Constraining the identification of epistemic judges across different syntactic categories

Jakob Maché
Universidade de Lisboa

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Abstract

As observed at various occasions, the usage of epistemic adverbs in information seeking questions is by far more restricted than the usage of epistemic adjectives. Starting from Lyons (1977) this contrast was motivated assuming that different types of epistemic operators come with different semantics and scope positions in the utterance, namely objective vs. subjective epistemic modality. However it is not possible to define clear classes of objective epistemic modal operators in terms of clear diagnostics. It will be shown here that the contrast of acceptability is more accurately explained in terms of locality and binding properties of the variable for the attitude holder rendering the epistemic judgement. If locally bound, epistemic modal operators can be embedded, if not, they are subject to much stricter conditions in order to be interpretable.

1 Introduction

This paper addresses the question under which conditions epistemic modal operators can be embedded in information seeking questions and complement clauses. Starting with Greenbaum (1969: 111, 153) and Jackendoff (1972: 344–345), it was observed that epistemic adjectives like *probable* with finite clausal complements can be more readily embedded in questions than their morphological cognate adverbs like *probably* (cf. 1). These contrast were originally observed in data from English.

(1) a. Is it probable that Frank beat all his opponents?
b. * Did Frank probably beat all his opponents?

Similar contrasts between epistemic adverbs and adjectives are also reported in other West Germanic languages such as with Dutch *waarschijnlijk* 'probable' and its German cognate *wahrscheinlich* (cf. Nuyts 2001a: 55–59, Nuyts 2001b: 389–390, 393), as well as with Hungarian adverbs *talán* 'perhaps', *valószinüleg* 'probably' and *biztosan* (Kiefer 1984: 69–70).[1]

This paper is structured as follows: Section 2 discusses some earlier explanations to account for this contrasting behaviour of epistemic adjectives and epistemic adverbs, which assume that the different syntactic categories

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[1]These authors do not provide explicit data for a contrast between epistemic adverbs and epistemic adjectives, but it follows from their claim that epistemic adverbs in these languages are excluded from questions.

come with different semantics. Moreover, challenges will be addressed, which these explanation face. In Section 3, it will be shown that it is necessary to take a broader perspective on that matter in order to understand how these modifiers differ precisely. It will investigate how different epistemic modal expressions are subject to different constraints to identify the attitude holder who renders the epistemic judgement. As German modal operators have a richer array of uses, the discussion will mainly draw from German data. Section 4 will present an alternative analysis, which demonstrates that the difference of acceptability is due to a difference of how the attitude holder involved in the epistemic judgement is syntactically represented and how much it is accessible for binding processes.

2 Objective vs. Subjective Epistemic Modality

In subsequent research on the different behaviour of epistemic adverbs and adjectives in information seeking questions, Lyons (1977: 799) suggested that the diverging behaviour is due to a difference in semantics: Epistemic adverbs are always interpreted in a 'subjective' epistemic manner, by means of which the speaker weakens their commitment to the truth. In contrast, epistemic adjectives always are interpreted in an 'objective' epistemic interpretation, which is based on 'quantifiable logical probability'. Lyons (1977: 749, 802) is inspired by R.M Hare's (1971) work, who assumes that each utterance consists of three components: (i) a *phrastic component*, which corresponds to the propositional content of the utterance; (ii) a *tropic component*, which determines the type of speech act and (iii) and finally a *neustic component*, which specifies the degree of commitment of the speaker to that speech act.

In Lyons' (1977: 749, 802) model, utterances are structures consisting of two operator positions; for the neustic and the tropic component and a slot for the proposition p. An assertion involves an "unqualified" neustic component with the meanining 'I-say-so' represented by a full stop and an "unqualified" tropic component with the meaning 'It-is-so', also represented by a full stop. Moreover, he gives a classification of five other types of speech acts which are result of the interaction of different 'qualifiers' '?' for questions, '!' for directives and '~' for negation and the different scopal positions.

(2)	a. assertion	.	.	p
	b. tropic negation	.	~	p
	c. question	?	.	p
	d. command	.	!	p
	e. prohibition	.	~!	p
	f. deliberative question	?	!	p

Building on this model of speech acts, Lyons (1977: 804) claims that the

diverging degree of acceptability with epistemic adjectives and adverbs in information seeking questions is due to their different scopes they may take in the representation of an utterance. Hence, he postulates two distinct types of epistemic modality: *objective epistemic modality* (ObjEM), qualifying the tropic *it-is-so* component (cf. 3) and *subjective epistemic modality* (SbjEM), qualifying the neustic *I-says-so* component (cf. 4):

(3) a. I say that it is possibly the case that p.
    b. .◇p

(4) a. Possibly/perhaps it is the case that p.
    b. ◇.p

From this model it follows that SbjEM operators and question operators compete for the same scopal position in the utterance, predicting that they can never co-occur (p.799–800).

> This suggests that subjectively modalized utterances, unlike categorical assertions and objectively modalized statements, are not acts of telling; and that their illocutionary force is in this respect similar to that of questions, which are also non-factive.

Although there is no clear statement about epistemic adverbs, Lyons (1977: 805–806) claims that epistemic modal verbs are much more appropriate for the expression of SbjEM, whereas epistemic adjectives and nouns in copula constructions are much more natural for the expression of ObjEM.[2] However, Lyons (1977: 797–801) notes that some epistemic modal auxiliaries can also be interpreted in an 'objective' epistemic way. His assumption is motivated by the observation that there are some uses of epistemic modal auxiliaries in English which can occur under negation, in antecedents of event-related conditionals and in information seeking questions. Accordingly, he concludes that a restricted group of modal auxiliaries can be used in an 'objective' way, whereas the majority only is acceptable with a 'subjective' epistemic interpretation. Despite the fact Lyons explicitly mentions that *can*, *must*

[2] Actually, Lyons (1977: 800) mentions the possibility that epistemic adverbs can come with a ObjEM interpretation:

> But we can express at least three different degrees of factuality in English by selecting one modal adverb rather than another from a set which includes, certainly', 'probably',and 'possibly'; and the difference between 'probably' and 'possibly', when they are used in objectively modalized statements, would seem to correlate, at least roughly, with the difference between a degree of factuality that is greater than and one that is less than 0.5.

