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Outline of an Object-Based Truthmaker Semantics for Modals and Propositional Attitudes

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Introduction

Possible-worlds semantics certainly is the most common approach to the semantics of modals, and it is also a dominant approach to the semantics of attitude reports, at least in formal semantics in the tradition of Montague (Thomason 1974). While philosophers have discussed problems with possible-worlds semantics for quite some time, possible-worlds semantics continues to have a range of attractive features that have made it persevere as a central tool of analysis in formal semantics. First of all, possible-worlds semantics appears to have the very general advantage of allowing for a unified compositional semantics of intensional and extensional expressions of various sorts, in the tradition of Montague Grammar. In addition, possible-worlds semantics appears to have more specific advantages, such as being a suitable basis for accounting for various sorts of connections between modals and attitude reports, for the way presuppositions are satisfied in attitude reports and in modal sentences, and for how utterances of sentences of different sorts contribute to the discourse context or common ground, which is standardly construed in terms of possible worlds (as set of worlds, a context set) (Stalnaker 1978, 1984, 2002).

The main shortcomings of possible-worlds semantics are well-known and derive from the fact that propositions construed as sets of possible worlds give too coarse-grained a notion of content. Thus, standard possible-worlds semantics does not distinguish the meanings of logically equivalent sentences and fails to account for the intuitive notions of subject matter and of partial content. The need for a more fine-grained notion of content, especially for attitude reports, was the motivation for an alternative, structured conception of content,

replacing sets of worlds by structured propositions, n-tuples of objects or concepts (Cresswell 1985 and others). The structured- propositions view comes with its own problems, however (Jubien 2001, Soames 2010, Hanks 2015, Moltmann 2003, 2013, 2014). For one thing, it raises serious conceptual problems (the unity of propositions problem, the arbitrariness of the order of propositional constituents). Moreover, it is tailored for attitude reports of a certain sort, but not modals, and it is harder to make use of for general semantic purposes, such as compositionality.

A third approach to the semantics of attitude reports makes use of situations rather than entire worlds, an approach that also gives a more fine-grained notion of content, though of a different sort. One recent version of such an approach is truthmaker semantics (Fine 2012, 2014, 2017a, b, c, 2018a, b). Truthmaker semantics is based on the relation of exact truthmaking or satisfaction between a situation or action and a sentence (as well as a corresponding relation of exact falsification or violation). Exact truthmaking holds between a situation and a sentence just in case the situation is wholly relevant for the truth of the sentence. Truthmaker semantics is able to distinguish contents of logically equivalent sentences and gives an immediate account of the notion of subject matter as well as that of partial content. Truthmaker semantics has been applied to a range of semantic and logical topics, including conditionals, intuitionistic logic, and deontic modals, but not attitude verbs and modals in general.

This paper gives an outline of an approach to the semantics of attitude verbs and modals that I call *object-based truthmaker semantics*. Object-based truthmaker semantics carries over the truthmaker semantic notion of content, based on situations or actions in the role of exact truthmaker or satisfiers. However, it applies the truthmaking/satisfaction relation (and the corresponding falsification/violation relation) not just to sentences, but also to a range of objects which I call *modal* and *attitudinal objects*. Modal objects are entities of the sort of obligations, permissions, and needs; attitudinal objects are entities like claims, requests, promises, judgments, decisions, intentions, and desires. Modal and attitudinal objects are the denotation of nominalizations of modal predicates and of attitude verbs. Modal and attitudinal objects, on the present view, are involved in the semantics of attitude reports and modal sentences, rather than propositions. Sentences have truthmaker-based meanings, and thus a propositional content, but such a propositional content does not serve as an argument of predicates and thus does not have the status of an object. The semantics of modal sentences and attitude reports based on modal and attitudinal objects avoids a range of problems for

standard proposition-based approaches, and it allows for a novel account of certain phenomena, such as harmonic modals.

Object-based truthmaker semantics avoids the problems of possible-worlds semantics, yet aims to retain similar advantages, in particular in providing a unified semantics of modals and attitude reports and a way of dealing with the connections between modals and attitude reports.

