types of attitudes: those that license epistemic modals in their scope, those that do not allow epistemic modals in their scope, and those that allow possibility but disallow necessity modals. Building on Bolinger (1968)'s generalization, and bulding on a corpus study done by Hacquard and Wellwood (2012), Anand and Hacquard (2013) observe that epistemic modals are acceptable in the complement of doxastic verbs such as *think*, argumentative verbs such as *say*, and semi-factive verbs like *realize*.

(1)   a.   John thinks that Mary must/might be innocent.
          b.   John said that Mary must/might be innocent.
          c.   John realized that Mary must/might be innocent.

The second type includes verbs that do not allow epistemic modals in their complement. These include desiderative verbs such as *want* and directives like *demand*.

(2)   a. #John wants Mary to have to be the murderer.
          b. #John demanded that Mary must/might have been the murderer.

The third kind includes emotive doxastic attitudes such as *fear* and dubitative verbs such as *doubt*: these verbs only allow possibility epistemic modals in their complement.

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(3)   a.   John fears that Mary may/might have known the killer.
        b.   #John fears that Mary must have known the killer.

(4)   a.   John doubts that Mary may/might have known the killer.
        b.   #John doubts that Mary must have known the killer.

2. Anand and Hacquard (2013)

To account for the contrast between the attitude verbs that allow embedded epistemic modals and those that do not, Anand and Hacquard propose that (i) only "representational" attitudes can provide an information state and (ii) embedded epistemic modals quantify over an information state determined by the embedding attitude. Let's begin with point (i). The non-representational nature of a desiderative verb like *want* derives – they claim – from the fact that *want*, unlike *believe*, has a comparative semantics. Following Stalnaker (1984), Asher (1987), Heim (1992), and more explicitly Villalta's work on desiderative predicates (Villalta (2008)), they provide the semantics in (5).

(5) $[\![\textbf{want}]\!]^{c,w,g} = \lambda p.\lambda x.\forall q \in g(C)\backslash p : p >_{DES_{x,w}} q$
        where $DES_{x,w}$ is defined as follows:
             -for any w, w', w'': $w' >_{DES_{x,w}} w''$ iff w' is more desirable to x in w than w''.
             -for any $p, q \subseteq W : p >_{DES_{x,w}} q$ iff $\forall w'' \in q : [\exists w' \in p : [w' >_{DES_{x,w}} w'']]$ and $\exists w' \in p : [\forall w'' \in q : [w'' \not>_{DES_{x,w}} w'']]$

Since *want* – they claim – is non-representational, it fails to provide an information state that will function as the "antecedent" for the embedded modal. As shown in (6), on the other hand, the attitude *believe* does provide an information state, i.e. the subject's doxastically accessible worlds, which will then be the set of worlds quantified over by the embedded epistemic modal.

(6) $[\![\textbf{believe}]\!]^w = \lambda p.\lambda x.\forall w' \in Acc_{dox}(w,x) : p(w') = 1$

Part (ii) of Anand and Hacquard's story, i.e. that embedded epistemic modals quantify over an information state determined by the embedding attitude, builds on Yalcin (2010), whose goal was to account for the contrast between (7a) and (7b).

(7)   a.   Imagine that [it's raining but you don't believe it is].
        b.   #Imagine that [it's raining but it might not be].

Yalcin's proposal is that the unacceptability of (7b) is due to the fact that the embedded epistemic modal "inherits" its modal base from the quantificational domain of the embedding attitude, generating a contradiction: (7b) asserts that all worlds compatible with the addressee's imagination are worlds where it is raining and there is a world compatible with the addressee's imagination where it is not raining. Extending this idea, Anand and Hacquard propose the general rule in (8).

(8)   For any attitude *att*,
        $[\![\textbf{att } \phi]\!]^{c,w,S,g} = \lambda x.\forall w' \in S' \ [\![\phi]\!]^{c,w',S',g} = 1$, where S' is the quantificational domain
        provided by **att**.

In the majority of cases this creates structures with redundant meanings, equivalent to a modal
sentence with the force of the embedded epistemic modal and the flavor of the embedding
attitude.

(9)   a.   John believes that Mary must be the killer $\equiv$ for all worlds w compatible with
             John's doxastic state in the evaluation world, Mary is the killer in w.
        b. $\forall w \in DOX_J[\forall w'' \in DOX_J :$ Mary is the killer in $w''] \equiv \forall w'' \in DOX_J :$ Mary is the
             killer in w''

(10)   a.   John believes that Mary might be the killer $\equiv$ there is at least a world w compati-
             ble with John's doxastic state in the evaluation world such that Mary is the killer
             in w'.
        b. $\forall w \in DOX_J[\exists w'' \in DOX_J :$ Mary is the killer in $w''] \equiv \exists w'' \in DOX_J :$ Mary is the
             killer in w''

The third type of attitude verbs we will discuss are emotive doxastic verbs like *fear* and *hope*
and dubitative *doubt*. Let's begin with the former. Anand and Hacquard propose the semantics
in (11): *a hopes that ϕ* presupposes that *a*'s doxastic state is compatible with both ϕ and $\neg\phi$
and it asserts that ϕ is compatible with *a*'s doxastic state and that ϕ is preferable to $\neg\phi$.

(11) $[\![\textbf{a hope that } \phi]\!]^{c,w,S,g}$
        a.   defined iff $\phi-$verifiers in $S' \neq \emptyset \land \phi-$falsifiers in $S' \neq \emptyset$;
             (uncertainty condition)
             if defined, =1 iff
        b. $\exists w' \in S' : [\![\phi]\!]^{c,w,S',g} = 1\land$
             (doxastic assertion)
        c. $\land \phi-$verifiers $>_{DES_{a,w}} \phi-$falsifiers
             (preference assertion)

When the complement is modalized, then we have (12).

