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Clauses as semantic predicates: difficulties for possible-worlds semantics

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Abstract The standard view of clauses embedded under attitude verbs or modal predicates is that they act as terms standing for propositions, a view that faces a range of philosophical and linguistic difficulties. Recently an alternative has been explored according to which embedded clauses act semantically as predicates of content-bearing objects. This paper argues that this approach faces serious difficulties when it is based on possible worlds-semantics. It outlines a development of the approach in terms of truthmaker theory instead.

The standard view of clauses when they are embedded under attitude verbs or modal predicates is that they act as singular terms standing for propositions. There are a range of difficulties for that view, though, which have motivated an alternative approach to the meaning and semantic contribution of embedded sentences. According to that approach, clauses act as predicates of content-bearing objects, such as mental states, cognitive or illocutionary acts or products of such acts, and modal objects (entities like obligations and permissions), objects that may be given by the content of the embedding predicate or the discourse context. In this paper, I want to point out some serious difficulties for possible-worlds semantics that arise when clauses embedded under attitude verbs or modal predicate are considered predicates of content-bearing objects. I will propose instead a situation-semantic account, based on the notion of an exact truthmaker or satisfier in the sense of Fine (2014, 2017). This account allows embedded sentences to apply to content-bearing objects of various sorts in virtue of a single meaning, and it can provide a more adequate semantics of what Kratzer (2016) calls ‘harmonic modals’.

1 The standard view of clausal complements of attitude verbs and of modal sentences

Let me start with the standard view of clausal complements of attitude verbs of the sort of *assume* and *hope*, before turning the attention to sentences embedded under modal predicates (and other sorts of sentence-embedding predicates).

The standard view of clausal complements of attitude verbs as in (1a) is that they act as singular terms standing for propositions, which in turn act as arguments of the embedding attitude verb. Formally, this is what I call the *Relational Analysis* (Moltmann 2003, 2013a), given for (1a) in (1b):¹

- (1) a. John assumes that Mary is happy.
 b. assume(John, [*that Mary is happy*])

Propositions are generally taken to play three roles: to be (the primary bearers) of truth values, the meanings of sentences (or referents of embedded clauses), and the contents or ‘objects’ of propositional attitudes. There are both linguistic and philosophical difficulties for the Relational Analysis.² First the Relational Analysis is considered problematic in that it fails to make a distinction between the content and the object of an attitude (treating propositions as things agents have attitudes to, rather than as the contents of attitudes). Second, there are problems for the notion of an abstract proposition as such, which are a major topic of discussion in contemporary philosophy of language (they concern in particular the graspability and truth-directedness of propositions). But also the linguistic plausibility of the Relational Analysis has been put into question. The difficulties it raises include accounting for the Substitution Problem, the problem of the unacceptability of (2b) as an inference from (2a), and the Objectivization Effect, the difference in the understanding between (3a) and (3b):

- (2) a. John assumed that S
 b. ??? John assumed the proposition that S.
- (3) a. John fears that S
 b. John fears the proposition that S.

Another issue concerns the analysis of nominal constructions. It has long been observed that clausal complements of nouns as in (4) do not behave like arguments, since they are not obligatory even if the verb requires a complement:

- (4) John’s assumption that S

¹ I chose the verb *assume*, rather than *think* or *believe*. I consider *think* a verb of (internal) saying, involving a different semantics than verbs like *assume*, *conclude*, or *claim* (Moltmann 2017b). Moreover, *believe* arguably involves a different semantics as well (Fn 8).

² See Moltmann (2003, 2013 chap 4, 2014) and reference therein.

