

Higher-Order Confidence with Epistemic Modals

I will discuss the interaction between epistemic modals and doxastic attitudes in Slovenian, using the existential belief predicate *dopuščati* ('to allow for the possibility'). I will argue that epistemic modals make reference to evidence even in embedded positions, contra [Yalcin \(2007\)](#), and that the properties of the modal base give rise to a natural interpretation in terms of how confident (or clueless) the attitude holder is in her capacity to assess the evidence.

Basic paradigm. Since [Hacquard \(2006\)](#), [Stephenson \(2007\)](#), and [Yalcin \(2007\)](#), there has been much interest in the analysis and distribution of embedded epistemic modals. [Anand and Hacquard \(2013\)](#) observe for Romance that universal epistemic modals do not embed under doxastic verbs like *fear*, *hope*, or *doubt* (analysed as existential), while any force is good under *believe* and *think*. Slovenian provides an additional data point to this landscape with the existential verb *dopuščati* ('to allow for the possibility'). As illustrated in (1), there are situations in which an existential modal like *utegniti* ('might') can be embedded (with a slight feel of redundancy) but a universal one like *morati* ('must') is odd (on the epistemic construal). Similarly, *ne more* ('cannot') in (1c) is odd, which fits the generalization that oddness comes from embedding a wide-scope universal force, assuming duality: *ne more* ('cannot') is relevantly equivalent to *mora ne* ('must not') ($\neg\Diamond p \Leftrightarrow \Box\neg p$).

(1) Context: John sees people come in with wet umbrellas.

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| <p>a. <i>Janez misli, da {utegne, mora} zunaj deževati.</i> John thinks that might must outside to.rain 'John thinks that it {might, must} be raining outside.'</p> | $B_J\Diamond r, B_J\Box r$ |
| <p>b. <i>Janez dopušča, da {utegne, #mora} zunaj deževati.</i> John allows that might must outside to.rain 'John allows for the possibility that it {might, must} be raining outside.'</p> | $D_J\Diamond r, \#D_J\Box r$ |
| <p>c. <i>Janez {misli, #dopušča}, da ne more biti sončno.</i> John thinks allows that not can be sunny 'John {thinks, allows} that it can't be sunny.'</p> | $B_J\neg\Diamond\neg r, \#D_J\neg\Diamond\neg r$ |

The way in which *dopuščati* differs from [Anand and Hacquard](#)'s cases is that it can be strengthened into a belief claim (cf. *some* to *most/all*), see (2). This significantly reduces the space of possible analyses for embedded epistemics, and one also cannot use [A&H](#)'s diversity presupposition.

- (2) *Seveda, dopuščam, da je Zemlja okrogla – trdno verjamem, da je.* $D_p \wedge B_p$
 of.course I.allow that is Earth round firmly I.believe that is
 'Of course I allow for the possibility that the Earth is round – I firmly believe that it is.'

Intuition. The intuition behind the oddnesses in (1b) that I aim to capture is that an embedded universal epistemic makes the choice of a weak attitude inappropriate. This will be cashed out with constraints on epistemic modals that ultimately cause a contextual equivalence with embedded universal force ($D\Box p \sim B\Box p, D\neg\Diamond p \sim B\neg\Diamond p$). The same assumptions will not yield an equivalence (pace [Yalcin](#)) for embedded existential force ($D\Diamond p \not\sim B\Diamond p$), which is a welcome result given the lack of oddness. (I'm setting aside the feel of redundancy, which I suspect is similar to $B\Box p$, contrasted with Bp .) On the proposed approach, $B\Diamond p$ will be strictly stronger than $D\Diamond p$. This is intuitively

correct. Consider a murder investigation in which Sherlock and Watson are given access to identical evidence. Given that Sherlock has a quick mind, he can form a better grasp of the evidence, so when asked to state his personal opinion on the murder, he could plausibly respond with (3a). Watson, on the other hand, might be more cautious and say (3b).