On page 798, Lyon discusses and example with *perhaps*, which he classifies as SbjEM.

and *may* have an 'objective' epistemic interpretation in English, he does not systematically specify the precise extension of the class of ObjEM auxiliaries.[3]

Turning to their specific meaning, Lyons (1977: 797, 799–800) notes that ObjEM is related to alethic modality, both being subtypes of Carnap's quantifiable logical probability. However, they cannot be sharply distinguished from one another. In contrast, SbjEM expresses a proper illocutionary act of assuming.

Finally, Lyons (1977: 797, 806) assumes that SbjEM is more basic than ObjEM and that the latter is derived from the former by a process of 'objectification', but that is impossible to draw a sharp distinction between the two of them either. At this point it should be stressed that Lyons hardly ever becomes explicit how different syntactic categories relate to the SbjEM vs. ObjEM distinction and that Lyons barely provides examples and thus does not come up with exhaustive lists of lexical items which can only be interpreted in an ObjEM way, only in a SbjEM way or in both ways.

Shedding more light on the usage of epistemic adjectives, Watts (1984: 136–137) argues that *likely* and *possible* yield 'objective' epistemic interpretations whenever occurring with *for-to*-infinitives and 'subjective' epistemic interpretations whenever occurring with finite *that*-clauses. In contrast, Watts (1984: 138) claims that adverbials are always interpreted in a SbjEM way and that *can* has only an ObjEM interpretation and *may* is allows for both interpretations.

Hengeveld (1988: 236–240) is much more explicit and systematic bringing constructed examples from English, which are meant to demonstrate that epistemic adverbs and epistemic adjectives are clearly distinguished by the meaning they convey: Whereas epistemic adverbs are always SbjEM, epistemic adjectives are always ObjEM. As regards their semantic contribution, Hengeveld is fairly loyal to Lyons' original proposal. But he crucially departs from Lyons' original claims, as he suggests that epistemic adverbs are always SbjEM. However, Hengeveld (1988: 237) makes a somewhat confusing statement too. He observes that epistemic *may* and *must* cannot occur in the scope of a negation. From this, Hengeveld (1988: 237) concludes that the inability of the modal auxiliaries to occur in the scope of a negation must be due to their are SbjEM nature. This is fairly surprising as this entails that Hengeveld assumes that they cannot be 'objective' epistemic. If they had an ObjEM variant, they were expected to be totally acceptable in the negation. At this point he contradicts Lyons (1977: 797–798), who takes precisely these two verbs as the most prototypical examples which can be interpreted in either way: SbjEM and ObjEM.

According to Hengeveld (1988: 236–240), this difference in semantics

[3]Lyons is not very explicit. Below are enlisted examples he uses for *may* as ObjEM (14) pp. 797–798, (24–25) p. 801, (45) p.804; *can't* as ObjEM (26–27) pp. 801, *must* (15) pp. 797–798, ObjEM, SbjEM hardly natural with *needn't* (31) p. 801; Examples of *may* as SbjEM (14) p. 797, (24–25) p. 801, *must* as SbjEM (15) p. 797.

is the reason why epistemic adjectives occur in a whole range of syntactic environments from which epistemic adverbs are excludes, such as: (i) embedded in information seeking questions, (ii) in the scope of a negation, (iii) embedded in the antecendent of an event-related conditional, (iv) in the scope of a past or future tense marker, (v) and they can be challenged.

In later research, the distinction between objective and 'subjective' epistemic modality is motivated by the type of evidence on which the epistemic judgement is based. This has been most explicitly elaborated by Nuyts (2001b: 384, 386) who argues that 'subjective' epistemic modality makes reference to evidence that is accessible to the speaker alone, whereas 'objective' epistemic modality makes reference to evidence that is accessible to a bigger group of referents. Some formal semantic approaches such as Tancredi (2007: 2) and Huitink (2008: 7) follow the idea that the accessibility of the evidence is the key to distinguish between these two types of epistemic modality. Departing from Lyons' original idea, Nuyts (2001b: 393) suggests that 'objective' epistemic modality is not related to alethic reasoning and that therefore it should be renamed into 'inter-subjective' modality. Crucially, Nuyts (2001a: 72–78) argues that the acceptability of epistemic modal operators in the scope of question operators or negations or in antecedents of event-related conditionals is not determined by the dimension 'objective' vs. 'subjective' but by a second, more functional dimension: descriptive vs. performative. As epistemic adverbs are always performative, they are excluded from these non-canonical environments, in opposition, epistemic adjectives are always descriptive, which renders them acceptable in the same contexts.

Turning to analyses on German, Öhlschläger (1989: 207, 210) and Diewald (1999: 82–84, 274) assume in their work inspired by Lyons (1977) that there are 'objective' epistemic modal auxiliaries in German, too. In contrast to Lyons, their study is based on a much broader selection of empirical data and it is much more systematic. Their analysis of German modal verbs leads them to the conclusion that the forms *kann* and *muss* allow for objective interpretations whereas the forms *mag* and *könnte* clearly do not. As they argue the former can be embedded in questions and in the scope of a negations, but the latter fail to do so.