Moreover, semantically, the clausal complement seems to stand for something closely related to what the nominal construction stands for, a proposition-like object, rather than providing an object entering a thematic relation to the event described by the verb. Clauses can also be complements of underived nouns, where they could not possibly fill in an argument position, as in *the idea that S* and *the thesis that S* (Moulton 2009). Yet, the semantic relation of the denotation of the clausal complement to the denotation of the entire NP is not plausibly that of identity: an assumption, idea, or thesis is not just a proposition, but rather, more plausibly, the (non-physical) *product* of a cognitive act in the sense of Twardowski (1911) (Moltmann 2014, 2017a)

The syntactic status of clausal complements of nouns, though, is far from obvious and there is a significant syntactic controversy surrounding it. Some researchers assimilate them to relative clauses (Arsenevič 2009, Moulton 2009, Kayne 2010).³ Others have argued against such an assimilation (de Cuba 2017). The proposal that I will discuss later, that clauses semantically act as predicates, would go along well with the view that clausal complements of nouns, and even verbs, are relative clauses. But the proposal is not strictly tied to that syntactic view. It is compatible with a different syntactic analysis of complement clauses, as long as the analysis permits them to be in some way interpreted as properties.⁴

There are also various phenomena where the choice of a category or expression in the clause (mood or modals) appears to depend on the semantics of the embedding verb and which thus indicate that the clause does not act as a referentially independent singular term. Such phenomena were Kratzer's main motivations for pursuing the approach of clauses as semantic predicates. In particular, as Kratzer (2016) points out, deontic modals with relevant sorts of speech act verbs as below display two readings, one of which does not contribute to the content of the reported speech but simply reflects the inherent modality associated with the embedding predicate:

- (5) He motioned / proposed / insisted / suggested / recommended / advised / demanded / petitioned / urged / begged / requested / required / wanted / pleaded that we *should* set up an emergency fund. (Kratzer 2016)

Such modals are what Kratzer calls *harmonic modals*. Harmonic modals are not available with verbs of saying of the sort *say, mention, claim*, etc.

There are, as expected, also harmonic uses of modals of possibility, with suitable embedding verbs:

³ Kayne (2010) in fact takes the view that all complement clauses are relative clauses.

⁴ In fact, even some relative clauses, unrestrictive relative clauses, have been analysed not as semantic predicates, but as (E-type) pronouns. See Cinque (2008) for discussion and further references.

- (6) a. John made Mary the offer that she *could* use the house.
 b. The document indicates that Bill *might* be guilty.
 c. John suggested that Bill *might* be at home.

For Kratzer, harmonic modals indicate that complement clauses are not referentially independent. They spell out the inherent modality of the content-bearing object of which the clause is to be predicated (a motion, proposal, suggestion, recommendation, or offer, for example).

Let me briefly turn to the standard view of modals. The standard view of modals consists in the *quantificational analysis* according to which a modal of necessity as in (7a) stands for a universal quantifier ranging over possible worlds, as in (7b), and a modal of possibility as in (8a) for an existential quantifier, as in (8b):

- (7) a. John needs to leave.
 b. $\forall w'(w' \in f(w) \rightarrow [John\ leave]^{w'} = \text{true})$
- (8) a. John is allowed to leave.
 b. $\exists w'(w' \in f(w) \& [John\ leave]^{w'} = \text{true})$

Here, the contextually given function f maps the world w in which the entire sentence is evaluated to the relevant set of worlds, the modal base. The quantificational account of modals was extended to verbs expressing belief and knowledge by Hintikka (1962), and the Hintikka-style analysis has since become a common approach to the semantics of attitude verbs in natural language semantics. The assimilation of attitude verbs to modals has been used, for example, to account for the presupposition projection behavior of the complement of attitude verbs (Heim 1992) and for the understanding of epistemic modals in the complements of attitude verbs (Anand /Hacquard 2013). Thus (9a) on that view has the truth conditions in (9b), where $bel_{w,j}$ is the set of worlds compatible with what John believes in w :

- (9) a. John believes that S
 b. $\forall w'(w' \in bel_{w,j} \rightarrow [S]^{w'} = \text{true})$

(9b) can be reformulated straightforwardly making use of a proposition p (the set of worlds in which the complement clause S is true) as an argument of the attitude verb:

- (9) c. $believe(j, p) \text{ iff } \forall w'(w' \in bel_{w,j} \rightarrow w' \in p)$.

