

Where Force Matters: Embedding Epistemic Modals and Attitudes

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Using novel data from Slovenian, we analyse the differences in embedding epistemic modals (*might, must*) and doxastic attitudes (*dopuščati* ‘allow for the possibility that’, *think/believe*) under doxastic attitudes. We develop a pragmatic account using blind (robust) scalar implicatures (Magri 2009).

Data. Anand and Hacquard (2013) (A&H) observe for Romance that universal epistemic modals (*must*) do not embed under emotive doxastics like *fear/hope*, while any force is good under *think/believe*. Slovenian elaborates on this contrast with a (non-biased) existential doxastic *dopuščati* (related to Russian *dopuskat*’ but different from English *allow*, which is more discursive), abbreviated as D. B abbreviates *think/believe*.

Embedding epistemic modals under *dopuščati*: an existential modal like *utegniti* (\diamond) (similarly for *mogoče* ‘perhaps’) is somewhat redundant but still acceptable, whereas the universal *morati* (\square) is decidedly odd.

(1) Context: John had seen a wet umbrella.

B \diamond p, D \diamond p, B \square p, #D \square p

(a) *Janez {misli/dopuščča}, da utegne zunaj deževati.* (b) *Janez {misli/#dopuščča}, da mora_{ep} zunaj deževati.*

John thinks allows that might outside to.rain *John thinks allows that must outside to.rain*

John {thinks/allows} that it might be raining outside. *John {thinks/#allows} that it must be raining outside.*

Importantly, the embedded readings under inspection are epistemic, with the modal anchored to the attitude holder (rather than echoing someone else’s words, or being shifted to some other body of evidence). We take *dopuščati* to be the dual of *think/believe*, thus like *some* it can be reinforced into *in fact all*:

(3) *Seveda, dopuščam, da je Zemlja okrogla – trdno verjamem, da je.*

Dp&Bp

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.

Standardly, *might/can* and *must* are duals ($\diamond p \equiv \sim \square \sim p$), so *can’t* is unsurprisingly also odd under D:

(4) *#Dopuščam, da ne more_{ep} biti sončno.*

#D \sim \diamond p

I.allow that not can be sunny

I allow for the possibility that it can’t be sunny.

Embedding epistemic/doxastic attitudes under *dopuščati* is intuitively odd with either force because (unless such an assumption is suspended) agents are assumed to be authorities on their belief/knowledge states.

(5) *#Dopuščam, da {verjamem/dopuščam}, da zunaj dežuje.*

#DDp, #DBp

I.allow that I.believe I.allow that outside it.rains

I allow for the possibility that {I believe/I allow for the possibility} that it’s raining outside.

Thus, *dopuščati* is an embedding environment with a contrast between embedded $\diamond p$ and Dp. That modals and attitudes should not receive an identical analysis was already pointed out by Yalcin (2007), who observed that modals, unlike attitudes, give rise to contradictions that do not disappear in some embeddings.

Problem. Embedded modals and attitudes behave differently, but a Yalcin-style revision is not sufficient to predict #D \square p. Since *dopuščati*, unlike *hope/fear*, can be strengthened without contradiction, it should be compatible with a universal (\square) claim (cf. diversity in A&H). In light of (4) and independent data, we need an analysis that does not break duality (cf. Ippolito 2017) and predicts: D \diamond p vs. #DDp, and D \diamond p vs. #D \square p.

This talk will also address the negation data. It is worth noting that the oddity of embedded modals extends to # \sim B \square p, which is why we do not pursue an analysis that is specific to the syntax-semantics of *dopuščati*.

Analysis. Modals and attitudes are quantifiers over sets of accessible worlds (Hintikka/Kratzer): attitudes specify this set lexically while modals determine their flavour through context. *Might/must* combine with a free (modal base) variable *i*, of type *sst* (von Stechow 1994; setting ordering sources aside). The index of evaluation contains a local context parameter κ (a set of worlds, Schlenker 2009), to play a role later.

$[[B_{Ap}]]^{g,\kappa,w}=1$ iff $\forall w' \in \mathcal{B}_A^w: [[p]]^{g,\mathcal{B}_A^w,w'}=1$

$[[D_{Ap}]]^{g,\kappa,w}=1$ iff $\exists w' \in \mathcal{B}_A^w: [[p]]^{g,\mathcal{B}_A^w,w'}=1$

$[[\square_i p]]^{g,\kappa,w}=1$ iff $\forall w' \in g(i)(w): [[p]]^{g,\kappa,w'}=1$

$[[\diamond_i p]]^{g,\kappa,w}=1$ iff $\exists w' \in g(i)(w): [[p]]^{g,\kappa,w'}=1$

We develop a pragmatic account of embedding under doxastic attitudes based on the assumption that D and B are Horn mates (like *some* and *all*). We build on Magri’s (2009) theory of blind scalar implicatures, which are computed in the grammar by a covert exhaustivity operator *Exh* (Fox 2007), akin to *only*. *Exh* computes the exhaustified meaning using logical entailment (ignoring contextual knowledge). A sentence is odd when this blindness of *Exh* yields a contextual contradiction. For example, the exhaustified meaning (some but

not all) of #Some Italians come from a warm country contradicts our knowledge that Italians come from the same country (*some* and *all* are contextually equivalent). Blindness allows scalar implicatures to be robust.