The assumption that there are two separate types of epistemic modality with different interpretation and different scope comes with various problematic consequences, as shown by Maché (2013: 360–373). To start with, there is no consensus at all what ObjEM really is and which elements can be used express it and which cannot, as illustrated in Table 1. For instance, Lyons (1977: 800, 805–806) assumes that epistemic adverbs may be more appropriate to express a SbjEM interpretation, he notes that ObjEM uses are not totally excluded. Opposed to that, Watts (1984: 138) and Hengeveld (1988: 236–240) claim that epistemic adverbs are limited to SbjEM uses. Moreover, Lyons (1977: 797–798) considers *may* and *must* as prototypical ObjEM, whereas Hengeveld (1988: 237) argues that these verbs cannot be

negated as they are SbjEM. Finally, Nuyts (2001a: 72–78) suggests that the acceptability of epistemic operators in questions is not determined by their degree of objectivity but by an entirely different dimension: performativity vs. descriptivity.

Summing up, there is only one observation which is supported by a broader range of studies, which is that epistemic adverbs are hardly acceptable in the scope information seeking question operator or negation whereas epistemic adjectives are to a much larger extent.

author	ADJ	ADV	VERB								
			ENGLISH				DUTCH	GERMAN			
			can	*can't*	*may*	*must*	*kunnen*	*kann*	*müssen*	*dürfte*	*mögen*
Lyons (1977)		S/O		S/O?	S/O	S/O					
Perkins (1983: 101)		S/O									
Kiefer (1984: 68–70)	OBJ	SBJ									
Watts (1984: 133)	S/O	SBJ	OBJ		S/O						
Hengeveld (1988: 236–240)	OBJ	SBJ			SBJ?	SBJ?					
Nuyts (2001a)											
Nuyts (2001b: 387–393)	S/O	S/O					S/O				
Tancredi (2007: 2)	S/O	S/O									
Huitink (2008)		SBJ			S/O	S/O	S/O				
Öhlschläger (1989: 207, 210)		SBJ						S/O	S/O	S/O	SBJ
Diewald (1999: 82–84, 274)		SBJ						S/O	S/O		SBJ

Table 1: Different statements on categories, elements and their interpretation

Secondly, there are different conceptions about which of the two modalities is more basic. Lyons (1977: 797, 806) and Nuyts (2001b: 392–393) assume that SbjEM is the more common and basic one and that ObjEM is derived from the latter. However, there is challenging evidence. Hengeveld (1988: 259) and Diewald (1999: 273,366) have shown that, from a historical perspective, it is ObjEM which is the base from which subjective modality develops. In similar vein, Watts (1984: 138) argues that *can* only can be interpreted in an SbjEM way. This would be surprising if ObjEM should always be derived from SbjEM uses. Finally, it remains to be shown for theories that assume that epistemic adjectives are restricted to ObjEM interpretations and epistemic adverbs to SbjEM interpretations, how there can be morphological derivation rules which derive the further from the latter.

Thirdly, there are instances of elements which are interpreted with respect to the knowledge of a singe attitude holder which occur in non-canonical environments. The instance of *können* (cf. 5) is definitely interpreted with respect to a single attitude holder who is rendering a intuitive judgement rather than in terms of quantifiable logical probability. Despite of that, they are attested in information seeking questions. Likewise, modal particles such as *wohl* are not considered to be compatible with quantifiable logical reasoning (cf. 6), nevertheless they occur in information seeking questions too, as shown by Zimmermann (2004: 263–264). A much more detailed

discussion is provided by Maché (2013: 360–373).

(5) a. „Wer *kann* Ihnen etwas ins Glas geworfen
who can you something into.the glass throw-PTCP.PRF
haben?", fragte der Richter.
have-INF asked the judge

b. „Ich denke, es war dieser Bekannte", erwiderte die Frau.[4]
I think it was that friend answered the woman
' "Who could have thrown something in your glass?" , the judge asked.
"I think it was this friend", the woman answered.'

(6) Ist Hein wohl auf See?
Is Hein wohl at sea
'Tell me your assumption concerning Hein's being at sea or his not being at sea: Is he at sea or not?'

Note that all of the involved modal operators involve a modal force on the lower end of the scale such as possibility or probability, epistemic necessity modals are not attested in information seeking questions (cf. Maché 2013: 304–309).

Fourthly, it is impossible to model something like objective public evidence. Attitude holder A and B can sit in the same foot ball stadium watching the same game *SL Benfica Lisboa* against *Sporting Club de Lisboa* but nevertheless use the claimed ObjEM adjective in a conflicting way based on their individual knowledge and expectations. Speaker A can say *It is probable that Benfica is going to lose today*, Speaker B can say at the very same moment *It is probable that Sporting is going to lose today.* If *probable* were an ObjEM, it would be expected that they yielded the same interpretation for any attitude in a given situation. Even expressions like *probable* are highly dependent on the individual speaker's beliefs, cf. Maché (2013: 366–367) for more details.

Summing up, studies on 'objective' epistemic modality only agree in a single point: That the use of epistemic adverbs are much more limited in the scope of a information seeking question operator or a negation as compaired to epistemic adjectives in predicative use. However, it was shown that the assumption of two independent types of epistemic modality fails to account for the bigger picture. A more elegant and accurate solution will be developed in Sections 3 and 4.

3 Context dependence of epistemic operators

Among the West Germanic languages, German has the richest array of modal verbs which are interpreted with respect to an attitude holder's knowledge

[4]DeReKo: BVZ07/FEB.00540 Burgenländische Volkszeitung, 07/02/2007.

and beliefs, namely reportative uses of *wollen* and *sollen*. Therefore, the remaining discussion will focus on German but it can easily be extended to the other West Germanic languages under discussion as well.

The main idea here is that epistemic modal operators introduce a variable for a *deictic center* (DC) who makes the epistemic judgement, as already suggested by Stephenson (2007: 497). As illustrated in more detail below, there are various ways to identify this DC-variable with an appropriate referent of an attitude holder which is syntactically encoded in the utterance.