Object-based truthmaker semantics assigns very different logical forms to attitude reports and modal sentences than the standard views of modals and of attitude reports do. On the standard view of attitude reports, clauses when they are embedded under an attitude verb act as singular terms standing for propositions. The present view is that such clauses act semantically as predicates of the attitudinal object associated with the attitude verb. The standard view is that modal predicates act as quantifiers over possible worlds and that what I will call the *sentential unit* associated with the modal predicate acts as the scope of such a quantifier (complement clause, subject clause, or prejacet). The present view is that the sentential unit semantically acts as a predicate of the relevant modal object. Clauses act as predicates of modal or attitudinal objects by giving their truthmaking or satisfaction conditions.¹

This paper will first give a general outline of object-based truthmaker semantics against the background of the standard semantic view of attitude reports and modals. Second, it will elaborate the ontology of modal and attitudinal objects and motivate their status as bearers of truthmaking or satisfaction conditions. Finally, the paper will apply object-based truthmaker semantics to attitude reports and modal sentences and in particular the semantics of response-stance verbs and factive verbs as well as performative and descriptive uses of modals. The paper will focus on the general picture and not give a more thorough discussion of the syntactic basis of the semantic analyses that are presented or a fully developed compositional semantics.

1. Standard views of propositional attitude and modals

1. 1. The relational analysis of attitude reports and the standard analysis of modals

¹ In this paper, no semantic distinction is made between *that*-clauses, infinitival clauses and the sentential units associated with modals.

The standard analysis of clausal complements of attitude verbs as in (1a) takes them to be terms standing for propositions, which in turn will be arguments of the embedding attitude verb. This is what I call the *Relational Analysis* (Moltmann 2003a, b, 2013), given for (1a) in (1b):

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

Propositions are entities that are generally taken to play three roles: to be the (primary) bearers of truth values, to be the meanings of sentences (or referents of embedded clauses), and to be the contents or ‘objects’ of propositional attitudes.

There are two standard views about the content of propositional attitudes: the possible-worlds view, according to which the content of propositional attitudes consists in a set of worlds, and the structured-propositions view, according to which that content consists in a structured proposition, such as, in a very simple case, a pair consisting of a property and an object.² While there are various difficulties for both views, the second view has gained more popularity among philosophers, whereas the first view is generally adopted by linguists.

The standard view of modals consists in the Quantificational Analysis according to which a modal of necessity as in (2a) has the meaning given in (2b), and a modal of possibility as in (3a) the meaning given in (3b):

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

The contextually given function f maps the world of evaluation w_o to the relevant set of world (the worlds in which all of John’s obligations are fulfilled). 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. Thus, (4a), on that view, has the truth conditions in (4b), where $bel_{w,j}$ is the set of worlds compatible with what John believes in w :

² Stalnaker (1984) is a representative of the possible-worlds view. Cresswell (1985) of the structured-propositions view.

(4) a. John believes that S

b. $\forall w' (w' \in \text{bel}_{w,j} \rightarrow [S]^{w'} = \text{true})$

(4b) can be reformulated straightforwardly in terms of the relational analysis, making use of a proposition p (the set of worlds in which the sentence S is true) as an argument of the attitude verb:

(5) $\text{believe}(J, p)$ iff $\forall w' (w' \in \text{bel}_{w,j} \rightarrow w' \in p)$.

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.³ But there are also verbs expressing mental attitudes that are correlates of modals of possibility and would involve not universal, but existential quantification over worlds, for example *suppose* and *hypothesize* as well as certain uses of *think* (thinking in the sense of taking a possibility into consideration). Among speech act predicates, examples are predicates describing acts of giving permission, acts of inviting, or acts offering: permissions, invitations, and offers are attitudinal objects associated with possibility, not necessity.

2. The attraction of the possible-worlds view of modals and propositional attitudes

The possible-worlds account of content is most plausible for implicit attitudes, such as implicit beliefs, including those of animals and small children, which can hardly involve any form of structured mental representation. In fact, it has been argued that such attitudes are ascribed on the basis of how an agent would act in counterfactual circumstances (possible worlds) (Stalnaker 1984). For implicit attitudes only the agent's dispositions regarding particular circumstances matter, not the structure of a mental representation. The possible-worlds account of content is much less plausible for other attitudes, though, such as occurrent thought, or generally mental or illocutionary acts, which involve a more finely grained content.