(12) $[\![\textbf{a hope that } Modp]\!]^{c,w,S,g}$
        a.   defined iff $Modp-$verifiers in $S' \neq \emptyset \land Modp-$falsifiers in $S' \neq \emptyset$;
             (uncertainty condition)
             if defined, =1 iff
        b. $\exists w' \in S' : [\![Modp]\!]^{c,w,S',g} = 1\land$
             (doxastic assertion)
        c. $\land Modp-$verifiers $>_{DES_{a,w}} Modp-$falsifiers
             (preference assertion)

Since *Modp* verifiers are the same as *p* verfiers (see Anand and Hacquard (2013) for a discussion of this point), a sentence such as *John hopes that it might be raining* carries an **uncertainty presupposition** (that there is a non-trivial subset of John's belief worlds where it is raining and a non-trivial subset where it is not raining); it makes a **doxastic assertion** (that there is at least some world compatible with John's beliefs where it is raining); and, finally, it also makes a **preference assertion** (that rain is more desirable to John than no rain). Crucially, the incompatibility between *hope* and *must* is explained away as a contradiction: *#John hopes that it must be raining* is ruled out as a contradiction between the doxastic assertion (that in all of John's doxastic worlds it is raining) and the uncertainty presupposition requiring John's doxastic state to be compatible with no rain.

Dubitative *doubt* receives a very similar semantics.

(13) $[\![\textbf{a doubts that } \phi]\!]^{c,w,S,g}$
  a.   defined iff $\phi-$verifiers in $S' \neq \emptyset \wedge \phi-$falsifiers in $S' \neq \emptyset$;
        (uncertainty condition)
        if defined, =1 iff
  b. $\exists w' \in S' : [\![\phi]\!]^{c,w,S',g} = 1 \wedge$
        (doxastic assertion)
  c. $\wedge \phi-$falsifiers $>_{PROB_{a,w}} \phi-$verifiers
        (preference assertion)

Just like in the case of *hope* and *fear*, embedding necessity modals under *doubt*, as in *#John doubts that it must be raining*, generates a contradiction between the uncertainty presupposition (requiring that John's doxastic state be compatible with rain and no rain) and the doxastic assertion (that John's doxastic state entails that it must be raining). In the next section, I will discuss some challanges for Anand & Hacquard's proposal.

3. Challenges

There are two challenges that one might raise to challenge the type of proposal defended by Anand and Hacquard. The first problem concerns the analysis of attitude verbs that show a mixed behavior with respect to the embeddability of epistemic modals, i.e. emotive doxastic and dubitative attitudes. In particular, this problem challenges the uncertainty presupposition that is essential in Anand and Hacquard's story to derive the unacceptability of embedded necessity modals. The second problem is a more general worry about Yalcin's "copying" analysis of the embedded epistemic modals when applied to the cases introduced above. Let us begin with the **uncertainty presupposition problem**.

3.1. The uncertainty presupposition problem

There is an immediate prediction that the uncertainty presupposition story makes, i.e. that a negated sentence with *doubt* should also carry the uncertainty presupposition. However, this prediction is not fulfilled, as (14) clearly shows.

(14)   John doesn't doubt that Mary will win the race. He is certain that she will.

Similarly for *fear*: a negated sentence with this attitude should still carry the presupposition that the subject's doxastic state is compatible with both the prejacent and its negation. However, (15) shows that this is not the case.

(15)   The police no longer fear that John's death was a homicide; they are certain that it was an accident.

One could argue that with negation, the uncertainty presupposition is locally accomodated to avoid inconsistency, along the lines of (16).

(16)   NOT(John is uncertain about whether Mary will win the race) John doubts that Mary will win the race.

The problem with this story is that we think of local accomodation as a "rescuing" mechanism, a mechanism that is called upon to avoid a contradiction. What is troubling about the (alleged) uncertainty presupposition is that it is *always* incompatible with the meaning of negated *doubt*, regardless of any explicit sentence contradicting it. Compare (14) to (17).

(17)   John doesn't doubt that Mary will win the race.

What (17) shows is that, if there is a contradiction, it is not caused by the continuation in (14) but by the meaning of negated *doubt* itself. Anand and Hacquard's uncertainty presupposition is anomalous in that it is never consistent with a negative assertion, a logical environment that we standardly take to be transparent to presuppositions. Nor can such a presupposition be detected in the other two environments we typically resort to to identify presuppositions.

(18)   a.   A: Does John doubt that Mary will win the race?
                B: Not at all, he's certain that she will.

(19)   a.   John might know that it is raining outside. But if he (still) doubts that it is, then he will open the window.

The conclusion is that the crucial piece of Anand and Hacquard's account of the distribution of necessity epistemic modals embedded under emotive doxastics and doubitatives is problematic and, as such, it undermines the whole proposal.

3.2. Epistemic flavor

Suppose Mary's colleagues have just returned from a walk outside and they tell her that there is a snowstorm outside. Since it's July, Mary doesn't believe them and insists that it can't be true. They tell her to go to the nearest window and look outside. Mary does and sees the snowstorm. Her colleagues can report Mary's belief with (20b) but not with (20a).

(20)   a. #Mary finally believes that there must be a snowstorm outside.
        b.   Mary finally believes that there is a snowstorm outside.

Anand and Hacquard's story assumes a standard semantics for the epistemic modal, where the modal is treated as a quantifier over possible worlds restricted by an epistemic accessibility function (called "conversational background" in Kratzer's system) as shown in (21).