The modal analysis of attitude verbs has generally been applied only to attitude verbs that are taken to involve universal quantification over worlds, such as belief and knowledge.⁵ It is not obvious that there are verbs expressing mental attitudes that are correlates of modals of possibility and thus would involve not universal, but existential quantification over worlds. Yet, at the same time, it is not obvious that there aren't. For example, there seem to be uses of *think* that function that way; thinking in the sense of taking a possibility into consideration (and so of course for *hypothesize*). Clearly, there are speech act verbs that correspond to modals of possibility. While an act of promising or demanding may result in an obligation, an act of allowing results in a permission and acts of inviting and offering in invitations and offers, modal objects associated with possibility, not necessity.

There is a notorious problem for possible-worlds semantics to account for explicit or heavy permissions, as opposed to implicit or light permissions.⁶ The distinction between the two sorts of permissions is well-reflected in English, in the contrast between simple predicates (*be* + impersonal adjectival passive) as in (10a), which display the light reading (as well as a heavy one), and complex predicates (light verb + nominal), as in (10b, c), which display the heavy reading:

- (10) a. *Mary is permitted to take a walk.*
b. *Mary has the permission to take a walk.*
c. *John gave the permission for Mary to take a walk.*

The possible-worlds-based account would give the same semantics to the two sorts of permission sentences: for a permission sentence such as (10a) or (10c) to be true, the clausal complement would have to be true in *some* world compatible with the agent's obligations. But having a permission means more than that: it means that there was an act whose content is, at least in part, given by the complement clause and whose product, the permission, can be taken up by performing the act described by the complement clause. Moreover, giving or receiving a permission does involve a change, but not in the set of worlds compatible what the agent is obliged to do. Rather it involves a change in a set of options to act that are at the agent's disposal.

A similar issue arises for epistemic modals (and epistemic or doxastic attitude verbs), which arguably display the same sort of distinction between weak and strong readings (Przyjemski 2017).

⁵ Some attitude verbs have been taken to impose an ordering of preference along worlds such as *want, wish, be happy* (Heim 1992).

⁶ See von Wright (1963) for the distinction between heavy and light (or 'explicit' and 'implicit') permissions.

The difference in the predicates in (10a) and in (10b, c) is revealing as to what is going on with light and heavy permission readings. The complex predicates in (10a, b) involve explicit reference to a permission, the product of an act of permission, and the complement clause serves to give the content of that product, as I will argue in the next section. By contrast, (10a) contains a stative predicate *is permitted to* describing a deontic state, rather than the product of an act, and it is that state that the complement relates to. The heavy reading thus will go along with the compositional semantics of complex predicates as in (10a, b), and the light or heavy reading with that of a simple stative predicate. Note that action verbs like *offer* and *invite*, can only serve to describe explicit forms of permission.

2 Clauses as semantic predicates

In order to account for the various problems that arise for the view that clauses act as singular terms standing for propositions, an alternative view has been pursued, namely according to which clauses act semantically as predicates of a content-bearing object that is given by the semantic or pragmatic context (Kratzer 2006, 2016, Moulton 2009, Moltmann 2014, 2017a, b, c).

Let me briefly elaborate a version of the view according to which clauses act as semantic predicates predicated of a content-bearing object, such as a claim, an assumption, a permission, or an obligation (Moltmann 2014, 2017a, b, c). For the present purpose it suffices to assume that a clause acts as a predicate of a content-bearing object by specifying its truth or satisfaction conditions.⁷

A first question to address is: where does the content-bearing object come from of which the clause is predicated? For different kinds of embedded clauses, the content-bearing object may have different sources. For complements of so-called volunteered-stance verbs such as *assume* and *fear*, the object should be closely related to the Davidsonian event argument.⁸ In the case of the verb *fear*, this would be the state of fear that is the event argument of *fear*. Thus, (11a) will have the logical form in (11b):

- (11) a. John fears that S.
 b. $\exists e(\text{fear}(e, j) \ \& \ [S](e))$

⁷ Another way for clausal complements to act as predicates of content-bearing objects is by specifying their structured content or even form, namely when a clausal complement is an indirect and direct quote (Moltmann 2017b).