With epistemic modal verbs such as *dürfte* 'be.probable/may' and epistemic adverbs such as *wahrscheinlich* which occur in canonical matrix declarative clauses the deictic center is identical to the speaker referent (8):

(7) Der Joseph *dürfte* die Maria kennen.
the Joseph be.probable the Mary knows-INF
'Joseph probably knows Mary.'
DEICTIC CENTRE=*spkr*

(8) Der Joseph kennt die Maria wahrscheinlich.
the Joseph knows the Mary probably
'Joseph probably knows Mary.'
DEICTIC CENTRE=*spkr*

In cases in which an epistemic modal verb or epistemic modal adverb is embedded under non-factive attitude predicates such as *denken* 'think' or *vermuten* 'assume', the DC-variable is identified with an appropriate attitude holder argument in the matrix clause, mostly the subject referent but sometimes also an object referent (cf. Stephenson 2007: 497)

(9) Der Gabriel vermutet, [dass der Joseph die Maria kennen
the Gabriel assumes that the Joseph the Mary knows-INF
dürfte].
may
'Gabriel assumes that Joseph might know Mary.'
DEICTIC CENTRE=matrix EXP = *Gabriel*

Note that in contrast to some claims (eg. Lyons 1977: 799), epistemic modal verbs are also attested embedded under factive predicates which embed *w*-interrogative clauses, such as *ermitteln* 'determine'.

(10) In Auswertungen des Netzwerks unter der Leitung von Pavel
in examinations the network-GEN under the direction of Pavel
Spurný von der Akademie der Wissenschaften der
Spurný of the Academy of Sciences the-GEN
Tschechischen Republik konnte schnell ermittelt
Czech Republic can-PST quickly determine-INF

werden, [was beim Durchgang durch die Erdatmosphäre
PASS.AUX-INF what at.the transit through the earth.atmosphere
geschehen sein *musste*].[5]
happen-PTCP.PST PRF.AUX-INF must-PST
'In examinations carried out by Pavel Spurný's team in the Czech Academy of Sciences, it was quickly determined [what must have happened during the transit through the Earth's atmosphere].'
DEICTIC CENTRE=matrix EXP = *Gabriel*

Examples like the one above provide further evidence that factive/resolutive predicates do actually not embed complements of the semantic type *question* but rather *facts* (cf. discussion in Ginzburg & Sag 2000: 63–80). The crucial fact is that epistemic necessity verbs like *müssen* are not common at all in information seeking *w*-questions as shown by Maché (2013: 304–309). Thus, the embedded interrogative in (10) does not have any counterpart as a main clause *w*-question.

As observed by Lasersohn (2005), Zimmermann (2004), Maché (2013: 299–305, 306–309), there are even more ways of how deictic centres can be interpreted. Epistemic modal verbs, epistemic adverbs and particles which occur in information seeking questions are interpreted with respect to the addressee.

(11) Wen dürfte der Joseph hier aller kennen?
who.ACC be.probable the Joseph here of.all know-INF
'Whom do you believe does Joseph know here?'
DEICTIC CENTRE=*addr*

It is important to stress that epistemic operators in information seeking interrogatives impose strict conditions of use on the contexts in which they can be employed. They are only felicitous in utterance situations in which the speaker assumes that the addressee is not in the position to commit to any answer and only able to provide assumptions that reflect the modal strength of the modal operator suggested by the speaker.

Unlike most European languages, German developed so-called reportative modal verbs, a highly specialised type of necessity verbs (cf. Becker 1836: 181, Bech 1949: 5–6, 11–13, 39). It is the only language which has two different of these verbs: The control verb *wollen*, which marks its subject as the source of some claim (cf. 12), and the raising verb *sollen*, which marks some referent which cannot be phonetically expressed by an argument but whose existence is at least presupposed (13). Arguably this could be some argument which lacks phonetical realisation. They behave like prototypical epistemic modal operators in many respects, but they crucially differ in that

[5] https://steiermark.orf.at/stories/3121388/ 14th September 2021.

the DEICTIC CENTRE is always identified with an attitude holder argument introduced by the modal verb itself.

(12) Der Joseph *will* die Maria kennen.
the Joseph wants the Mary knows-INF
'Joseph wants everybody to add the proposition to the common ground that Joseph knows Maria.'
DEICTIC CENTRE=SUBJ

(13) Der Joseph *soll* die Maria kennen.
the Joseph shall the Mary knows-INF
'someone wants everybody to add the proposition to the common ground that Joseph knows Maria.'
DEICTIC CENTRE=EXP

As Manfred Sailer (pers. commun.) pointed out, there is yet another possibility to bind open DC-variables. Reportative adverbials such as *laut*-PPs 'according to' may bind DC-variables under certain circumstances, but this relation only optional. Alternatively, the *laut*-PP can be interpreted as the source of evidence that makes the speaker assume the content of the prejacent proposition (cf. 15), similar observations have been made by Döring (2013: 115–117) for the German modal particle *wohl*. .

(14) [Laut dem Woiferl] *dürfte* der Joseph die Maria
according.to the Woiferl be.probable the Joseph the Mary
kennen.
knows-INF
(i)'Woiferl provided evidence that makes SPKR assume Joseph knows Maria.'
DEICTIC CENTRE=*spkr*
(ii)'Woiferl is assuming that Joseph probably knows Maria.'
DEICTIC CENTRE=*Woiferl*

(15) [Laut dem Woiferl] *soll* der Joseph die Maria
according.to the Woiferl be.claimed the Joseph the Mary
kennen.
knows-INF
'According to Woiferl, Joseph knows Maria.'
DEICTIC CENTRE=*Woiferl*

Coming to a conclusion, there are five different ways in which epistemic operators can be interpreted: They can be evaluated with respect to the knowledge of the speaker, of the addressee, of some argument of a superordinate clause and with respect to the knowledge of a referent which is contributed by the predicate meaning itself. As shown by Maché (2013: 422), the DC-variable is always bound by the most local potential binder:

(16) *Locality Requirement for Deictic Centres (LRDC)*

1. If the epistemic modal operator itself provides an appropriate argument referring to an attitude holder, a free DC-variable will be bound by that argument
2. If the epistemic modal operator is embedded by an attitude predicate and if there is no other more local intervening binder, a free DC-variable will be bound by the predicates argument that refers to the attitude holder
3. If there is no other more local intervening binder, a free DC-variable can be bound by the referent expressed by a *laut*-PP
4. If there is no other more local intervening binder, a free DC-variable will be bound by the most salient participant involved in updating the common ground,
   (a) which is the speaker in the case of assertions
   (b) which is the addressee in the case of questions

In order to yield an interpretable utterance, DC-variables have to be bound in order to ensure the *Condition on Deictic Centres* is met.