(21) $[\![\mathbf{must}]\!]^{w,f} = \lambda p_{<st>}.\forall w' \in \bigcap f(w) : [p(w') = 1]$

The modal base of the modal is $\bigcap f(w)$, where f is the epistemic accessibility function. Combining this semantics with Yalcin's proposal that, when embedded, the modal base of an epistemic modal is inherited from the modal base of the higher attitude, it follows that, when embedded under an attitude verb, an epistemic modal loses its modal base and, therefore, its epistemic flavor as well. However, the contrast between (20a) and (20b) shows that this is inaccurate: the epistemic flavor of the modal is retained. It looks like we have a choice to make: either we abandon Yalcin's idea (as applied to the problem we are concerned about in this paper) or we abandon the standard semantics for the modal. In what follows I am going to explore the latter option. The tentative conclusion will be that this is not an unproblematic solution after all.

An obvious alternative to the standard semantics for epistemic *must* is the proposal in von Fintel and Gillies (2010), according to which *must* has a strong semantics (quantifies over all worlds in which the speaker's direct evidence is true) but carries an "unsettledness" presupposition, according to which the speaker's direct evidence does not settle the truth of the prejacent.

(22)   Strong *must* + Evidentiality.
        Fix a *c*-relevant kernel K:
        a. $[\![\mathbf{must}\ \phi]\!]^{c,w}$ is defined only if K does not directly settle $[\![\phi]\!]^c$
        b. $[\![\mathbf{must}\ \phi]\!]^{c,w} = 1$ if $B_K \subseteq [\![\phi]\!]^c$
        where $B_K = \bigcap K$ and K whatever direct information is available to the speaker.

However, we are faced again with the challenge of presuppositions disappearing all too easily, as shown in (23) and (24b).

(23)   A: Do the police believe that the murderer might be a woman?
        B: #Hey, wait a minute! The police don't believe that their evidence doesn't settle whether the murderer is a woman.
        B′: No, they have ruled that out.

(24)   a. John doesn't believe that the keys might be in the car.
            von Fintel & Gillies: $>>$ John believes that K_J does not directly settle whether the keys are in the car.
        b. John doesn't believe that the keys might be in the car since he saw them on the kitchen table just now.

One might hold that (24b), just like the cases we discussed above, is acceptable because the unsettledness presupposition is locally accomodated in the scope of negation. However, consider the question below.

(25)   A: Does the detective believe that the murderer might be a woman?
    a.   B: Not at all. He is certain that the murderer is a man.
    b.   B: Yes. In fact, he is certain that the murderer is a woman.

Both answers are fine. A defender of the unsettledness presupposition could explain the possibility of the negative answer in (25a) as the result of local accommodation. But explaining the positive answer in (25b) is harder. Locally accomodating the presupposition in the scope of the question operator would generate the question in (26).

(26)   Is it the case that (**the detective believes that his evidence does not directly settle whether the murderer is a woman** and it is consistent with his doxastic state that the murderer is woman)

However, positively answering (26) entails "endorsing" the presupposition and as such it should be in contradiction with the continuation in (25b).

The conclusion is that (i) if we adopt a Kratzerian semantics for epistemic modals combined with the Yalcin/Anand & Hacquard semantics in (8) we cannot explain the contrast in (20) and (ii) if we adopt the semantics in (8) combined with a presuppositional story like the one proposed by von Fintel & Gillies, we run into the projection problems just described. The source of these difficulties is, I claim, the semantics in (8).

4. Constraints on embedded V-to-C movement in German

This section is about embedded V-to-C sentences in German, an apparently unrelated phenomenon that shows restrictions very similar to the restrictions on embedding epistemic modals. The V-to-C data discussed in this paper are from Truckenbrodt (2006). The V-to-C phenomenon has some of the properties of what Dayal and Grimshaw call "quasi-subordination" clauses which show properties of both main and subordinate clauses (Dayal and Grimshaw (2009)). V-to-C clauses have also been said to have assertive illocutionary force (e.g. Gärtner (2002)). In what follows, we will look at V-to-C sentences embedded under four kinds of attitudes and operators. Following the classification established in the V-to-C literature, these four groups are: (i) doxastic and speech act verbs, (ii) desiderative verbs, (iii) negation and inherently negative verbs such as *doubt*, and (iv) emotive doxastic verbs such as *hope*. By looking at these two phenomena in parallel, we will see that embedded German V-to-C clauses pattern like epistemic modals with respect to groups (i) and (ii) but show a split behavior with respect to groups (iii) and (iv): embedded V-to-C patterns like possibility epistemic modals with respect to emotive doxastics but like necessity epistemic modals with respect to negative or negated attitudes. The first observation is that V-to-C clauses in German can be embedded under doxastic verbs, speech act verbs, and so-called verbs of cognition.

(27) a.   Maria glaubt,   Peter geht nach Hause.
           Maria believes, Peter goes to   house
           Maria believes that Peter is going home.
      b.   Maria behauptet, Peter geht nach Hause.
           Maria claims,   Peter goes to   house
           Maria claims that Peter is going home.
      c.   Maria träumt, Peter geht nach Hause.
           Maria dreams, Peter goes to   house
           Maria dreams that Peter is going home.

V-to-C sentences cannot be embedded under desiderative verbs.

(28) *Maria will,   sie ist in diesem Fall in Berlin.
       Maria wants, she is in this   case in Berlin
       Maria wants to be in Berlin in that case.

V-to-C can occur embedded under an emotive doxastic predicate like *hoffen*, "to hope". However, V-to-C cannot occur embedded under an inherently negative verb like *zweifeln*, "to doubt", or under a negated attitude verb as in (30b).

(29) Maria hofft,   sie ist in diesem Fall in Berlin.
      Maria hopes, she is in that   case in Berlin
      Maria hopes that she is in Berlin in that case.

(30) a. *Hans bezweifelt, Peter geht nach Hause.
           Hans doubts,   Peter goes to   house
           Hans doubts that Peter is going home.
      b. *Hans glaubt   nicht, Peter geht nach Hause.
           Hans believes not,   Peter goes to   house
           Hans doesn't believe that Peter is going home.