⁸ See Cattell (1978) for the notion of a volunteered-stance verb as well as that of a response-stance verb. The two sorts of verbs, Cattell argues, behave differently syntactically.

In the case of *assume*, the content-bearing object is more plausibly the product *product(e)* of the act *e* of assuming, the assumption. The assumption is the bearer of representational properties and truth conditions, unlike the act of assuming, which intuitively lacks such properties (Twardowski 1911, Moltmann 2003, 2013, 2014, 2017a). Thus, (12a) will have the logical form in (12b):

- (12) a. John assumes that S.
b. $\exists e(\text{assume}(e, j) \ \& \ [S](\text{product}(e)))$

This analysis straightforwardly accounts for nominal constructions as in (13a), which would be analysed as in (13b), with the *that*-clause acting as a predicate of the referent of the NP:

- (13) a. John's assumption that S
b. $\iota d[\text{assumption}(d, j) \ \& \ [S](d)]$

The nominalization in (13a) is semantically related to the verb in that (13b) is synonymous with $\iota d[\exists e(\text{assume}(e, j) \ \& \ d = \text{product}(e) \ \& \ [S](d))]$.⁹

Not all embedded clauses should lead to a logical form as in (11b) or (12b). Such an analysis is hardly applicable to factive verbs, where the complement more plausibly characterizes a fact (however that may be conceived), in addition to perhaps characterizing the content of a mental state or act. It is also implausible for response-stance verbs such as *agree*, *deny*, *repeat* or *confirm*, where the complement arguably characterizes a contextually given content bearer (a claim, rumor, or suggestion, for example), in addition to characterizing (the product of) the act described by the verb. Thus, (14a) would have the logical form in (14b), where *d* is a suitable contextually given content bearer (Moltmann 2017c).¹⁰

- (14) a. John agreed that S.
b. $\exists e(\text{agree}(e, j) \ \& \ [\textit{that S}](\text{product}(e)) \ \& \ [\textit{that S}](d))$

Also a clause in subject position with a predicate like *is true* arguably gives the content of a contextually given content-bearer (e.g. a claim, rumor, or suggestion) (Moltmann 2015a):

- (15) That S is true.

⁹ There is an issue whether the verb of the nominalization is semantically prior, see Moltmann (2017a).

¹⁰ Kratzer (2016) also proposes such an account for *believe*, which, she argues, behaves syntactically different from verbs like *think* and *assume* regarding its clausal complement.

The general view that clauses act semantically as predicates of content-bearing objects naturally carries over to modals as well. This is most intuitive for deontic modals as in *it is obligatory to do V* and *it is permitted to do V* (Moltmann 2015b, 2017a). (Deontic) modals arguably take as implicit (Davidsonian) arguments entities that I call *modal objects*, entities of the sort of needs, obligations, and permissions. Modal objects may be produced by an illocutionary act (of demanding, promising, or permitting). As such, they have the status of (abstract) artifacts (in the sense of Thomasson 1999), for example as laws or rules. But they need not be the product of an illocutionary act. What is important about modal objects rather are their characteristic properties, most importantly that they come with satisfaction conditions: a need may be satisfied; a promise fulfilled, a permission or offer taken up. The clausal complement of a modal predicate (or the subject clause or prejacent) then serves to give the satisfaction conditions of the modal object that is the implicit argument of the embedding verb. (17a) and (18a) will thus have the logical forms in (17b) and (18b) respectively:

- (16) a. John needs to leave.
 b. $\exists d(\text{need}(d) \ \& \ [\textit{John to leave}](d))$
- (17) a. John is permitted to leave.
 b. $\exists d(\text{permission}(d) \ \& \ [\textit{John to leave}](d))$

How does a clause characterize the content of a content-bearing object, that is, what property of content-bearers does it express? Given possible-worlds semantics, the property below would be the most obvious candidate, a view endorsed by Kratzer (2006, 2016) and Moulton (2009):

- (18) $[S] = \lambda d[\forall w(w \in f(d) \rightarrow S \text{ is true in } w)]$

Here $f(d)$ is the set of worlds compatible with the content of d (or in which the conditions represented by d are fulfilled). f thus represents the modality associated with the content-bearing object d , and various features or elements of the clause S , according to Kratzer, may relate to it.

