Do modals take propositions or questions? Evidence from Japanese

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Introduction: The standard view is that modal operators apply to propositions. Under this view, the interrogative-embedding use of responsive modal verbs like *know* is 'reduced' to their declarative-embedding use (e.g., Karttunen 1977, Spector & Egré 2015). For instance, *John knows who left* is analyzed as 'For some proposition p that is an answer to the question expressed by the complement *who left*, John knows p.' Thus, whether *know* combines with a declarative or an interrogative complement, it is always taken to apply to a proposition.

Another, more recent view is that modals always take questions, modeled as sets of propositions, as their input (Uegaki, 2015; Ciardelli and Roelofsen, 2018). Under this view, both declarative and interrogative complements denote sets of propositions. In the case of a declarative complement this set only has one element (or only one *maximal* element in inquisitive semantics, where sentence denotations are downward closed). Thus, the interrogative-embedding use of a verb like *know* does not need to be reduced to its declarative-embedding use. Rather, the verb gets a single entry which applies uniformly to both types of complement.

Elliott et al. (2017) argue for the question-based view, observing that so-called verbs of relevance like *care* and *matter* cannot be given a reductive account. In particular, *John cares who left* cannot be analyzed as 'For some answer p to *who left*, John cares that p.' On the other hand, George (2011) and Spector and Egré (2015) (S&E) raise a concern for the question-based view, which is that it does not predict any constraints on the range of possible responsive modal operator meanings. To illustrate this point, S&E consider the fictitious verb *shknow*, which is equivalent to *know* when taking a declarative complement and equivalent to *wonder* when taking an interrogative complement. Under the reductive treatment of responsive modal operators, such verbs are predicted not to exist in any language. On the non-reductive, question-based treatment of responsive modals, such constraints are not predicted.

We offer new evidence for the question-based view coming from the Japanese modal particle *darou*, which behaves roughly like S&E's *shknow*. Below we present the core empirical observations (building on Hara and Davis, 2013; Hara, 2015) and an outline of our theoretical account, which is fully spelled out in the paper.

Empirical observations: With a declarative prejacent, as in (1a), *darou* translates as 'I expect'. In contrast, in the presence of the question particle *ka*, it translates as 'I wonder', as in (1b)-(1c).

(1) a. Taro-wa utau-**darou**.   b. Taro-wa utau-**darou**-ka.   c. Dare-ga utau-**darou**-ka.
     Taro-TOP sing-DAROU   Taro-TOP sing-DAROU-Q   who-NOM sing-DAROU-Q
     'I expect Taro will sing.'   'I wonder if Taro will sing.'   'I wonder who will sing.'

Sentences like (1b)-(1c), do not behave like questions. For instance, one cannot respond to them with "Why are you asking *me* that question?". Therefore, it is assumed that *ka* does not apply to the matrix clause in such constructions, but is part of the prejacent of *darou* (Hara and Davis 2013). This means that *darou* is a responsive modal particle that is compatible with both declarative and interrogative prejacents, just like verbal responsive modals like *know*. Importantly, however, the interrogative-embedding use of *darou* cannot be reduced to its declarative-embedding use: 'I wonder Q' does not mean that for some answer p to Q, 'I expect p'.

What makes *darou* even more interesting is its interaction with intonation (Hara 2015). As seen in (2a), with final rising intonation, *darou* with a declarative prejacent expresses a biased question, similar to English tag-questions. On the other hand, rising intonation is incompatible with *darou-ka*, as in (2b)-(2c).

(2) a. Taro-wa utau-**darou**↑.   b. *Taro-wa utau-**darou**-ka↑.   c. *Dare-ga utau-**darou**-ka↑.
     'John will sing, won't he?'

Theoretical background: Our account is formulated in inquisitive epistemic logic (IEL) (Ciardelli and Roelofsen, 2015). In this framework, every individual a is associated, in every world w, with a doxastic state DOX_a^w and an inquisitive state INQ_a^w. As usual, DOX_a^w is a set of possible worlds. On the other hand, INQ_a^w is a set of doxastic states, all extensions (i.e, subsets) of DOX_a^w, in which the issues that a entertains in w are resolved. It is assumed that $\text{DOX}_a^w = \bigcup \text{INQ}_a^w$. Besides these basic IEL notions, we also associate every individual a in every world w with an 'expectation state' EXP_a^w, consisting of all worlds compatible with what a expects in w.

The semantic value of a sentence φ in IEL, $[\![\varphi]\!]$, is a downward-closed set of propositions, namely those propositions that support the information that φ conveys (if any) and resolve the issue that φ raises (if any). The truth-conditions of φ are derivable from $[\![\varphi]\!]$: φ is true in w iff $\{w\} \in [\![\varphi]\!]$. The informative content of φ, $\text{info}(\varphi)$, is the set of all worlds where φ is true, $\bigcup[\![\varphi]\!]$. The semantics of the relevant operators in IEL is given below: E_a stands for 'a expects', W_a for 'a wonders', ? is an operator that trivializes the informative content of φ, and ! one that trivializes the issue that φ expresses, leaving its informative content intact.