In the remaining part of this section, I will summarize Truckenbrodt (2006)'s proposal for embedded V-to-C in German. With the German facts and his apparatus in place, I will then return to the topic of embedded epistemic modals and lay down my proposal in the next section. Truckenbrodt proposes that embedding a V-to-C clause in German requires that the embedding predicate make salient a set of worlds $B_w(x)$ that represents x's doxastic (or doxastic-like) state in w, where x is the subject of the attitude. It also requires that the proposition p expressed by the embedded CP be entailed by $B_w(x)$. Following Gärtner (2002), Truckenbrodt also proposes an "absorption" requirement.

(31)   Absorption:
          The meaning of attitude + CP must entail $B_w(x) \subseteq p$.

To see how the proposal works, we will look at a case of grammatical embedding of a V-to-C sentence and a case of an ungrammatical embedding. The grammatical one is illustrated in (32).

(32)   Maria glaubt, Peter geht nach Hause.
         Maria believes, Peter goes to   house
         Maria believes that Peter is going home.

The two requirements introduced above are satisfied: (i) the predicate makes salient a set of doxastic-like words, i.e. $DOX_w(Maria)$ (see (33a)); (ii) $DOX_w(Maria)$ entails the proposition expressed by the embedded clause, i.e. that Peter is going home as shown in (33b).

(33)   a. $B_w(x) = DOX_w(Maria)$
         b. $DOX_w(Maria) \subseteq (\lambda w'.\ \text{Peter is going home in } w')$

Since (32) asserts that Maria's doxastic state entails that Peter is going home ($DOX_w(Maria) \subseteq (\lambda w'.\ \text{Peter is going home in } w')$), the assertion entails (33b) and Absorption is satisfied. A violation of Absorption is the cause of the unacceptability of V-to-C under an inherently negative verb like *bezweifeln*, "to doubt". *To doubt* (and the same applies to *bezweifeln*) is a "weak" predicate: according to Truckenbrodt, saying that *a doubts p* only requires *a*'s doxastic state to be compatible with *p*, something that we can represent as: $DOX_w(Hans) \cap (\lambda w'.\ \text{Peter is going home in } w') \neq \emptyset$. Hence, the assertion is weaker that what V-to-C requires, i.e. that Hans's doxastic state entails that Peter is going home.

To sum up, embedded V-to-C requires that the proposition expressed by the complement clause be entailed by the doxastic state of the subject of the embedding attitude verb and this require-ment cannot be weaker that what the whole sentence (matrix clause + embedded clause) asserts. In the next section we will go back to the restrictions on embedded epistemic modals and, build-ing on the strong similarities with the restrictions on embedded V-to-C in German and on some of the insights of Truckenbrodt's proposal, we will defend a proposal that accounts for the constraints on embedded epistemic modals.

5. Back to embedded epistemic modals

I assume a standardly weak semantics for epistemic modals, along the lines of Kratzer (1981), Kratzer (1991), and following Stephenson (2007), I treat epistemic modals as being judge de-pendent, where the judge parameter is manipulated by an embedding attitude verb. Epistemic modals (both necessity and possibility modals) carry a doxastic presupposition requiring that the judge be in a certain (to be specified) doxastic relation to the modal statement. When embedded under an attitude verb, the latter will bind the judge parameter of the embedded epistemic modal. As a result, the doxastic presupposition will require that the subject of the attitude verb (now identified with the lower judge) be in a certain doxastic relation to the epis-temic complement.[2] The meaning for both epistemic *must* ϕ and *might* ϕ are given in (34) and (35): the necessity modal presupposes that the subject believe the modal proposition, whereas the possibility modal presupposes that the subject's doxastic state is compatible with the modal statement. Similarly to the Kratzerian entries above, EPI is the epistemic conversational back-

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[2]It is possible to maintain that even "unembedded" occurrences of an epistemic modal are actually embedded under a covert ASSERT operator, along the lines defended in Alonso-Ovalle and Menéndez-Benito (2010), among others. In this case, the embedded judge parameter would end up coinciding with the speaker.

ground and ST is the stereotypical ordering source ranking the accessible worlds according to how close they are to a set of stereotypes holding in the actual world.[3]

(34) $[\![\textbf{must } \phi]\!]^{c,w,t,j}$ is defined just in case $DOX_j(w) \subseteq (\lambda w'. \text{must}_j(w')(\phi))$; if defined, $[\![\textbf{must } \phi]\!]^{c,w,t,j} = 1$ iff $\forall w'' \in ST_w(EPI_j(w)) : p(w'') = 1$

(35) $[\![\textbf{might } \phi]\!]^{c,w,t,j}$ is defined just in case $DOX_j(w) \cap (\lambda w'. \text{might}_j(w')(\phi))$; if defined, $[\![\textbf{might } \phi]\!]^{c,w,t,j} = 1$ iff $\exists w'' \in ST_w(EPI_j(w)) : p(w'') = 1$

To illustrate this part of the proposal, take the case of the attitude verb *believe*, as in *John believes that it must be raining*. The structure shows that the judge parameter for the epistemic modal is abstracted over so that it can be manipulated by *believe*. As a result of this operation, the judge parameter of the modal is bound by the subject of the doxastic attitude.