There is a problem, however, with the possible-worlds-based property in (16), and that is that it could apply only to modal objects of necessity, not of possibility. In application to modal objects of possibility, it would have to stand for the property below, given the standard view of modals of possibility:

- (19) $[S] = \lambda d[\exists w(w \in f(d) \ \& \ S \text{ is true in } w)]$

But then clauses as complements of modal predicates as in (17a) and (18a) would not have a single meaning, but would be ambiguous, depending on the lexical meaning of the embedding predicates. This of course violates compositionality. The very same compositionality problem arises for complements of speech act verbs associated with necessity and with possibility (*demand, request* vs *give the permission, invite, offer*).

In addition to the problem for compositionality, of course, the possible-worlds account is just not applicable to explicit permissions and obligations (and explicit doxastic and epistemic attitudes).¹¹

3 A different approach: clauses expressing truthmaker-based properties

Possible-worlds semantics thus faces serious difficulties with complements of verbs describing explicit attitudes and speech acts, content-bearing objects described by underived nouns, with explicit obligations and permissions. Furthermore, it is unable to provide a single meaning of clauses applicable to embedding predicates (or nouns) associated with different modal forces.

In what follows, I will sketch an alternative to the possible-worlds-based account. It uses situations or actions instead of possible worlds and makes use of the exact truthmaking relation of Fine's recent truthmaker semantics. The advantages of that account will be first that it applies to explicit permissions as well as explicit attitudes and second that it allows for a single meaning of clauses applicable to content-bearing objects associated with different modal forces.

Here is a very brief outline of Fine's (2014, 2017, to appear a, b) truthmaker semantics, which should suffice for the present purposes. Truthmaker semantics involves a domain of situations or actions containing actual, possible, as well as impossible situations and actions. This domain is ordered by a part relation and is closed under fusion. A situation or action s stands in the relation \Vdash of exact truthmaking (or exact satisfaction) to a sentence S just in case s is a truthmaker of S and s is wholly relevant for the truth of S . \Vdash applies to both declarative and imperative sentences: declarative sentences are made true by situations that are their exact truthmakers; imperatives are complied with by actions that are their exact satisfiers.

The following standard conditions on the truthmaking of sentences with conjunctions, disjunctions, and existential quantification then hold:¹²

¹¹ Fine (to appear a, b) gives distinct accounts of deontic modals of possibility and of necessity within truthmaker semantics. This will raise the very same problem for compositionality if clauses are treated as semantic predicates.

¹² The truthmaking condition for sentences with universal quantification and conditionals are less obvious and would require a lot more discussion.

- (20) a. $s \Vdash S \text{ and } S'$ iff for some s' and s'' , $s = \text{sum}(s', s'')$ and $s' \Vdash S$ and $s'' \Vdash S'$.
 b. $s \Vdash S \text{ or } S'$ iff $s \Vdash S$ or $s \Vdash S'$.
 c. For a one-place property P , $s \Vdash \exists x S$ iff $s \Vdash S[x/d]$ for some individual d

Truthmaker semantics assigns sentences not only truthmakers or verifiers, but also falsifiers, situations or actions that are falsemakers of a sentence and wholly relevant for the sentence being false. This allows a straightforward formulation of the truthmaking conditions of negated sentences: a truthmaker for $\neg S$ is a falsifier for S . With $\dashv\vdash$ as the relation of (exact) falsification (or contravention), the condition on the truthmaking of a negated sentence is given below:

- (21) $s \dashv\vdash \text{not } S$ iff $s \dashv\vdash S$

Also complex sentences are assigned both truthmaking and falsemaking conditions. For conjunctions and disjunctions the false-making conditions are those below:

- (22) a. $s \dashv\vdash S \text{ and } S'$ iff $s \dashv\vdash S$ or $s \dashv\vdash S'$
 b. $s \dashv\vdash S \text{ or } S'$ iff for some s' and s'' , $s = \text{sum}(s', s'')$ and $s' \dashv\vdash S$ and $s'' \dashv\vdash S'$

A sentence S has as its meaning a pair $\langle \text{pos}(s), \text{neg}(S) \rangle$ consisting of a *positive denotation*, the set $\text{pos}(S)$ of verifiers of S , and a *negative denotation*, the set $\text{neg}(S)$ of falsifiers of S . In what follows, I will not make use of the positive and negative denotation of a sentence, but just of the meaning of a sentence S as a property of content-bearing objects, namely $[S]$.

We can now turn to formulating the meaning of a sentence as a property of content-bearing objects. First of all, let us note that sentences may underspecify the truth conditions of a modal or attitudinal object. Complement clauses may underspecify an attitudinal or modal object with respect to its satisfaction conditions (as well as, of course, in other respects). One case of such underspecification has recently been discussed by Graff Fara (2013), namely desire reports in which the clausal complement underspecifies the satisfaction conditions of the reported desire, as in Graff Fara's example below:

- (23) Fiona wants to PRO catch a fish.

The desire described by (23) is not simply satisfied in case Fiona catches some fish or other. It is satisfied only when she catches a fish suitable for eating, for example. In a desire report, the clausal complement of the desire verb may give only necessary, not sufficient conditions on the satisfaction of the reported desire.

This is captured by assigning to a sentence S as its meaning the property of modal or attitudinal objects in (24):

$$(24) [S] = \lambda d[\forall s(s \Vdash d \rightarrow \exists s'(s' \Vdash S \ \& \ s < s') \ \& \ \forall s'(s' \Vdash S \rightarrow \exists s(s \Vdash d \ \& \ s < s')))]$$

That is, a sentence S expresses the property that holds of a modal or attitudinal object d just in case every satisfier of d is part of a satisfiers of S and every satisfier of S contains a satisfier of d as part – or in other words, the content of S is a partial content of the content of d (Fine 2017). In (24), \Vdash is the relation of exact truthmaking or satisfaction now holding between situations or actions s and modal or attitudinal objects d as well as sentences.

The relation \Vdash as a relation between situations or actions and modal or attitudinal objects comprises different satisfaction relations reflected in the use of different satisfaction predicates in natural language applicable to modal and attitudinal objects. They include the truthmaking, satisfaction, fulfillment, acceptance, and compliance relation.

(24) cannot yet be adequate, though, since it would not allow distinguishing necessity and possibility semantically. Given (24), a permission (for Mary to enter the house) could be a modal object with the very same satisfaction conditions as an obligation (for Mary to enter the house). But the permission for Mary to enter the house is not an obligation for Mary to enter the house.

What distinguishes a permission from an obligation? Permissions allow for certain actions, those they permit. Obligations allow for certain actions, those that comply with them, but they also exclude certain actions, those that violate them. The permission for Mary to enter the house allows for actions of Mary entering the house, but does not exclude any other actions. By contrast, the obligation for Mary to enter the house allows for actions of Mary entering the house and excludes actions of Mary's not doing so. This means that permissions have only satisfiers, whereas obligations have both satisfiers and violators. Also illocutionary products can be distinguished in terms of having violators or not. An offer or an invitation has only satisfiers, but no violators. By contrast, a request or an order has both satisfiers and violators.