(3) a. $[\![E_a\varphi]\!] := \{p \mid \forall w \in p : \text{EXP}_a^w \subseteq \text{info}(\varphi)\}$
     b. $[\![W_a\varphi]\!] := \{p \mid \forall w \in p : \text{DOX}_a^w \notin [\![\varphi]\!] \text{ and } \text{INQ}_a^w \subseteq [\![\varphi]\!]\}$
     c. $[\![?\varphi]\!] := [\![\varphi]\!] \cup [\![\neg\varphi]\!]$
     d. $[\![!\varphi]\!] := \{p \mid p \subseteq \text{info}(\varphi)\}$

Account: We treat *ka* and the final rise as in (4) and *darou* as in (5), where $[\![\varphi]\!]$ is the at-issue content of φ, $[\![\varphi]\!]^\bullet$ its non-at-issue content, and $\odot$ the deictic center which for our purposes here is the speaker (the deictic center can shift in embedded contexts, Hara & Davis 2013). To paraphrase: φ *darou* has the informative content of φ as its at-issue content, and contributes 'I expect φ but wonder whether indeed φ' as non-at-issue content.

(4) a. $[\![\varphi\ ka]\!] = [\![\varphi^\uparrow]\!] = [\![?\varphi]\!]$ (5) a. $[\![\varphi\ darou]\!] = [\![!\varphi]\!]$
     b. $[\![\varphi\ ka]\!]^\bullet = [\![\varphi^\uparrow]\!]^\bullet = [\![\varphi]\!]^\bullet$ b. $[\![\varphi\ darou]\!]^\bullet = [\![E_\odot!\varphi \wedge W_\odot?\varphi]\!] \cap [\![\varphi]\!]^\bullet$

We assume that in uttering a sentence φ, a speaker always commits herself to $\text{info}(\varphi)$, unless the non-at-issue meaning of φ signals that the speaker does not believe $\text{info}(\varphi)$. Further, we assume that a sentence that is marked as a question by a final rise is degraded if it is necessarily non-inquisitive (both at-issue and non-at-issue), i.e., no matter what its prejacent is, and that a sentence which is marked as an assertion by a final fall is degraded if it is necessarily non-informative (both at-issue and non-at-issue) (cf., Gajewski 2002).

Predictions: The following semantic values are derived for the crucial examples (using the fact that for any atomic sentence ψ, $!\psi \equiv \psi$, $??\psi \equiv ?\psi$, and $E_\odot!\psi$ is tautologous.)

(6) a. $[\![\psi\ darou]\!] = [\![\psi]\!]$ (8) a. $[\![\psi\ darou^\uparrow]\!] = [\![?\psi]\!]$
     b. $[\![\psi\ darou]\!]^\bullet = [\![E_\odot\psi \wedge W_\odot?\psi]\!]$ b. $[\![\psi\ darou^\uparrow]\!]^\bullet = [\![E_\odot\psi \wedge W_\odot?\psi]\!]$
(7) a. $[\![\psi\ darou\text{-}ka]\!] = [\![!?\psi]\!]$ (tautologous) (9) a. $[\![\psi\ darou\text{-}ka^\uparrow]\!] = [\![?!?\psi]\!]$ (tautologous)
     b. $[\![\psi\ darou\text{-}ka]\!]^\bullet = [\![W_\odot?\psi]\!]$ b. $[\![\psi\ darou\text{-}ka^\uparrow]\!]^\bullet = [\![W_\odot?\psi]\!]$

As seen in (6), the non-at-issue meaning of ψ *darou* conveys that the speaker expects ψ, and wonders whether ψ is indeed the case. The first conjunct captures the most salient implication of (1a), described in its translation above. The second conjunct implies that the speaker does not know whether ψ (by (3b), wondering implies lack of knowledge), which means that we correctly predict that in uttering (1a) the speaker does not commit to the at-issue informative content, $\text{info}(\psi)$. Turning now to (7), we predict that ψ *darou-ka* has trivial at-issue content but carries a non-at-issue implication that the speaker is wondering whether ψ. This matches the intuitive translation of (1b) above. In (8), we see that the at-issue meaning of ψ*-darou-ka*$^\uparrow$ is

that of a polar question, *whether ψ*, while its non-at-issue meaning conveys a bias toward *ψ*, matching the translation in (2a). Finally, we predict the degradedness of *ψ-darou-ka*[↑] since, as seen in (9), both its at-issue and its non-at-issue content are necessarily non-inquisitive, even though the sentence is marked as a question by the final rise, and thus requires inquisitiveness.

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