(36)
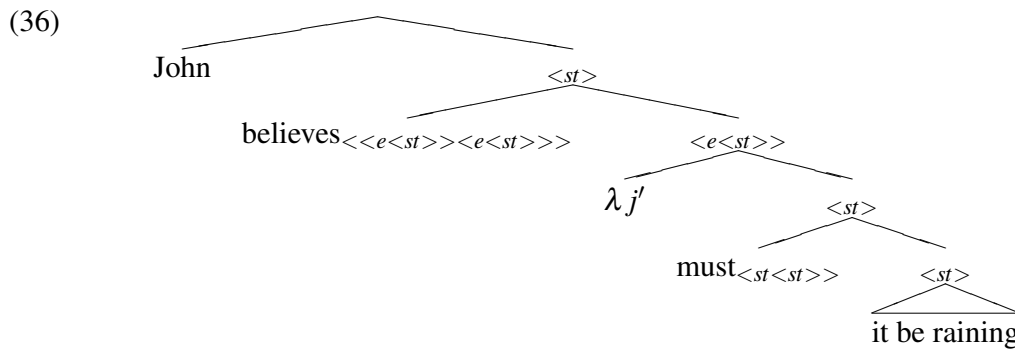
Following Gärtner's and Truckenbrodt's proposal, I will adopt a variant of their Absorption principle. As shown in (37), this principle requires that the meaning of the attitude + CP be at least as strong as the doxastic presupposition of the epistemic modal. This principle rules out cases where the doxastic condition is stronger than (asymmetrically entails) the assertoric meaning of the complex sentence.[4]

(37)   *Absorption Principle*
         The doxastic presupposition must not be stronger that the meaning of attitude + CP.

When the meaning of attitude + CP and the doxastic presupposition are inconsistent, the sentence can be rescued if it is possible to locally accommodate the presupposition.

In what follows, we will go through the three types of embedding predicates we discussed above: doxastic-like predicates, desiderative predicates; emotive doxastic and dubitative verbs.

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[3]The proposal sketched in this section of the paper shares some features with the proposal in Crnič (2014). The two proposals were developed independently.

[4]I assume that cases where the presupposition and the assertion are inconsistent are ruled out on independent grounds.

5.1. Embedding epistemic modals under different types of attitude verbs

The doxastic type is unproblematic: recall the observation that both necessity and possibility modals can be embedded under this kind of predicate. Here is an example discussed above.

(38)   John believes that the keys must be in the car.

The doxastic presupposition is that $DOX_J(w) \subseteq (\lambda w'.$ the keys must be in the car in $w')$ and, since the assertion is the same, Absorption is satisfied and the doxastic condition is "absorbed". Note that in this proposal, (38) both presupposes and asserts that John believes that the keys must be in the car. This is not unprecedented, though: for example, consider the following sentences.

(39)   a.   The king of France exists.
         b.   God exists.

(40)   If John believes that the king of France exists, . . .

In (39a), assuming a presuppositional analysis of the definite article, the presupposition of the definite description is that there exists a King of France, and the assertion is that he exists. Assuming the view according to which proper names presuppose the existence of their reference, (39b) presupposes that God exists and it asserts just that. (40) is a different case. Here, the presupposition triggered again by the definite article is that a King of France exists and, since it is embedded under the attitude *believe*, it is John's doxastic state that is required to entail that there exists a King of France: someone uttering the conditional antecedent in (40) would seem to be presupposing exactly the content of the antecedent itself. Since whether John's doxastic state entails that a King of France exists is precisely the content of the conditional supposition, the presupposition has been argued to be is suspended or locally accommodated. We leave the exact nature of this process aside. What we are interested here is merely pointing out that the identity of presupposition and assertion is not unique to (38).

The emotive doxastic and dubitative predicates are more challenging: they allow possibility but not necessity modals. Let's begin with the former type.

(41)   a.   John fears that Mary may/might have known the killer.
         b.   #John fears that Mary must have known the killer.

I assume here that *to fear* has a doxastic assertoric component according to which *a fears that p* asserts that $p \cap DOX_\alpha(w) \neq \emptyset$. *To fear* also has a (un)desirability component (that p is less desirable than $\neg p$ to the attitude's holder) but since this component is not doxastic, I am leaving the issue of its precise status aside in the present discussion.[5] Now, let's begin with the unacceptability of embedded *must*. As we can see in (42), the assertion (in (42a)) is weaker than the doxastic presupposition (in (42b)). Therefore, Absorption fails.

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[5] One possibility is that the (un)desirability component of *fear* is presupposed. A question like (i) is interpreted as a question about the possibility of a certain eventuality (as in (a)) and not as a question about its desirability (as in (b)):

(42)   a. $DOX_J(w) \cap (\lambda w'.\ \text{must}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$
         b. $DOX_J(w) \subseteq (\lambda w'.\ \text{must}_J(w')(\lambda w''.\text{the keys are in the car in } w''))$

Not with *might*, however. The doxastic presupposition (in (43b)) requires that John's doxastic state be compatible with the embedded clause; hence, it is not stronger than the assertoric content of *fear* + CP. In other words, the doxastic presupposition only requires that there be some doxastic worlds where the relevant evidence/knowledge is true and the keys are in the car. Embedding *might* under *to fear* satisfies Absorption because the presupposition is identical to the assertion in (43a).

(43)   a. $DOX_J(w) \cap (\lambda w'.\ \text{might}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$
         b. $DOX_J(w) \cap (\lambda w'.\ \text{might}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$

Dubitative verbs such as *to doubt* show the same restrictions as emotive doxastic attitude verbs, i.e. they are compatible with possibility but not necessity epistemic modals.[6] The relevant examples are repeated below.

(44)   a.   John doubts that Mary may/might have known the killer.
         b.   #John doubts that Mary must have known the killer.

I will assume that the doxastic assertoric content in a sentence like *a doubts that p* is that *a*'s doxastic state does not entail *p*: $\neg(DOX_\alpha(w) \subseteq \phi)$ ($\equiv \neg\phi \cap DOX_\alpha(w) \neq \emptyset$).[7] Let's begin with embedded *must*: as we can see in (45), Absorption fails because the assertion in (45a) and the doxastic presupposition in (45b) are inconsistent.