³ Some attitude verbs have been considered imposing an ordering of preference along worlds such as *want*, *wish*, *be happy* (Heim 1992).

Possible-worlds semantics, however, has been attractive to formal semanticists for other reasons. First, possible-worlds semantics, it appears, allows for a unified compositional semantics of the sentential units (clausal complements or subjects or prejacent) associated with both attitudinal and modal predicates. Sentential units on that view always stand for sets of possible worlds, which are obtained compositionally from possible-world-based meanings of subsentential expressions.

Possible worlds have also played an important role for representing the common ground. The common ground is generally conceived as an unstructured content of what the interlocutors take for granted, as a set of worlds or context set. The common ground plays a central role in theories of presuppositions, in the so-called the satisfaction theory of presupposition projection (Heim 1983). On the satisfaction theory, the presuppositions of a sentence *S* need to be true in the worlds of the common ground *C* (a set of worlds) in order for *C* to be updated with the proposition *p* expressed by *S* (a set of worlds) with *C* (which means intersecting *p* with *C*). Complex sentences such as conjunctions and conditionals involve complex conditions on updating. Updating a context set *C* with the utterance of a conjunction *S* & *S'* consist in first intersecting *C* with the proposition expressed by *S* and then intersecting the result with the proposition expressed by *S'*.

In addition to the primary context set representing what is shared by the interlocutors, the common ground, various *secondary context sets* need to be distinguished, representing what the interlocutors take the content of a particular type of attitude of a particular agent to be. Thus, in a sequence *John believes that it is raining. He believes that it will stop soon*, the presupposition of *it will stop soon* needs to be true not in the worlds in the primary context set, but in the worlds compatible with what the interlocutors take to be John's beliefs. The latter make up just one secondary context. Another secondary context may represent John's fears, and yet another Bill's beliefs.

Further additions to the context set (or the context sets) are needed in order to account for updating with questions as well as with imperatives and performatively used deontic modals, that is, modals that put a requirement in place, rather than describing it, as on one reading of (6) below:⁴

(6) You must leave.

⁴ For more on the notion of a performative use of a modal see Portner (2007).

Thus, Portner (2004) proposes to augment the common ground with a set of issues (sets of propositions) for updating with questions, as well as a *to do*-list (a set of properties or action types) for updating with imperatives and performatively used deontic modals (or several such lists, cf. Portner 20007).

There are also particular connections among propositional attitudes and modals. I will focus on just two. One of them consists in that attitude or illocutionary act reports may permit particular inferences to modal sentences such as the inferences below:

(7) a. John asked Mary to leave.

Mary must leave.

b. John offered Mary to use the house.

Mary may use the house.

For (7a) to be felicitous, John must have the right authority to set up an obligation by issuing a request.

Another connection between attitude reports and modals is certain occurrences of modals in embedded exhibiting modal concord, ‘harmonic modals’, as Kratzer (2016) calls them. Harmonic modals are occurrences of modals in the complement clause of an attitude verb that appear to resume the modal force associated with the reported attitude rather than contributing to a modal content of that attitude:

(8) John insisted that Mary should leave.

The harmonic use of the modal *should* in (8) matches the subjunctive mood in (9a) and contrasts with the non-harmonic use of *must* in (9b):

(9) a. John insisted that Mary leave.

b. John reported that Mary must leave.

Again, possible-worlds semantics appears to be suited to capture this sort of connection between modals and propositional attitudes given that attitude verbs are basically treated as

modal operators ranging over worlds and thus may range over the same worlds as a modal (Section 4.2.).⁵