(17) *Condition on Deictic Centres (CoDeC)*
The use of an epistemic operator indicates that the embedded proposition is not part of the DEICTIC CENTRE's knowledge.

4 Analysis

In this section, it will be shown how to model lexicon entries of the different types of epistemic modifiers and how to formalise the *Locality Requirements for Deictic Centres*. Finally, some tree structures which involve the various types of epistemic modifiers will be exemplified.

4.1 Lexicon entries of modal predicates and adverbs

Presently, there is little work on modal semantics within the existing semantic frameworks of HPSG. The foundations are yet to be developed for Minimal Recursion Semantics and Lexical Resource Semantics. Thus, the semantic aspects will remain fairly superficial in the analysis outlined here. However, there is an implementation for a possible world semantics for *Type Theory with Records* in work under development by Robin Cooper, based on Kratzer's (1978) analysis which might be a possible way to follow for the analysis developed here.

Turning to predicative uses of epistemic adjectives like *wahrscheinlich* or *probable*, they can be modelled based on previous work by Pollard & Sag (1994: 330) and Müller (2013a: 80–82), as illustrated in Figure 1. It comes

wahrscheinlich 'probable'

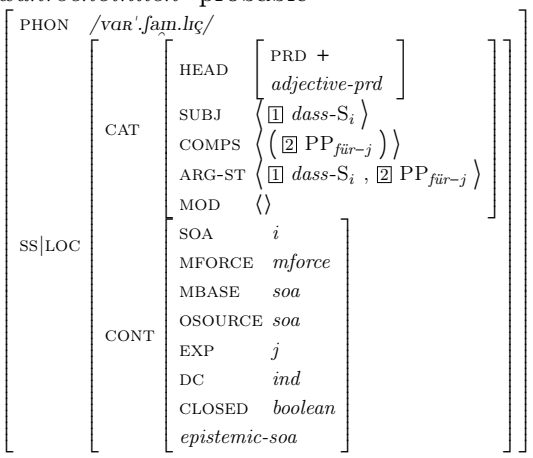

Figure 1: *wahrscheinlich* 'probable' – epistemic adjective (predicative)

with two arguments one subject clause and an optionally realised *für*-PP which encodes the attitude holder making the epistemic evaluation. If the latter is not spelled out, it is usually interpreted as a generic pronoun similar to PRO_{arb}.

The analysis of modal semantics presented here follows Robin Cooper's (pers. comm.) approach to model propositions as *RecordTypes*, an situation semantic entity in *TTR* which could be roughly translated as *state-of-affairs*.[6] Accordingly, the CONT of an epistemic modifier is of the type *epistemic-soa* which is specified for the following attributes: SOA for the modified prejacent proposition, MFORCE to determine the modal force (possibility, probability, necessity,...), MBASE for a modal base, and OSOURCE for ordering source. Moreover there is a variable for a deictic center DC, which is required to identify the attitude holder with respect to whose knowledge the epistemic modal operator is identified. Independently from that variable some epistemic modifiers have the potential to phonetically realise that attitude holder as an argument; this is represented under the attribute EXPERIENCER-argument. In the case of epistemic adjectives, this argument can be phonetically realised by a *für*-PP in German and as the subject-NP in the case of reportative *wollen*. Provided the right syntactic configuration, this argument qualifies as the most local legitimate binder of the DC-variable. Note that, following Cooper, the modal base and ordering source are modelled as *RecordTypes* here loosely translated as *soa*, an epistemic modal base could be conceived then as the very rich *soa* corresponding to the model of the actual world consistent with the knowledge of the speaker rather than as a set of possible worlds in the Kratzerian tradition. Finally, there is the boolean feature CLOSED which indicates whether or not the DC-variable is already locally bound by some argument directly introduced by the model operator itself. It is needed

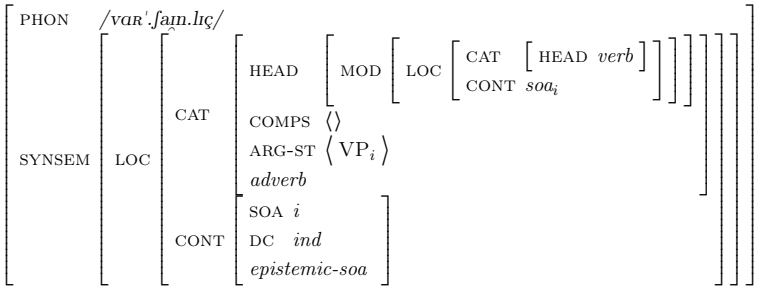

Figure 2: *wahrscheinlich* 'probably' – epistemic adverb

to explain why there are some operators that embed epistemic operators which are locally bound ([CLOSED +]), but fail to whenever they are not ([CLOSED −]), as shown in the corpus study by Maché (2013: 261–404). In the remainder of this paper, the features MFORCE, MBASE and OSOURCE will no longer be shown, as they are not relevant to the analysis presented here.