To account for that difference requires modifying (24) by adding a condition on the falsification or violation or the modal or attitudinal object, namely that every falsifier of the sentence also be a falsifier or violator of the modal or attitudinal object (Moltmann 2018). The notion of violation or falsemaking \dashVdash will now be a relation between actions or situations and modal or attitudinal objects or else sentences. The modified meaning of a sentence S then is as follows:

- (25) $[S] = \lambda d[\forall s(s \Vdash d \rightarrow \exists s'(s' \Vdash S \ \& \ s < s') \ \& \ \forall s'(s' \Vdash S \rightarrow \exists s(s \Vdash d \ \& \ s < s')) \ \& \ \forall s(s \Vdash S \rightarrow s \Vdash d, \text{ in case } \text{neg}(d) \neq \emptyset]$

That is, a sentence S expresses the property that holds of a modal or attitudinal object d just in case the content of S is a partial content of d and if every exact falsifier of S is exact falsifier of d , should there be falsifier or violator of d .

On this account, modals of necessity and modals of possibility lead to exactly the same logical form; but they involve different sorts of modal objects with different satisfaction and violation conditions. Thus, (26a) and (26b) will have the logical forms in (27a) and (27b) respectively, involving the very same meaning of the complement clause in (28):

- (26) a. John asked Mary to come to his house.
b. John allowed Mary to come to his house.
- (27) a. $\exists e(\text{ask}(e, j, m) \ \& \ [\text{Mary come to his house}](\text{product}(e)))$
b. $\exists e(\text{allow}(e, j, m) \ \& \ [\text{Mary come to his house}](\text{product}(e)))$
- (28) $[\text{Mary to come to his house}] = \lambda d[\forall s(s \Vdash d \rightarrow \exists s'(s' \Vdash \text{Mary to come to his house} \ \& \ s < s') \ \& \ \forall s'(s' \Vdash \text{Mary to come to his house} \rightarrow \exists s(s \Vdash d \ \& \ s < s')) \ \& \ \forall s(s \Vdash \text{Mary to come to his house} \rightarrow s \Vdash d, \text{ in case } \text{neg}(d) \neq \emptyset]$

Unlike the possible-worlds-based account of attitude verbs and modals, this account applies to explicit permissions and obligations. If the object d to which a clause S applies is a permission, then S will specify which sorts of actions will be exact satisfiers of d ; S will not just say what is true in some world in which d is satisfied. If d is an obligation, then a clause S applying to it will specify what sorts of actions fulfill d and what sorts of actions violate it; S will not just say what is true in all worlds in which d is fulfilled (which may not content-wise relate to the fulfillment of d).

The account is thus tailored to explicit (strong or heavy) permissions and obligations. Would it also account for implicit (weak or light) permissions and obligations? The answer is yes, since these would simply be different modal objects, modal objects that are not products of illocutionary acts, but states (however they may have been set up) that come with a greater range of satisfiers and violators.

4 Another application: harmonic modals

Kratzer (2016) proposes an account of harmonic modals based on a possible-worlds-based property meaning of clauses. She focuses on modals of necessity as in (29a) and proposes that the harmonic modal in the embedded clause spells out

universal quantification over possible worlds that make up the content $f(d)$ of the content-bearing object d , as in (29b):

- (29) a. John requested that Mary should leave.
b. $\lambda d[\forall w(w \in f(d) \rightarrow [Mary\ leave]^w = true)]$

One major problem for this account is that it is inapplicable to modals of possibility, as in (6a-c), repeated below:

- (30) a. John made Mary the offer that she *could* use the house.
b. The document indicates that Bill *might* be guilty.
c. John suggested that Bill *might* be at home.

(31) does not make sense as the meaning of the clauses in (30a-c), with the existential quantifier spelling out the contribution of *could* or *might*:

- (31) $\lambda d[\exists w(w \in f(d) \& [S]^w = true)]$

In (30a), the *that*-clause does not just specify what is the case in some world compatible with the content of the offer, that is, in which John's offer is taken up. Rather it states (at least) what is the case in all the worlds in which the offer is taken up. Similarly in (30b), the *that*-clause does not just say what is the case in some world compatible with what the document indicates, but what is the case in all such worlds, and so for (30c).