3. The structured-propositions view and verbs of saying

Structured propositions have been proposed as an alternative to propositions as sets of worlds since they give a more fine-grained notion of content. A structured proposition is generally conceived of as an n-tuple consisting of meanings of elementary constituents. Thus, a simple type of structured proposition, as the meaning of the subject-predicate sentence *Mary is happy*, would be a pair consisting of a property (the property of being happy) and an object (Mary). With structured propositions as their meanings, two sentences that are logically equivalent, but involve significantly different syntactic structures, are distinguished, as are sentences that about different objects or involve different properties. Though structured proposition appear more suited than sets of worlds for the content of propositional attitudes, structured propositions come with conceptual problems of their own, especially the problem of the unity of propositions: truth conditions for structured propositions need to be stipulated, and are not inherent in the nature of structured propositions as such (Jubien 2001, Moltmann 2003b, 2014, Soames 2010, Hanks 2011). Moreover, the structured-propositions view imposes a fineness of grain that is not generally considered needed for the semantics of modals, and even perhaps the semantics of various sorts of implicit attitudes, and sometimes even for explicit attitudes. For example, the distinction between an active and a passive sentence should not generally lead to a difference in the content of reported attitudes (John's belief that Mary greeted Sue is not necessarily distinct from John's belief that Sue was greeted by Mary). Furthermore, if the objects of attitudes are construed as structured propositions, attitudes would lose their similarity to modals, which means that connections between attitudes and modals would be harder to account for.

Yet, it appears that for certain sorts of attitude reports a highly fine-grained, structured notion of content is unavoidable, especially reports with verbs of saying (including (occurrent) *think*, Moltmann 2017b). The sensitivity of reports of acts of saying to syntactic structure and perhaps even choice of words can be enforced by the use of *literally* as below:

⁵ There are other sorts of connections between attitude reports and modals that have been discussed in the literature, for example the interpretation of epistemic modals in complement clauses of attitude reports (Pranav/Hacquard 2013).

(10) John literally said that S.

However, if for verbs of saying, the particular choice of words as well as the syntactic structure of the complement clause may matter, this should not so much motivate a particular conception of sentence meaning as such (structured propositions as opposed to sets of worlds). Rather it motivates a view according to which the complement of verbs of saying contributes differently to the characterization of the reported attitude than the complement of other attitude verbs, namely by specifying the structure of the product of a locutionary act, rather than just providing a propositional content (or the truth or satisfaction conditions of the reported attitudinal object) (Moltmann 2017b). In what follows, therefore I will set aside verbs of saying, as they arguably involve a rather different overall semantics than other attitude verbs.

4. Truthmaker semantics

Truthmaker semantics, as recently developed by Fine (2017a, b, 2018a, b), gives a notion of content that is more fine-grained than that of possible-worlds semantics, but yet not as fine-grained as that of the structured-propositions view. In particular, content is not taken to reflect syntactic structure in the way structured propositions do. The following is a very brief outline of Fine's truthmaker semantics, which should suffice for the present purposes.

Truthmaker semantics is based situations and actions (rather than entire worlds), as well as the relation of exact truthmaking or satisfaction holding between situations or actions and sentences. 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 wholly relevant for the truth (or satisfaction) of S . This means that s should not, so to speak, contain any 'information' that does not bear on the truth (or satisfaction) of S . The use of the notion of exact truthmaking older situation-based semantics approaches such as that of Barwise / Perry (1983) and Kratzer (2014) and is defended in Fine (2017a).⁶ A situation or action s is an falsifier (or violator) of a sentence S just in case S is whole relevant for the falsity (or violation) of S .

Situations are taken to be parts of worlds, and no further assumptions are made regarding their ontology beyond the roles they play within truthmaker semantics. Actions are a specific kind of situation, those that may comply with or violate sentences, rather than making them

⁶ The relation of exact truth making to the notion of verification (inexact truthmaking) used in Barwise/Perry (1983) and Kratzer (2014) is discussed in detail in Fine (2017).

true. The domain of situations divides into actual, possible as well as impossible situations. Actual situations are part of the actual world; impossible situations are part of impossible worlds and would be truthmakers of contradictory sentences. The domain of situations is ordered by a part relation and is closed under fusion.