Epistemic adverbs in turn can be modelled along the lines of the entry for sentential negation as suggested by Müller (2020: 223) or Kim (2021: vii), cf. Figure 2. The main difference between epistemic adjectives and adverbs is that adjectives still have the potential to phonetically realise its attitude holder argument, for adverbs PP/NP arguments are no longer available on the ARG-ST list and the CONT-value. This is confirmed by the fact that those German adjectives which can license arguments in there predicative uses, such as *treu* + NP_{DAT} 'loyal', *ähnlich* + NP_{DAT} 'similar', *bewusst* + NP_{GEN} 'aware' or *schuldig* + NP_{GEN}, they no longer have the potential to realise their arguments in their adverbial uses. In other words, they lack representations of these arguments in their CONT and ARG-ST attributes. Thus predicative epistemic adjectives always involve some mostly phonetically unrealised generic pronoun, similar to *sollen*, which is commonly analysed as predicating a wish to a unrealised referent different from the subject referent (cf. Becker 1836: 181, Bech 1949: 11). This is much in line with Lasersohn's (2005: 273–277) observation that predicates of personal taste always come with a variable for a judge according to whose attitude the predicate is evaluated.

Epistemic modal verbs are a subclass of raising verbs and can be modelled along the lines of the analysis developed by Müller (2013b: 243, 277), as illustrated in Figure 3. Crucially, their CONT-value does not include any attitude holder argument, only a DC-variable, as they are never observed with phonetically realised arguments – just as with epistemic adverbs.

Reportative *wollen* is a control predicate which introduces an attitude holder argument as its subject, yielding a structure with a verbal head which

[6]The analysis developed here is also perfectly compatible with Ginzburg & Sag's (2000: 38–44) alternative assumption of distinct *message* types.

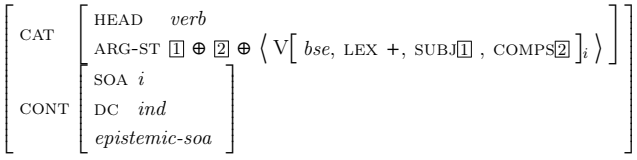

Figure 3: *dürfte* 'be.probable' – epistemic modal verb

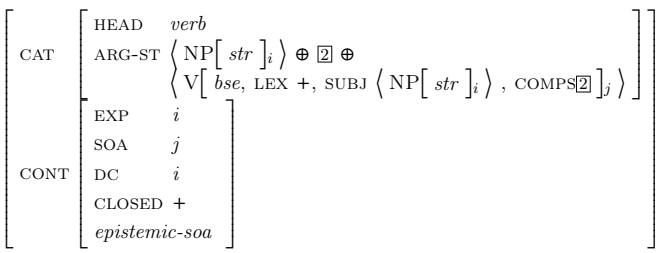

Figure 4: *wollen* 'want/claim' – reportative modal verb

has a EXP-argument on its ARG-ST and its CONT and its CONT is of the type *epistemic-soa*, as shown in Figure 4. As already demonstrated in Section 4.2, this is exactly the configuration in which *LRDC 1* can apply, binding the DC-variable is locally by the EXP-argument. The analysis of control verbs employed follows the spirit suggested by Müller (2013b: 280). The entry for reportative *sollen* is almost identical except that its attitude holder argument is not its subject but it remains phonetically unrealised.

4.2 Formalising the *Locality Requirement for Deictic Centres*

The first clause of the *LRDC* applies to epistemic modifiers which introduce an EXPERIENCER-argument referring to the attitude holder that locally binds the DC-variable. The requirement is that the input structure has to contain a verbal head, a CONT-value of the type *epistemic-soa* and a representation of an EXP-argument in its CONT-attribute, as shown in Figure 5. This constraint applies to configurations which involve either predicative epistemic adjectives or reportative modal verbs.

The formalisation of *LRDC 2* states that whenever an attitude predicate embeds a finite or nonfinite clauses which contains an epistemic operator indicated by the type *epistemic-soa* whose DC-variable is still free ([CLOSED −]), this DC-variable is co-indexed by an appropriate argument in the matrix clause referring to the attitude holder, as demonstrated in Figure 6. The

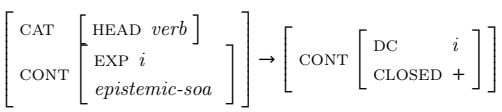

Figure 5: Locality Requirement for Deictic Centres – Clause 1

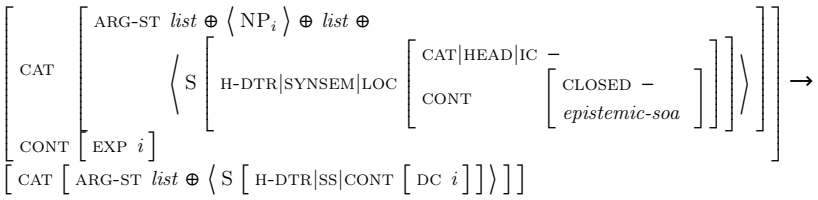

Figure 6: Locality Requirement for Deictic Centres – Clause 2

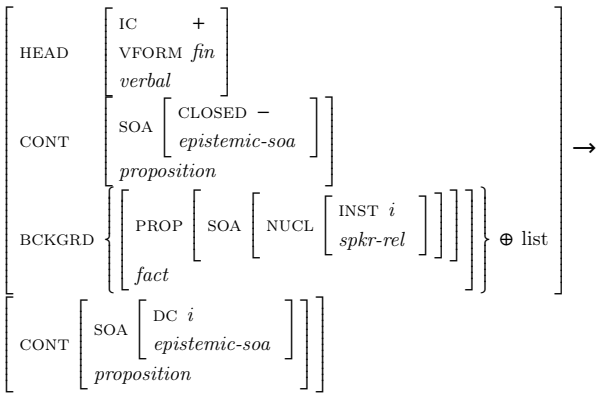

Figure 7: Locality Requirement for Deictic Centres – Clause 4a

feature IC− (INDEPENDENT CLAUSE) as suggested by Ginzburg & Sag (2000: 41, 45) signals that the relevant clause is embedded.