In fact, the content of the offer, indication, or suggestion in (30a-c) should not be considered the modal base determining the possible worlds in which the complement clause is to be evaluated. In the case of a light permission the modal base consists in the agent's obligations and not in what he or she is permitted to do. There is no correlate of that, however, for offers, indications, or suggestions. This, again, means that the possible-worlds-based analysis of modals of possibility is just unsuited for 'heavy' content-bearing objects. These include not just explicit permissions, but also offers, suggestions, and indications.

The truthmaker-based semantics of clauses as semantic predicates allows for a straightforward account of harmonic modals, by considering harmonic modals as performative uses of modals in embedded contexts.¹³

The semantics of performative modals will be parallel to that of sentences with a performative use of an illocutionary verb. Sentences with a performative use of an illocutionary verb such as (32a) and (32a) can be assigned as their

¹³ With the performative use of a modal a speaker puts forward a modal state of a affairs described by the sentence. For the notion of a performative use of a modal see Portner (2007).

meaning the properties of illocutionary products in (33a) and (33b), where s is the speaker of the utterance:

- (32) a. I ask you to leave.
b. I allow you to leave.
- (33) a. $\lambda d[\exists e(\text{ask}(e, s) \ \& \ d = \text{product}(e) \ \& \ [(\text{addressee}) \textit{leave}](d))]$
b. $\lambda d[\exists e(\text{allow}(e, s) \ \& \ d = \text{product}(e) \ \& \ [(\text{addressee}) \textit{leave}](d))]$

That is, a performative use of an illocutionary verb leads to the sentence expressing a property meant to hold of the illocutionary product produced by uttering the sentence. Similarly, sentences with a performative use of a modal such as (34b) and (34b) will express properties of modal products meant to be produced by uttering the sentence, as in (35a) and (35b):

- (34) a. You must leave!
b. You may leave!
- (35) a. $\lambda d[\text{must}(d) \ \& \ [(\text{addressee}) \textit{leave}](d)]$
b. $\lambda d[\text{may}(d) \ \& \ [(\text{addressee}) \textit{leave}](d)]$

A modal product can be produced by the very same illocutionary act as an illocutionary product, and it will have the very same satisfaction conditions as the illocutionary product (Moltmann 2017a). Thus, an act of demanding produces a demand as well as possibly an obligation, and an act of permitting produces both a permission in the sense of an illocutionary product and a permission in the sense of a modal product.

With a harmonic modal having the status of a performative use of a modal in an embedded context, (36a) will simply have the logical form in (36c) based on the meaning of the embedded clause in (36b):

- (36) a. John requested that Mary should leave.
b. $[\textit{that Mary should leave}] = \lambda d[\text{should}(d) \ \& \ [\textit{Mary leave}](d)]$
c. $\exists e(\text{request}(e, \text{John}) \ \& \ [\textit{that Mary should leave}](\text{modal-product}(e)))$

Similarly (37a) will have the logical form in (37c), based on (37b):

- (37) a. The document indicates that Bill might be guilty.
b. $[\textit{that Bill might be guilty}] = \lambda d[\text{might}(d) \ \& \ [\textit{Bill be guilty}](d)]$
c. $\exists e(\text{indicate}(e, [\textit{the document}]) \ \& \ [\textit{that Bill might be guilty}](\text{modal-product}(e)))$

Thus, truthmaker semantics combined with an ontology of modal objects permits an account of harmonic modals based on a single truthmaker-based meaning of embedded (and independent) sentences.

5 Summary

There are a range of semantic and syntactic reasons to consider clauses semantic predicates of content-bearing objects. However, possible-worlds semantics turns out to be unsuited for developing that view. In this paper, I have outlined a particular version of truthmaker semantics which allows assigning sentences a single meaning as a property of content-bearing objects of different sorts, including implicit (light) and explicit (heavy) permissions. In addition, this account provides a straightforward analysis of harmonic modals.

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