

# What might be known: Epistemic modality and uncertain contexts

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This presentation proposes an enhancement of the dynamic semantics of epistemic modality in order to provide an account for the informativeness of assertions and for the inquisitiveness of questions containing an epistemic modal.

**Background.** Modalities are canonically (Kratzer, 1981) analysed as quantifications over possible worlds, and in the case of epistemic modality the restriction of the quantification (i.e. the *modal base*) is defined as (the intersection of) the set of “all those propositions which are established knowledge [...] – for a group of people” (Kratzer, 1981, p. 45).

Dynamic semantics defines the meaning of an expression as its *context change potential* (CCP), that is a function from contexts to contexts. In dynamic implementation of epistemic modality (Groenendijk et al., 1996; von Stechow and Gillies, 2007) contexts are formalized as *information states* (ISs) which are sets of possibilities or, more simply, sets of worlds. Such contexts represent some knowledge of the speakers and as in the Stalnakerian’s model of assertion, they are updated by eliminating all the worlds w.r.t. which the proposition uttered is not true. Following this, these contexts have been “naturally” assimilated to the epistemic modal bases, and consequently the CCP of a modal statement is defined as in (1):

$$(1) \quad s[\diamond\varphi]^{\text{ccp}} = \{w \in s \mid s[\varphi]^{\text{ccp}} \neq \emptyset\} = \begin{cases} s & \text{if } s \cap \llbracket\varphi\rrbracket \neq \emptyset \\ \emptyset & \text{otherwise} \end{cases}$$

**Issue.** Such a formalization is problematic in at least two respects. First as long as ISs represent what is known and what is learned in a conversation, (1), as it leaves the input IS unchanged, implies that the assertion of an epistemic modal statement is not formally informative. However one does learn information from a sentence such as (2):

(2) Smith might be the murderer.

Second, the formalization improperly predicts that questions containing an epistemic modal (3) are not inquisitive (Groenendijk, 1999) (i.e. they’re not real requests for information).

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(3) Might Smith be the murderer?

Demonstration: Let  $?\diamond\varphi$  be the semantic representation of such a question, and  $s$  an IS representing the speaker’s knowledge. Either  $\varphi$  is not consistent with  $s$  ( $s \cap \llbracket\varphi\rrbracket = \emptyset$ ), which means that the speaker already knows (or believes) that both  $\varphi$  and  $\diamond\varphi$  are false; or  $\varphi$  is consistent with  $s$ , which means that the speaker already knows that  $\diamond\varphi$  is true. In both cases the speaker appears to already know the answer of  $?\diamond\varphi$ .

Actually the issue lies in the inability to formalize contexts in which, for any sentence  $\varphi$ , a speaker *doesn’t know* whether  $\diamond\varphi$  is true or not.

**Proposal.** Our proposal basically consists in formalizing the conversational context as a *set* of information states. Accordingly the CCP of an epistemic modal statement can be defined recursively as follows, where  $S$  is a set of ISs:

$$(4) \quad S[\diamond\varphi]^{\text{ccp}} = \{s \in S \mid s[\diamond\varphi]^{\text{ccp}} = s\} = \{s \in S \mid s \cap \llbracket\varphi\rrbracket \neq \emptyset\}$$

Such an update will only keep (unchanged) the ISs which are consistent with  $\varphi$  (the other ISs are discarded). More generally, the CCP for any proposition  $\psi$  will be:

$$(5) \quad S[\psi]^{\text{ccp}} = \{s' \mid \exists s \in S, s[\psi]^{\text{ccp}} = s'\}$$

If  $\psi$  is a non modal sentence, the update of  $S$  is eliminative as usual: the output set contains all the ISs from  $S$  after they have been updated (i.e. “shrunk”) themselves by  $\psi$ .

This proposal thus accounts for the need to bring into the context the ISs of several participants in the conversation (as proposed e.g. in von Stechow and Gillies (2008)), but more importantly to assign several ISs to each participant. This is a direct way to account for the fact that speakers may be unsure about what is true, i.e. what they know, and even about what is possible, ie what they might know.

We will subsequently provide a more detailed and motivated account of the proposal by appealing to the notion of *ordering source* (OS) (Kratzer, 1981). The main idea is to implement the uncertainty about what a speaker knows by supplying her epistemic modal base (or IS) with *several* OSs. Recall that an OS can include propositions which represent *more or less reliable* information (assumptions) the speaker wishes to add to what she “reliably” knows. According to Kratzer (1981) an OS enables to select a subset of the modal base, viz. the subset of worlds that come closest to the OS. Several OSs thus yield several (sub)sets of worlds over which the modal-quantification will apply. This amounts to our notion of *sets of ISs*.

**Consequences.** This formalization of the conversational context has several consequences. First we define some variants of the logical notions of consistency and support (Groenendijk et al., 1996). *Consistency* (6) is what prevents an update failure, it guarantees the informativeness of an assertion. *Support* (7) keeps information states intact; it enables speaker’s sincerity.

$$(6) \quad \varphi \text{ is consistent with } S \text{ iff } S[\varphi]^{\text{ccp}} \text{ exists and } S[\varphi]^{\text{ccp}} \neq \emptyset.$$

$$(7) \quad \varphi \text{ is supported by } S \text{ iff } S[\varphi]^{\text{ccp}} \text{ exists and } S[\varphi]^{\text{ccp}} = S.$$

$$(8) \quad \varphi \text{ is minimally supported by } S \text{ iff } S[\varphi]^{\text{ccp}} \text{ exists and } \exists s \in S \text{ s.t. } s \in S[\varphi]^{\text{ccp}}.$$

$$(9) \quad \varphi \text{ is maximally consistent with } S \text{ iff } S[\varphi]^{\text{ccp}} \text{ exists and } \forall s \in S[\varphi]^{\text{ccp}}, s[\varphi]^{\text{ccp}} \neq \emptyset.$$

*Minimal support* (8) renders the idea that a speaker would assert a sentence which is certain w.r.t. *some* of her information states, but not all. *Maximal consistency* (9) characterizes the utterance of propositions that are completely informative (or new) w.r.t. to a given context  $S$ . It also provides a proper means to account for the inquisitiveness of a question containing an epistemic modal:

(10)  $? \diamond \varphi$  is inquisitive in  $S$  iff  $\varphi$  is consistent *but not maximally consistent* with  $S$ .

Eventually our formalization enables to define the (static) meaning of such questions in a relational fashion along the lines of (Groenendijk, 1999, a.o.):

(11)  $[[? \diamond \varphi]]^S = \{ \langle s, s' \rangle \in S \times S \mid s \cap [[\varphi]] \neq \emptyset \Leftrightarrow s' \cap [[\varphi]] \neq \emptyset \}$

(11) can be glossed as: “is there an IS which is consistent with  $\varphi$  in the context?”. This is a singular result as it shows that such questions do not directly ask about how the world is (as do standard questions) but about how the context is. This particular analysis in (11) can lead to an explanation of why a question containing an epistemic modal often happens to be interpreted as a special or biased question, conveying surprise or incredulity.

## References

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