- (3) a. *Mislim, da utegne biti Janez morilec.* ('I think John might be the murderer')
 b. *Dopuščam, da utegne biti Janez morilec.* ('I allow for the possibility that John might...')

I argue that we can think of this distinction in terms of the shape of the (epistemic) accessibility function: when an agent, such as Sherlock, fully masters the evidence, the worlds compatible with his evidence are always the same: his set of belief worlds (Figure 1a). By contrast, when the agent takes himself to have a lesser grasp of the evidence at hand, the worlds compatible with his evidence can differ per doxastic world (Figure 1b). In particular, there can be doxastic worlds (w_2) at which the agent learns more from his evidence than at others. The difference between Sherlock and Watson is in how confident they are of their assessment of the evidence. Figure 1 illustrates this with two different modal base functions f .



(a) Confident agent (note: $D\Diamond p \Leftrightarrow B\Diamond p$)

(b) Non-confident agent (note: $D\Diamond p \not\Leftrightarrow B\Diamond p$)

Figure 1: Confidence in one's capacity to conclude $\Diamond p$, $\Box p$, etc.

Formal implementation. Yalcin (2007) interprets sentences with respect to a point of evaluation containing a world and an information state (a set of worlds). Attitude verbs shift the information state to the attitudinal state. I extend this by adding another parameter (also a set of worlds) that specifies which worlds in the information state are salient. The motivation for this is for now technical; further work is needed to explore how attitude verbs structure their domains in terms of salience cross-linguistically. The intuitive idea, however, is that *dopuščati* (D) makes salient the witnesses to its existential statement, while *misliti* (B) does not make salient anything in particular.

- (4) a. $\llbracket B_{John} \varphi \rrbracket^{g,s,s',w} = 1$ iff $\forall w' \in \mathcal{B}_J^w : \llbracket \varphi \rrbracket^{g,\mathcal{B}_J^w, \mathcal{B}_J^w, w'} = 1$ *misliti* ('think')
 b. $\llbracket D_{John} \varphi \rrbracket^{g,s,s',w} = 1$ iff $\exists w' \in \mathcal{B}_J^w : \llbracket \varphi \rrbracket^{g,\mathcal{B}_J^w, \{w'\}, w'} = 1$ *dopuščati* ('allow for the p.')

Epistemic modals encode constraints on the kinds of modal base functions they combine with. Mandelkern (to appear) proposes that epistemic modals are inherently **Local**: the modal base is restricted to the information state it is evaluated against (the modal cannot "look outside"). Since this constraint undergenerates ($D_J \Box_i p \not\Leftrightarrow_{Locality} B_J \Box_i p$), I propose a further constraint (**Totality**) that effectively forces some worlds to behave like w_1 in Figure 1.

- (5) a. $\llbracket \Box_i \varphi \rrbracket^{g,s,s',w'}$ is defined when $\forall v \in s [g(i)(v) \subseteq s]$ (Locality, Mandelkern) and $\exists v \in s' [s \subseteq g(i)(v)]$ (Totality), and, when defined, is true iff $\forall w'' \in g(i)(w') : \llbracket \varphi \rrbracket^{g,s,s',w''} = 1$
 b. $\llbracket \Diamond_i \varphi \rrbracket^{g,s,s',w'}$ is defined when $\forall v \in s [g(i)(v) \subseteq s]$ (Locality, Mandelkern) and $\exists v \in s' [s \subseteq g(i)(v)]$ (Totality), and, when defined, is true iff $\exists w'' \in g(i)(w') : \llbracket \varphi \rrbracket^{g,s,s',w''} = 1$