The truthmaking / satisfaction relation \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, where \oplus is the operation of fusion:⁷

- (11) a. $s \Vdash S \text{ and } S'$ iff for some s' and s'' , $s = s' \oplus s''$ 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 satisfiers, but also falsifiers or violators. Making use of the relation of (exact) falsification or violation allows a straightforward formulation of the truthmaking conditions of negative sentences: a truthmaker for $\neg S$ is a falsifier for S . With \nVdash as the relation of (exact) falsification or violation, the condition on negation is given below:

- (12) $s \nVdash \text{not } S$ iff $s \Vdash S$

Also complex sentences are assigned both verification and falsification conditions. For conjunctions and disjunctions, the falsification conditions are those below:

- (13) a. $s \nVdash S \text{ and } S'$ iff $s \nVdash S$ or $s \nVdash S'$
 b. $s \nVdash S \text{ or } S'$ iff for some s' and s'' , $s = s' \oplus s''$ and $s' \nVdash S$ and $s'' \nVdash S'$

A sentence S then 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

⁷ The truthmaking condition for sentences with universal quantification and conditionals are less obvious and would require a lot more exposition.

falsifiers of *S*.

In truthmaker semantics, logically equivalent sentences have different semantic values as long as they are about different things. Truthmaker semantics provides a straightforward account of the notion of subject matter of a sentence, namely as the fusion of its truthmakers or satisfiers. In truthmaker semantics, the contents of sentences thus are considerably more fine-grained than in possible-worlds semantics, which does not provide a notion of subject matter if sentence meanings are just taken to be sets of worlds (Yablo 2015). Truthmaker semantics, moreover, provides a straightforward account of the notion of partial content (Yablo 2015, Fine 2017a):

- (14) For sets of situations or actions *A* and *B*, *B* is a *partial content* of *A* iff every satisfier of *A* contains a satisfier of *B* and every satisfier of *B* is contained in a satisfier of *A*.

The notion of partial content is extremely well-reflected in the way we talk about content, including the contents of modal and attitudinal objects: *part of the content of this sentence*, *part of John's belief*, *part of John's obligation* all stand for a partial content (of a belief, a sentence and a modal object). It is also reflected in the adverb partly when modifying attitude verbs (Section 9).

Truthmaker semantics as developed by Fine assigns content only to sentences and has not been developed so as to allow for an application to attitude reports and modals in general.⁸ An obvious way in which one might try to apply truthmaker semantics to attitude reports would be to take the truth-maker-based meanings of sentences to be the arguments of the attitudinal relation. This means (15a) would have the logical form in (15b):

- (15) a. John believes that *S*.
 b. believe(John, <pos(*S*), neg(*S*)>)

However, there are reasons why such an analysis would be unsatisfactory. One reason is that it could hardly be used to account for the connections between modals and attitude reports. Another reason is that (15b) would fall under the Relational Analysis of attitude reports,

⁸⁸ Fine (2018 a, b) applies truthmaker semantics to deontic modality focusing on logical, rather than linguistic aspects.

which is associated with a range of philosophical and linguistic difficulties, as will be discussed in the next section.

3. Problems for the Relational Analysis of attitude reports and the importance of modal and attitudinal objects

The Relational Analysis on which attitude verbs take propositions as arguments is compatible with a more or less fine-grained notions of content: a proposition may be construed as a set of worlds or as a structured propositions of some sort. There are a range of philosophical and linguistic difficulties, however, for the Relational Analysis.⁹ I will just mention them briefly, since they are elaborated elsewhere in the literature and my own previous work.

[1] The Relational Analysis 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 that agents engage in (Moltmann 2018).

[2] Abstract propositions raise a number of conceptual problems, which are a major topic of discussion in contemporary philosophy of language and include the problem of the graspability of propositions, the problem of the unity of the proposition, and the problem of how propositions as abstract objects can be true or false (Jublien 2001, Soames 2010, Hanks 2015, Moltmann 2014, 2017).

[3] The Relational Analysis has difficulty accounting for the Substitution Problem, the problem of the unacceptability of (16b) as an inference from (16a), and the Objectivization Effect, the difference in the understanding between (17a) and (17b) (Moltmann 2003b, 2013):

(16) a. John assumed that S.

b. ?? John assumed the proposition that S.

(17) a. John fears that S.

b. John fears the proposition that S.

[4] The Relational Analysis has difficulties accounting for the semantics of nominal constructions (Moulton 2009):

(18) John's request that S

⁹ See Moltmann (2003b, 2013 chap 4, 2014) and reference therein.