(45)   a. $DOX_J(w) \cap (\lambda w'.\neg\text{must}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$
             (it's doxastically possible that it is not epistemically necessary that the keys are in the car; i.e. it's possible that it is consistent with J's knowledge that the keys are not in the car)
         b. $DOX_J(w) \subseteq (\lambda w'.\text{must}_J(w')(\lambda w''.\text{the keys are in the car in } w''))$
             (it is doxastically possible that it is epistemically necessary that the keys are in the car)

(i)   Do you fear that the Raptors will lose?
         a.   Do you think it's possible that the Raptors will lose?
         b.   Do you find it undesirable that the Raptors will lose?

The semantics for *fear* might then look like this:

(ii) $[\![\alpha\ \textbf{fears that}\ \phi]\!]$ is defined only if $\phi <_{DES,\alpha} \neg\phi$; if defined, = 1 if $\exists w' \in DOX_\alpha(w) : \phi(w') = 1$

This would also explain the judgment in (15).

   [6]It might be that *fear* and *be afraid* have slightly different semantics, but for reasons of space I cannot explore this possibility here.

   [7]This seems a fairly weak semantics for *doubt* since intuitively an utterance of *a doubts that p* conveys that *a* believes *p* to be somewhat unlikely. Whether this "unlikelihood" meaning should be part of the assertoric content of the sentence, is not clear. The verb *to doubt* seems to have an evidential component, which might be responsible for this stronger interpretation. A more detailed investigation of the meaning of this predicate is needed.

When the embedded modal is a weak modal (*might* or *may*), Absorption succeeds because the weakness of the modal weakens the whole doxastic condition, as shown in (46b).

(46)   a. $DOX_J(w) \cap (\lambda w'.\neg(\text{might}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$
          b. $DOX_J(w) \cap (\lambda w'.(\text{might}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$

The doxastic presupposition in (46b) requires that John's doxastic state be compatible with it being epistemically possible that the keys are in the car, while the assertion in (46a) is that it is doxastically possible that the evidence/knowledge is incompatible with the keys being in the car. Since these two components are consistent and the doxastic presupposition in (43b) is not stronger than the assertion, Absorption is satisfied.

This correctly predicts that when *to doubt* is negated, embedding *must* is possible: the assertion is that John believes that it is epistemically necessary that the keys are in the car, and this is exactly what the doxastic condition requires. A similar situation arises with embedded *might*.

5.2. Back to embedded V-to-C

Recall that embedded V-to-C patterns like embedded epistemic modals with respect to doxastic verbs and desiderative verbs but shows a split with respect to the other categories. This is summarized again in (47).

(47)   a.   V-to-C patterns like possibility epistemic modals when embedded under emotive doxastic verbs.
          b.   V-to-C patterns like necessity epistemic modals when embedded under inherently negative or negated attitude verbs.

One might try to capture the difference between German embedded V-to-C and embedded epistemic modals by proposing that embedded V-to-C in German requires Absorption to be weaker than what we proposed for epistemic modals.

(48)   a.   Strong Absorption (epistemic modals): the doxastic presupposition cannot be stronger than the assertion.
          b.   Weak Absorption (V-to-C): doxastic presupposition and assertion must be merely compatible.

I have repeated the relevant examples in (49a) and (49b). Recall that in German, a V-to-C clause can be embedded under *hoffen*, "to hope", but not under *bezweifeln*, "to doubt".

(49)   a.   Maria hofft, sie ist in diesem Fall in Berlin.
                  Maria hopes, she is in that   case in Berlin
                  Maria hopes that she is in Berlin in that case.
          b. *Hans bezweifelt, Peter geht nach Hause.
                  Hans doubts,   Peter goes to   house
                  Hans doubts that Peter is going home.

Let us begin with (49b). If you doubt that *p*, the assertion is that ¬*p* is (doxastically) possible, while the doxastic presupposition that comes with the V-to-C configuration is that the subject believes that *p*. Assertion and doxastic condition are incompatible and Weak Absorption is not satisfied. Things are different with *hoffen*, "to hope": if you hope that *p*, the assertion is that *p* is (doxastically) possible. Since this is compatible with the V-to-C doxastic presupposition that the attitude's subject believes that *p*, Weak Absorption is satisfied.

5.3. Negated attitude verbs

Our next task is to look into the (un)acceptability of V-to-C in negated sentences and relate this discussion to the behavior of epistemic modals embedded under negated attitude verbs. The following German sentence with negation is judged unacceptable in Truckenbrodt (2006).

(50)   *Hans glaubt   nicht, Peter geht nach Hause.
          Hans believes not,   Peter goes to   house
          Hans doesn't believe that Peter is going home.

However, other sentences with negation are judged fine by the same author. In (51) we have a periphrastic negative form.[8]

(51)   Es ist nicht der Fall dass Hans glaubt   Peter geht nach Hause.
          it is not   the case that Hans believes Peter is   going home
          It is not the case that Hans believes that Peter is going home.

As for English, epistemic modals embedded under negated *believe* seems acceptable in most contexts.[9]

(52)   After reviewing the evidence, the police no longer believe that it must/might be a homicide.

This is especially interesting when one compares the acceptability of (52) with the (relative) unacceptability of *doubt* + *must*. The puzzle is the following. We have argued that embedding a necessity epistemic modal under *doubt* violates (Strong) Absorption because the doxastic condition is inconsistent with the assertion. Therefore, embedding *must* under negated *believe*

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[8]Judgments improve also if negation is in the quantifier *niemand* as in the following response to the question *Who believes that Peter is going home?*:

(i)   NIEMAND glaubt,   Peter geht nach Hause.
          nobody   believes Peter is   going home
          NOBODY believes that Peter is going home

[9]There is variability in the judgments with negation. For example, some speakers accept (i) but find (ii) rather odd:

(i)   I believe that it must have been hard to write on epistemic modals.
(ii)   I don't believe that it must have been hard to write on epistemic modals.