Clause 4a addresses cases in which a declarative main clause (IC+) contains an epistemic operator (type *epistemic-soa*) which has a DC-variable, which has not been locally bound yet (CLOSED−). In such a configuration the DC-variable is bound by the representation of the speaker referent he BACKGROUND feature proposed by Ginzburg & Sag (2000: 120–124).

Clause 4b is almost identical except that CONT is of the type *question* and that the DC-variable is bound to the representation of the addressee in BCKRD. As *LRDC 3* is more complicated to describe and and requires more space, it cannot be addressed in this paper.

4.3 Binding of the deictic centre

In this section, it will be shown why the interpretation of clauses that contain some epistemic modifiers is mostly almost identical in many cases despite the fact that these modifiers may be entirely different categories. Secondly, it will shed light on the differences between epistemic adverbs and epistemic adjectives, which cause the former to be by far less acceptable in information seeking questions than the latter.

Figure (8) illustrates the combination of a predicative epistemic adjective with a copula by means of predicate complex formation as suggested by Müller (2013b: 28). The essential assumption here is that the copula is not

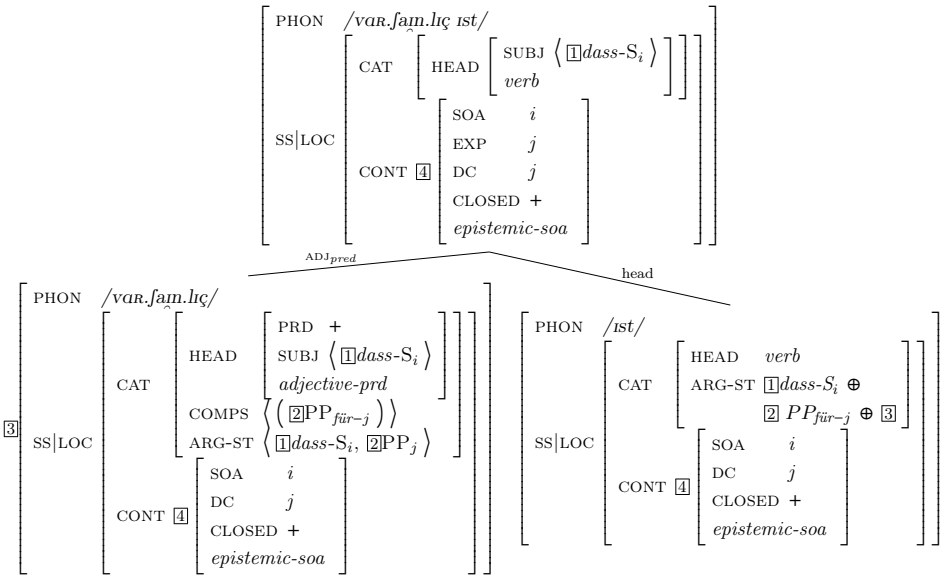

Figure 8: Copula with predicative epistemic adjective

semantically empty but transparent, in other words, it inherits the full lexical content of the embedded predicative. Note that in Müller's (2013b: 20) MRS-based analysis the copula only inherits parts of the embedded predicative's CONT-value. The inspiration for the analysis pursued here comes from the fact that a copula with a predicative behaves semantically the same way as a verb. The combination of the predicative epistemic adjective with a copula yields a phrase which (i) contains a verbal head with an *epistemic-soa* as a CONT-value and (ii) its CONT-value has a EXP-argument. This is exactly the configuration in which *LRDC 1* applies and binds the DC-variable

In contrast, epistemic adverbs which are adjoined to VPs yield an argument structure which essentially differs from epistemic adjectives in predicative function, cf. Figure 9. As the adverb is lacking a representation of an EXP-argument in its CONT-attribute, the VP resulting from the adjunction of the adverb does not have any CONT-attribute which contains an EXP-argument either, which means *LRDC 1* fails to apply and the DC-variable is left free. So *LRDC 2*, *3* & *4* are the only options. Embedded in an information seeking question, the DC-variable theoretically still could be bound by the addressee by means of *LRDC 4*. But it appears that there are pretty strict conditions on discourse: the speaker believes the addressee is not able to commit to truth value of the proposition but only to the degree reflected by the modal force of the epistemic operator.

So why are predicative epistemic adjectives in information seeking questions then more acceptable despite the fact that they also are used in contexts in which the speaker believes that the addressee is not able to commit to truth

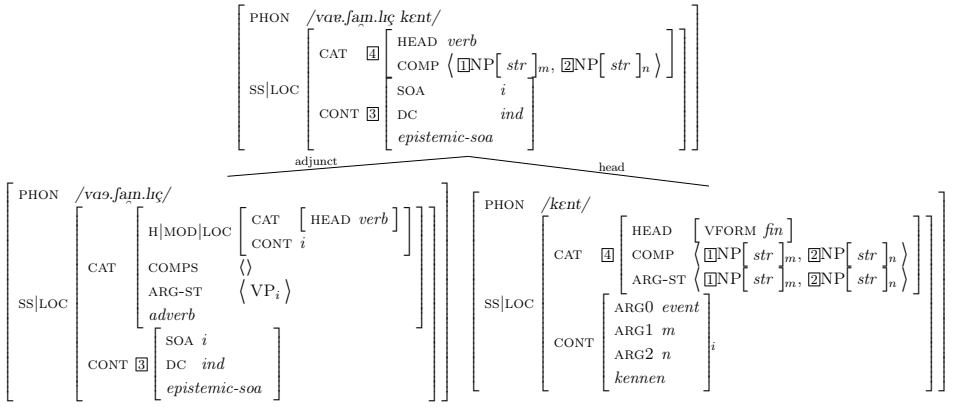

Figure 9: Epistemic adverbs adjoined to VP

value of the proposition? The crucial difference is that in the case of epistemic adverbs the request of epistemic evaluation is directed to the addressee alone. In contrast, predicative epistemic adjectives most typically select a generic pronoun as their attitude holder argument and by means of that the addressee may include epistemic evaluations done by some other referent. Due to their lack of an EXP-argument in their CONT-value, the DC-variable in epistemic adverbs is only available to binders in a superordinate clause (attitude holder of a matrix attitude predicate) or participating in the speech act (speaker, addressee). In contrast, predicative adjectives involve a generic pronoun as optional argument, which means the DC-variable is bound by that generic pronoun also allowing for reported assessments. This would also account for the more 'objective' or 'inter-subjective' flavour which is often associated with these adjectives.