Semantically, the *that*-clause in (18) seems to stand for what the entire NP stands for (a request), rather than providing an object entering a thematic relation to the noun *request*. Yet, the clausal complement would stand for a proposition and a proposition is not the same thing as a request. For example, a request can be fulfilled or ignored, but a proposition cannot (at least not in the same sense) (See Section 5.3.).¹⁰

[5] The Relational Analysis does not get the semantics of what I call *special quantifiers* right (Moltmann 2003a, b, 2013). Special quantifiers (and pronouns), which include *something*, *everything*, *that*, and *what*, can take the position of clausal complements of attitude verbs. In that position, given the Relational Analysis, they should stand for propositions, but in fact they can only stand for attitudinal objects or kinds of them (Moltmann 2003a, b, 2013, 2014, 2017a, to appear).

5. The ontology of modal and attitudinal objects

Object-based truthmaker semantics pursues an alternative to the propositions-based Relational Analysis of attitude reports as well as to the Quantificational Analysis of modal sentences. Besides its use of truthmaker semantics, its most important feature is a novel ontology of attitudinal and modal objects

Attitudinal and modal objects are part of the ontology implicit in natural language: they are referents of NPs with nominalizations of attitude or modals (*John's belief that S*, *Mary's claim that S*, *John's obligation to VP*) and they act as semantic values of special quantifiers and pronouns and as implicit arguments of predicates. The characteristic properties of attitudinal and modal objects are reflected in the semantics of those constructions, in addition to various language-independent intuitions we have about them.

Kinds of attitudinal and modal objects also play an important role. They act as referents of NPs of the sort *the belief that S*, *the claim that S*, *the obligation to do X* as well as semantic values of special quantifiers and pronouns. Two particular attitudinal objects (of the same sort) belong to the same kind just in case they are exactly or closely similar ('are the same'),

¹⁰ 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). Others have argued against such assimilation (de Cuba 2017). The present view that clauses asemantically act as predicates, would go along well with the view that clausal complements of nouns, and even verbs, are relative clauses, but 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. Note that 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.

which means they are the same in content. If John's belief is the same as Mary's belief, John and Mary share a belief, and if John's claim is the same as Mary's, they made the same claim. Sharing a content thus means either engaging in attitudinal objects that are closely similar or engaging in the same kind of attitudinal object.

Attitudinal objects are distinct from the more familiar ontological categories of actions and states. Attitudinal objects share characteristic properties that jointly distinguish them from actions (and states) and propositions, and in particular, they display properties that could hold neither of actions (and states) nor of propositions (which I will turn to shortly). Attitudinal objects however, divide into *act-related attitudinal objects*, which include judgments, decisions, claims, requests, promises, and *state-related attitudinal objects* such as beliefs, intentions, desires, and fears. Some attitudinal objects are products of acts in the sense of Twardowski's (1911) distinction between actions and products, artifacts that lack a material realization or, in the case of decisions, a physical realization, 'abstract' artifacts in Thomasson's (1999) sense (Moltmann 2014, 2017a). Thus, a claim is the (illocutionary) product of an act of claiming, a promise the (illocutionary) product of an act of promising, and a judgment the (cognitive) product of an act of judging. Attitudinal objects that are products of acts need not last longer than the act that produced them (Section 5.1.).

Modal objects may be products of illocutionary acts, but need not be. Heavy permissions and heavy obligations are generally the products of illocutionary acts, but not so for light permissions and obligations.¹¹ Modal objects share the characteristic properties of attitudinal objects (and in particular are sharply distinguished from states). But they can last longer than the act that produced them – and in fact they need not have come into existence at a particular point in time in the first place.

5.1. Properties of concreteness

Attitudinal objects are concrete content bearers and as such play a central role in our mental life as well as in communication. Their characteristic properties thus divide into properties of concreteness and content-related properties. These are some of their properties of concreteness.

First of all, attitudinal objects are involved in various forms of content-based causation. Thus, causal predicates naturally apply to attitudinal objects and then convey content-based causation but not so when they apply to the corresponding actions (Moltmann 2013a 2014, 2017a). Thus, *Mary's claim caused excitement* means that the content (conveyed by

¹¹ See Wright (1963) and Fine (2018a, b) for the distinction between heavy and light permissions.