Totality is a presupposition defined with respect to a parameter (s') that gets bound by the outermost quantifier under *dopuščati*, due to the shift in (4b). While Locality could be projected out, I will just assume that Totality and Locality always accommodate into the restrictor of the attitude predicate and that restrictors are non-empty. So, $\llbracket D_{John} \Box_i p \rrbracket^{g,s,s',w} = 1$ iff $\exists w' \in \mathcal{B}_J^w [\forall v \in \mathcal{B}_J^w [g(i)(v) \subseteq \mathcal{B}_J^w] \wedge \exists v \in \{w'\} [\mathcal{B}_J^w \subseteq g(i)(v)] \wedge \forall w'' \in g(i)(w') [\llbracket p \rrbracket^{g,\mathcal{B}_J^w,\{w'\},w''} = 1]]$. In Figure 2a, w_1 is a witness to this existential statement. Notice that $B_{John} \Box_i p$ is entailed ($\llbracket B_{John} \Box_i p \rrbracket^{g,s,s',w} = 1$ iff $\forall w' \in \mathcal{B}_J^w [\dots \wedge \exists v \in \mathcal{B}_J^w [\mathcal{B}_J^w \subseteq g(i)(v)] \wedge \dots]$). As Figure 2b shows, $\llbracket D_{John} \Diamond_i p \rrbracket^{g,s,s',w} \neq \llbracket B_{John} \Diamond_i p \rrbracket^{g,s,s',w}$.

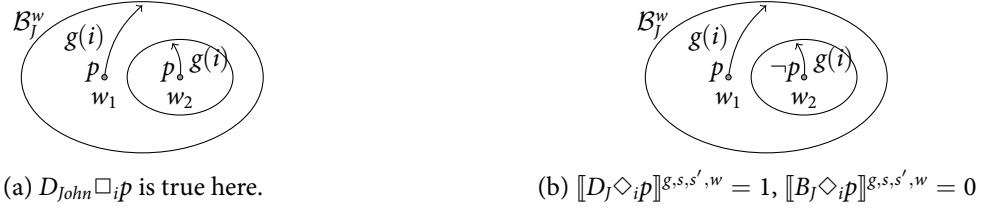


Figure 2: Some models

These ingredients can be used to build on Magri (2009, 2011) to derive oddness for *dopuščati* when the *misliti* statement is equivalent to it (cf. #Some Italians come from a warm country). With embedded universal force the oddness occurs regardless of the attitude holder’s confidence, due to the equivalence between $D_x \Box_i p$ and $B_x \Box_i p$ when i satisfies Locality and Totality (importantly then, i is not in this case shifted to some other body of evidence). For existential force, this line of reasoning predicts that when the attitude holder is known to be confident (forcing Figure 1a), it should be odd to say (3b). This seems correct but it is harder to show since politeness and attenuation support tentative claims, even from an otherwise confident agent.

Intuition (continued). Epistemic modals are sensitive to whether the agent is confident in her capacity to make an epistemic inference like *might p*, and this property is revealed in certain embedded positions ($D \Diamond p$ vs $B \Diamond p$). Such a view on epistemic modals is possible because the modal base function is world-dependent (a doxastic world w' is mapped onto a set of (possibly different) worlds compatible with the agent’s evidence in w'). The data therefore provides an argument against modals-as-tests analyses like Yalcin’s and supports a more standard conception of epistemic modals.

More needs to be said about what the two constraints on epistemic modals (Locality, Totality) tell us about the *content* of evidence and its assessment, and how this relates to salience (Totality effectively requires that the agent be confident in the salient worlds of the information state). There is also hope that non-confidence can provide a potential source of weakness that is sometimes observed with *must* (perhaps in addition to other sources like indirectness). On the current account, embedded universal epistemics are *strong*, in the sense of von Stechow and Gillies (2010). Imagine now a situation in which p is true throughout the belief state. For $B \Box p$, Figure 1a would express that the agent has full control of the evidence and concludes that p , while Figure 1b (=2a) would depict a situation in which the agent is less confident in how she reasons with the evidence, but is nevertheless convinced that p follows. The modal base can be of either kind and perhaps contextual factors suggest the latter in some cases of weakness.

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