Despite their very different argument structure, epistemic modal verbs share two important aspects with epistemic adverbs adjoined to a VP. Firstly, they do not have an ARG-ST with an EXP-argument and secondly, their CONTENT-value that lacks an EXP-argument. These parallels predict that epistemic modal verbs and epistemic adverbs should behave in a similar manner. And indeed they do. When embedded under attitude predicates, they are always interpreted with respect to the attitude holder argument in the superordinate clause:

(18) Der Opa glaubt, dass ich vielleicht den Kurz gewählt
the granpa thinks that I maybe the Kurz vote-PTCP.PST
habe[7]
have
'Grandpa thinks that I maybe voted for Kurz.'
DEICTIC CENTRE=*Opa*

The binding behaviour in Example (18) also demonstrates that Nuyts's

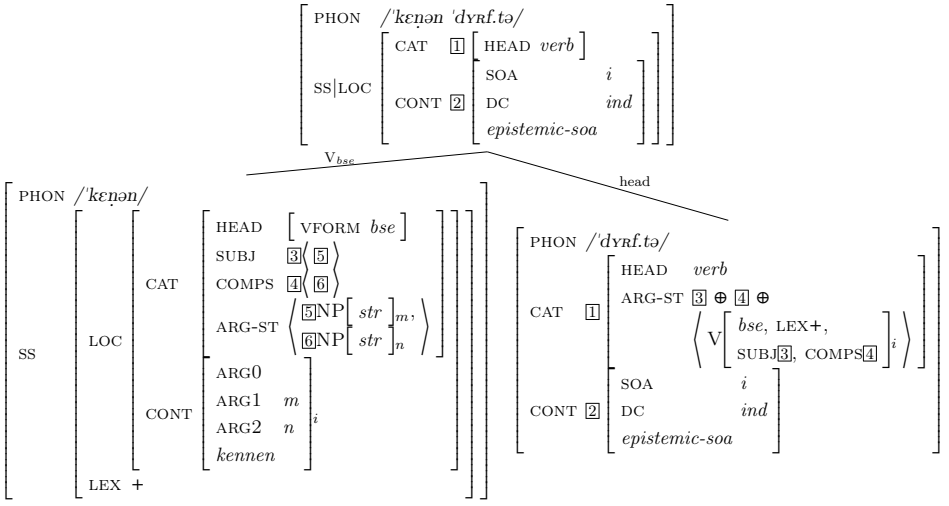

Figure 10: Epistemic modal verbs

(2001a: 72–78) claim that epistemic adverbs are intrinsically performative, in other words performing a weakening of the commitment to the truth by the speaker is not accurate: The epistemic adverb is interpreted with respect the matrix subject alone, excluding the speaker. Thus, epistemic adverbs are context dependent operators.

4.4 Further Evidence

There is another puzzle yet to be solved. As shown by Doherty (1985: 118–119), Reis (2001: 296), Maché (2013: 387–390), reportative *sollen* and *wollen* are attested in information seeking questions and they are subject to less restrictions than epistemic modal verbs are. Example (19) was uttered in a context in which the common ground contains the following facts: (i) house searches were conducted in several apartments of Austrian politicians. (ii) in order to order house searches, the federal prosecutor for corruption has to file a report in which accusation against the suspected are documented.

(19) Fabian erklär mir das nochmal, was genau sollen die
Fabian explain-IMP me this again what exactly is.claimed the
Beschuldigten getan haben?[8]
accused do-PTCP.PST have-INF
'Fabian, explain me this once again. What exactly are the accused claimed to have committed?'

[8] *Hausdurchsuchungen: Der Anfang vom türkisen Ende?* https://www.derstandard.at/story/2000130226235/hausdurchsuchungen-der-anfang-vom-tuerkisen-ende?ref=rec. Time 4:48. Accessed on October 6 2021.

(20) Wo will Grass eine Tabuisierung von Israel-Kritik entdeckt
where wants Grass a taboo of Israel.criticism find-PPP
haben? Kein anderes Land wird so viel kritisiert wie Israel.[9]
have-INF no other country is so much criticised as Israel
'Where does Grass claim to have found a criticism of Israel? No other country is subject to as much criticism as Israel is.'

Examples (19–20) involve some puzzling aspects, too. As mentioned above, reportative *wollen* and *sollen* are counted among epistemic necessity verbs in the broader sense, but unlike these latter they are acceptable in information seeking questions. As shown in Section 4.3, unbound DC-variables are only licensed in information seeking questions if a full range of discourse conditions are met. One condition states that epistemic necessity operators are almost impossible in this environment. However, reportative modal verbs have a bound DC-variable, by virtue of which they are not subject to these conditions. The analysis proposed here is further supported by accurately predicting the diverging preferences of epistemic necessity verbs and reportatives.

5 Conclusions

The different behaviour of predicative epistemic adjectives and epistemic adverbs in West Germanic languages is due to a difference in argument structure: The former have an potentially phonetically unrealised attitude holder argument, which by virtue of predicate complex formation is attracted onto the copulas valency list and treated as its own argument. In this configuration the argument becomes a legitimate local binder of the variable for the deictic centre. Epistemic operators which contain a bound DC-variable are subject to less discourse conditions as free ones. With epistemic adverbs this is not the case. When they adjoin to a VP they do not contribute any attitude holder argument to the VP, which means the DC-variable remains free and the epistemic operator is only interpretable under rather unlikely circumstances.

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