Mary) was causally responsible, but not so for *Mary's speech act caused excitement*. Mary's request may cause anxiety in virtue of its content, but not so for Mary's act of requesting. Propositions as abstract objects, on the standard understanding, cannot play causal roles. Some attitudinal objects, for example remarks and claims, can be heard and thus be objects of perception.

Attitudinal objects also act as the targets of content-related memory. We remember thoughts, beliefs, decisions and intentions, rather than propositions. We may remember facts, which are not attitudinal objects. However, facts may be conceived as modal objects (Section 9), which, though less concrete than attitudinal objects, are entities of the very same sort.

Attitudinal objects have other properties of concreteness. Attitudinal objects generally having a limited life span. Mary's belief that S comes into existence only once Mary believes that S and ceases to exist once Mary no longer believes that S. Twardowski (1911) took products to share their lifespan with the acts that produce them. However, this does not seem correct for products such as claims and promises, which have a modal character that permits them to last beyond the illocutionary act that produced them. Modal objects generally endure past the act that may have created them, for example permissions and obligations that result from particular illocutionary acts. But modal objects need not have been created in the first place (for example those that represent universal ethical laws).

5.2. Content-related properties

Modal and attitudinal objects have three characteristic content-related types of properties, none of which pertain to states and actions.

[1] Truth or satisfaction conditions

Attitudinal objects such as claims, judgments, and beliefs have truth conditions, but not so for their correlated states or actions. John's claim or judgment may be true or false, as may be John's belief. But a speech act cannot intuitively be true or false, and neither can an act of judging. Also a mental state described as such (a belief state) cannot intuitively be true or false. Other attitudinal objects do not have truth conditions, but rather satisfaction conditions and thus can be satisfied, fulfilled, implemented, or realized. This also holds for modal objects: obligations and needs can be fulfilled or satisfied, permissions and offers taken up.

[2] Similarity relations based on sameness of content

Attitudinal objects that are of the same sort (involving the same kind of physical realization and force) enter similarity relations (conveyed by *is the same as*) just on the basis of a shared

content. Thus, *John's thought is the same as Mary's* is true just in case their thoughts share their content. *Is the same as* does not apply in that way to actions: for two actions to be the same they need to share features of their performance; sameness of content will not be enough. For *John's thinking is the same as Mary's* to be true, sharing of content is not enough, rather their way of thinking need to be similar. Also attitudinal objects enter similarity relations just on the basis of shared types of satisfaction conditions: *John's obligation is the same as Mary's* is true just in case the obligations are satisfied and violated by the same types of actions.

[3] Part structure strictly based on partial content

This property is best reflected in the way *part of* is understood when applying to a modal or attitudinal object (Moltmann 2013, Chap. 4, 2014, 2017a). *Part of John's need* can only pick out a partial content of the need, not the temporal part of a state. 'Part of John's decision' cannot be 'part of the action of deciding', the temporal part of an action. 'Part of John's claim' cannot be 'part of the speech act of claiming'. Similarly, 'part of John's belief' and 'part of John's hope' can only be partial contents, not what is normally considered the parts of a state (temporal parts).

It is remarkable that even physically realized attitudinal objects (e.g. claims) fail to have a physical part structure. They differ in that respect from physically realized artifacts like books or letters, which have content-based and material part structures. Given standard ontological assumptions, the lack of a physical and a temporal part structure of attitudinal objects is a serious puzzle. However, it appears that there are various types of physical objects that are attributively limited in the sense of lacking expected property specifications. Thus ontologically dependent objects such as wholes, folds, and tropes lack an object-independent spatial location (Moltmann 2019b). Moreover, as is more familiar, material objects have parts only in space, not in time (temporal stages), according to general and linguistically reflected intuitions. Various sorts of objects may exhibit such 'attributive limitations', an issue in descriptive metaphysics that needs to be much further explored (Moltmann 2019b).