Hopefully, the accommodation story that we will tell can help towards explaining this variability.

should also fail Absorption since the assertion (that the subject does not believe *p*) is inconsistent with the doxastic condition (that the subject believes *p*). One way to resolve this tension is to propose that, when Absorption is not met, the last resort is to locally accommodate the presupposition, *if possible*. In the cases we are considering here, what rescues embedding *must* under a negated *believe* is the possibility of locally accommodating the doxastic presupposition in the scope of negation. However, this possibility does not seem available to inherently negative verbs like *doubt*, as the following contrast shows:

(53)　　a.　Mary doesn't believe that John quit smoking because she knows that he is not a smoker.
　　　　b.　??Mary doubts that John quit smoking because she knows that he is not a smoker.

The last example suggests that, unlike negation, the inherent negative component of the verb *doubt* cannot be targeted for local accommodation. The contrast between (50) and (51) in German could be construed as also stemming from the possibility of locally accommodating the doxastic condition with the periphrastic form *es ist nicht der Fall dass* but not with postverbal *nicht*. However, more research on this is needed.

5.4. Desiderative attitude verbs

As noted by many already, neither necessity nor possibility epistemic modals can be embedded under desiderative verbs like *want* and directive verbs like *demand*.

(54)　　a.　John wants the keys to have to be in the car. (*epistemic)
　　　　b.　#John demanded that Mary must have been the murderer.

As we saw above, this contrasts with emotive doxastic *to hope* which can embed possibility epistemic modal *might* (but not necessity *must*; cf. (3) and (4)).

Anand and Hacquard attribute the impossibility of embedding epistemic modals under *want* to the non-representational nature of this attitude verb, which they claim only has a desiderative (ranking) semantics, as shown in the entry below from Anand and Hacquard (2013).

(55)　　$[\![\mathbf{want}]\!]^{c,w,g} = \lambda p.\lambda x.\forall q \in g(C)\backslash p : p >_{des_{x,w}} q$

This move is problematic, though, since we know that it is possible, and in fact even advisable, to provide a semantics for *want* which includes a doxastic component (Stalnaker (1984), Asher (1987), Heim (1992)). Below is a possible entry for *want*, modeled after Heim (1992). There is no reason to believe that the subject's doxastic state would not be made salient by (56).

(56)　　$[\![\mathbf{want}]\!]^{c,w,g} = \lambda p.\lambda x.(DOX_x(w) \cap p) <_{DES_{x,w}} (DOX_x(w) \cap \neg p)$

There is, however, an interesting difference between *to hope* and *to want* which might be relevant in explaining their different behavior with respect to the embeddability of epistemic

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modals. Consider the following examples.

(57)   a.   John wants Mary to win the game.
       b.   John wants Mary to have won the game. (somewhat strange)
       c.   John hopes that Mary will win the game.
       d.   John hopes that Mary won the game.

Want, but not *hope*, is typically future-oriented (and more agentive), and if (57b) is acceptable at all, the verb *want* seems to be interpreted as synonymous to *hope* (with no agentivity and no futurity). Note that the majority of verbs that do not allow embedded epistemic modals have a future orientation: desiderative verbs (*want*, *wish*); directive verbs like commands (*command*, *order*), permissions (*allow*, *permit*), and prohibitions (*forbid*, *ban*); "future" verbs like *promise*. Note as well that if a "future" verb can take a non-future complement, then it does allow an epistemic modal (*expect*, *guess*).[10] Thus, what would explain the incompatibility of *want* and epistemic modals is not the lack of a representational component but its future orientation, which is somehow incompatible with epistemic modal verbs.[11]

6. Open questions and conclusion

One phenomenon that seems to share some features with embedded epistemic modals is *slifting* (Ross (1975), Grimshaw (2011), Reis (1996), Wagner (2004)) illustrated in the following example from Grimshaw (2011).

(58)   Mary, they say / I'm sure / it's clear / the teacher explained to me, is a talented singer.

The phenomenon of slifting has been already connected to embedded V-to-C by Scheffler (2009): V2 embedding and slifting are possible with verbs of saying, belief, and verbs like *hope* and *fear*; neither one is possible with factive verbs, downward epistemic verbs, desiderative verbs like *want*, and negative verbs like *doubt*. One of the contributions of the present paper is to highlight that the constraints on embedded V-to-C (and slifting) show striking similarities to the constraints on the embeddability of epistemic modals. One open question is whether the proposal defended here can be extended to the slifting cases. A second issue that one might explore in the future is the issue of cross-linguistic differences. Anand and Hacquard's paper offered some cross-linguistic experimental data but there is more variability than is conceded by the generalizations the authors take their data to support. The strongest variability I found is in the area of emotive doxastic and dubitative verbs. In addition to finding that a not marginal number of English speakers accept necessity epistemic modals under *hope*, *fear*, and *doubt*, I have encountered varieties of languages that accept necessity epistemic modals under *fear* and *doubt*. Below are some examples from Russian and Bengali. The acceptability contrast between (59a) and (59b) in Russian correlates with the different modal expression in the em-

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[10]One might follow Abusch (2004) and her treatment of futurate predicates in assuming that the LF representation in (ia) for the complement of future oriented attitudes contains a future shifting operator as in (ib).

(i)   a.   *want*: $[_{CP} \lambda n [_{IP} n [FUT [_{CP} \lambda n [_{IP} n VP]]]]]$
       b. $[\![\mathbf{FUT}]\!] = \lambda P.\lambda t.P((t, \infty))]$

[11]See Homer (2010) for more on the relation between epistemic modals and tense operators.

bedded clause: in (59b) an adverbial form is used. Note, also, that the modal expression used in Bengali is also adverbial.[12,13]

(59)   Russian
        a. ??Ivan somnevaetsja chto Masha dolzhna   byt' doma
            Ivan doubts-refl   that Masha must-F-sg to-be home
            John doubts that Mary must be home
        b.   Ivan somnevaetsja chto Masha dolzhno   byt' doma
            Ivan doubts-refl   that Masha must-Adv(N-sg) to-be home
            John doubts that Mary must be home.