Attitudes. We illustrate with #DDp from (5). Scalar alternatives are computed by replacing lexical items with their Horn mates: the set of alternatives for DDp, in schematic notation, is {BDp, DBp, BBp}. The exhaustified meaning, $Exh(DDp) = DDp \& \sim BDp \& \sim DBp \& \sim BBp$, is obtained by negating these alternatives and excluding logical contradictions, if any. Since speakers are commonly assumed to have full access to their own beliefs, the exhaustified meaning will give rise to a contextual contradiction because DDp and BDp are in that case contextually equivalent. [We can show this formally in [KD45](#)] (see [Stalnaker 2006](#)), which assumes that if an agent believes p , they believe they believe it (positive introspection) and if they do not believe p , they believe they do not believe it (negative introspection). We can take these axioms to be part of the common ground for the relation encoded by *think/believe* and *dopuščati*.]

Modals. We assume that the introspection principles are not parasitic on the kind of modal base function modals select. Instead, we will appeal to two other principles, which generate a contextual contradiction for #D□p but not for D◇p. Since $Exh(D◇p) = D◇p \& \sim B◇p \& \sim D□p \& \sim B□p$ and $Exh(D□p) = D□p \& \sim B□p \& \sim B◇p$, which are both logically consistent, contain (underlined) material of the same shape (cf. $\sim B◇p = D□\sim p$), making one pair contextually inconsistent makes the other pair so as well. We will propose to break this symmetry by restricting one of the two principles to the complement of *Exh* (as opposed to the alternatives).

[Mandelkern's \(2017\)](#) proposal, which improves on [Yalcin \(2007\)](#) a.o., is that epistemic modals quantify over subsets of their local context (by constraining the set of accessible worlds: the modal base $g(i)$ maps only to subsets of κ). Under doxastics, κ is just the attitude holder's belief worlds (see definitions above).

$[[might_i]]^{g,\kappa,w}$ and $[[must_i]]^{g,\kappa,w}$ are defined only if $\forall v \in \kappa: g(i)(v) \subseteq \kappa$

[Mandelkern's Locality](#)

We take it that just like *Exh* is said to be blind to some properties of the word *Italians* (same countryhood), the entailment used by *Exh* does not see that epistemic modals are local. (This move is not necessary, but it has the potential of explaining shifting (see [Egan et al. 2005](#)) as giving up this locality assumption.) This does not yet turn $Exh(D□p)$ into a contextual contradiction since the modal base of *must* can be restricted to a proper subset, making $D□p$ consistent with $\sim B□p$. (Note that $D◇p$ is not an excludable alternative because non-empty restrictors are commonly assumed at this step for all natural language quantifiers, cf. also $B□p$.) We therefore propose interaction with a related idea: *might/must* are assumed to also talk about their whole local context, not just subsets. For this we use a function K that maps v to the whole local context κ :

$[[must_i\phi]]^{g,\kappa,w}$ is defined only if $\exists v \in \kappa: [[must_i\phi]]^{g,\kappa,w} = [[must_i\phi]]^{g[i/K],\kappa,v}$, where $K(v) = \kappa$

[Non-Vacuity](#)

$[[might_i\phi]]^{g,\kappa,w}$ is defined only if $\exists v \in \kappa: [[might_i\phi]]^{g,\kappa,w} = [[might_i\phi]]^{g[i/K],\kappa,v}$, where $K(v) = \kappa$

To break the aforementioned symmetry, we assume that Non-Vacuity (unlike Locality) applies only to what was actually said, i.e. to the complement of *Exh*, and not to the negated alternatives that *Exh* generates:

Double Blindness Hypothesis: Alternatives can be blind to some contextual information.

For example, $[[Exh(D□_ip)]]^{g,\kappa,w}$ is true iff $[[D□_ip]]^{g,\kappa,w} = 1$ and $[[B□_ip]]^{g,\kappa',w} = [[B◇_ip]]^{g,\kappa',w} = 0$, where κ (an unembedded local context is just the global context) contains contextual knowledge and common ground assumptions like Locality and Non-Vacuity, while κ' is blind to what pertains only to the actually asserted material (i.e. κ' excludes Non-Vacuity). Since $[[D□_ip]]^{g,\kappa,w}$ is felicitously true when all the belief worlds are p -worlds, $[[B□_ip]]^{g,\kappa',w}$ cannot be *false* while obeying Locality, which restricts $g(i)$ to the belief worlds. In other words $[[D□_ip]]^{g,\kappa,w}$ entails $[[B□_ip]]^{g,\kappa',w}$ (this tracks the intuition that #D□p is odd because the speaker “only” allows □p). By contrast, $[[Exh(D◇_ip)]]^{g,\kappa,w}$ is contextually consistent (cf. $B^w = \{w_1, w_2\}$ with $p(w_1) = 1$, $p(w_2) = 0$, $g(i)(w_1) = B^w$ and $g(i)(w_2) = \{w_2\}$). Non-Vacuity pragmatically strengthens *must* but weakens *might*.

Contribution. We bring in a new attitude verb from Slovenian, contributing to the landscape of attitude verbs embedding epistemic modals (#D□p) and to the literature on the differences between epistemic modals and epistemic/doxastic attitudes (D◇p vs #DDp). We analyse the data using blind scalar implicatures.

The analysis shares some spirit with [Ippolito \(2017\)](#) but does not rely on doxastic presuppositions that break the duality of *might/must*. We also explicitly discuss embeddings of attitudes under attitudes.

Selected References. [Mandelkern, M. 2017. *Coordination in Conversation*, PhD Thesis, MIT.](#) [Magri, G. 2009. A theory of individual-level predicates, NLS 17\(3\):245-297.](#)