(60)   Bengali
        a.   Johner   bhoe Ø   je   niscoi   norohotto hoeche
            John-gen fear   COP COMP certainly homicide happen-Pfv-3.pres
            John is afraid that a homicide must have occurred.

To conclude, I have shown that the restrictions on which attitude verbs can embed epistemic modals bear a strong resemblance to the restrictions on embedded V-to-C movement in German, and that these two phenomena can be given similar explanations. I have proposed that epistemic modals presuppose that their judge (the owner of the epistemic state we quantify over) believes the modal claim. When embedded under attitude verbs, the judge parameter of the epistemic modal is bound by the attitude's subject and, as a result, it is the attitude's subject that is required to believe the embedded modal statement. I argued that the semantics proposed by Anand and Hacquard (2013) for emotive doxastic and dubitative verbs to explain the impossibility of embedding necessity epistemic modals is problematic. Instead, I have argued that Absorption can explain these restrictions once a minimal semantics for these attitude verbs is assumed. A weaker Absorption principle explains the restrictions on embedded V-to-C in German. Open questions remain, in particular about the incompatibility between future operators and epistemic modals (as discussed in the section on desiderative verbs), the relation between embedded epistemic modals/V-to-C and slifting, the behavior of factive predicates (which we haven't talked about in this paper), as well as the nature of Absorption itself.

References

Abusch, D. (2004). On the temporal composition of infinitives. In J. Guéron and J. Lecarme (Eds.), *The Syntax of Time*. MIT Press.

Alonso-Ovalle, L. and P. Menéndez-Benito (2010). Modal indefinites. *Natural Language Semantics 18(1)*, 1–31.

Anand, P. and V. Hacquard (2013). Epistemics and attitudes. *Semantics and Pragmatics 6.8*, 1–59.

Asher, N. (1987). A typology for attitude verbs and their anaphoric properties. *Linguistics and Philosophy 10*, 125–198.

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[12]For some Italian speakers these embedding are also acceptable, even though on a scale of acceptability, a bit degraded compared with the corresponding weaker modal cases. Note also that Italian uses regular modal verbs.

[13]Thanks to Julie Goncharov and Neil Banerjee for their Russian and Bengali judgments respectively.

Bolinger, D. (1968). Post-posed main phrases: An English rule for the Romance subjunctive. *Canadian Journal of Linguistics 14*, 3–30.

Crnič, L. (2014). Pragmatics of epistemics in attitudes: A reply to Anand & Hacquard (2013). Hebrew University of Jerusalem, manuscript.

Dayal, V. and J. Grimshaw (2009). Subordination at the interface: A quasi-subordination hypothesis. Rutgers University, manuscript.

Gärtner, H.-M. (2002). On the force of V2 declaratives. *Theoretical Linguistics 28*, 33–42.

Grimshaw, J. (2011). The place of slifting in the English complement system. Handout, FGIST 3.

Hacquard, V. and A. Wellwood (2012). Embedding epistemic modals in English: A corpus-based study. *Semantics and Pragmatics 5(4)*, 1–29.

Heim, I. (1992). Presupposition projection and the semantics of attitude verbs. *Journal of Semantics 9*, 183–221.

Homer, V. (2010). Epistemic modals: High ma non troppo. In S. Kan, C. Moore-Cantwell, and R. Staubs (Eds.), *Proceedings of NELS 40*. GSLA.

Kratzer, A. (1981). The notional category of modality. In H.-J. Eikmeyer and H. Rieser (Eds.), *Words, Worlds, and Contexts*, pp. 38–73. Berlin: de Gruyter.

Kratzer, A. (1991). Modality. In A. von Stechow and D. Wunderlich (Eds.), *Semantics. An International Handbook of Contemporary Research*, pp. 639–650. Berlin: De Gruyter.

Reis, M. (1996). Extractions from verb-second clauses in German? In U. Lutz and J. Pafel (Eds.), *On Extraction and Extraposition in German*, pp. 45–48. John Benjamins.

Ross, J. R. (1975). Slifting. In M. Gross and M. Halle (Eds.), *The Formal Analysis of Natural Language*, pp. 133–169. Mouton.

Scheffler, T. (2009). Evidentiality and German attitude verbs. In *Proceedings of the 32nd Annual Penn Linguistics Colloquium*. Penn Libraries, retrieved at http://repository.upenn.edu/pwpl/vol15/iss1/21/.

Stalnaker, R. (1984). *Inquiry*. Cambridge, MA: MIT Press.

Stephenson, T. (2007). Judge dependence, epistemic modals, and predicates of personal taste. *Linguistics and Philosophy 30(4)*, 487–525.

Truckenbrodt, H. (2006). On the semantic motivation of syntactic verb movement to C in German. *Theoretical Linguistics 32*, 257–306.

Villalta, E. (2008). Mood and gradability: An investigation of the subjunctive mood in Spanish. *Linguistics and Philosophy 31(4)*, 467–522.

von Fintel, K. and A. S. Gillies (2010). *Must ... stay ... strong! Natural Language Semantics 18*, 351–383.

Wagner, M. (2004). Asymmetries in the syntax and prosody of verb-initial interpolated clauses in German. In S. Blaho, L. Vicente, and M. de Vos (Eds.), *Proceedings of Console XII*.

Yalcin, S. (2010). Probability operators. *Philosophy Compass 5(11)*, 916–936.