5.3. Predicates of satisfaction

Attitudinal and modal objects generally have truth conditions, or rather, more generally, satisfaction conditions. This is reflected in the great range of predicates of satisfaction that can apply to attitudinal and modal objects (*was satisfied, was fulfilled, was executed, was followed, was broken, was complied with*). The applicability of such predicates sharply

distinguishes attitudinal and modal objects both from sentences, propositions and ‘mental representations’ and from actions. Four types of satisfaction predicates can be distinguished (Moltmann 2018b):

[1] Truth predicates: *true, correct,*

[2] Predicates of fulfillment and violation: *fulfill, satisfy, follow, violate, and ignore*

[3] Predicates of acceptance: *accept, take up*

[4] Predicates of realization: *realize, execute, implement*

The four classes of satisfaction predicates select different types of attitudinal objects. Truth predicates apply to attitudinal objects such as beliefs, claims, and judgments, but hardly to events and states:

(19) a. The claim / belief / judgment is true.

b. ??? The speech act / belief state / act of judging is true.

Truth predicates apply to attitudinal objects with a word-world direction of fit, to use Searle’s (1969, 1983) term (Moltmann 2018b).

Predicates of fulfillment and violation such as *satisfy, fulfil, follow, comply with, keep, break, and violate* apply to various attitudinal objects, such as requests, demands, and promises, as well as to modal objects of the sort of obligations and needs. These are attitudinal objects with a world-word/mind direction of fit in Searle’s (1969, 1983) sense, associated with modal force of necessity (Moltmann 2018b). Predicates of fulfillment and violation, apply neither to actions nor to propositions, as the predicates *keep* and *break* illustrate in a particularly striking way:¹²

(20) a. John kept / broke his promise.

b. ??? John kept / broke the proposition that S.

c. ??? John kept / broke the act of promising / the speech act.

Attitudinal objects associated with the modal force of possibility such as offers and invitations do not accept predicates of fulfillment, but rather go with predicates of acceptance, such as *take up* and *accept*.

¹² The observation about satisfaction predicates when applied to nominalizations of illocutionary verbs was made by Ulrich (1979). Twardowski (1911) made the point with different sorts of attitudinal objects.

Attitudinal objects of the sort of intentions and decisions do not go with predicates of fulfilment, violation or acceptance, but rather predicates of realization such as *realize*, *implement*, or *execute*. Those predicates do not apply to the corresponding states: states of intending or acts of deciding cannot be realized or executed.

Different types of satisfaction predicates thus select different types of modal and attitudinal objects. An account of that selection is given in Moltmann (2018b), based on truthmaker theory and a normative construal of the notion of a direction of fit

Representational properties (satisfaction conditions) are characteristic of all attitudinal and modal objects, including those that do not result from acts, such as state-like attitudinal objects (intentions, beliefs, desires, fears), and light permissions or obligations. This means that the representational ability of modal and attitudinal objects should not be traced to the intentional act that may have created them. Rather it is better regarded as a primitive feature of mind-dependent entities (attitudinal objects).¹³

6. Motivations for object-based truthmaker semantics

There are a range of specific motivations for the use of modal and attitudinal objects in connection with truthmaker semantics. I will mention five of them.

6.1. Avoiding propositions

Object-based truthmaker semantics allows dispensing with abstract propositions and thus avoids the sorts of problems associated with them (Section 3). On the present view, sentences embedded under attitude verbs act as predicates of attitudinal objects specifying their satisfaction conditions. Propositions then longer play a role as entities, as referents of *that*-clauses and as arguments of attitudinal relations. They play a role only in the sense of being propositional contents of sentences, that is, as truthmaker-based meanings.

6.2. Extending truthmaker semantics to the mental

Object-based truthmaker semantics accounts for the representational ability of the mental as well. In object-based truthmaker semantics, truthmaking applies to both sentences and

¹³ In that respect, the theory of attitudinal objects differs from the act-based conceptions of propositions of Soames (2010) and Hanks (2015).

attitudinal objects, which allows linking truthmaker semantics to the intentionality of the mind. Attitudinal objects such as intentions and decisions come with inherent satisfaction or realization conditions, and are satisfied or realized not by worlds or world states, but rather by actions.¹⁴

6.3. The dependency of truthmakers on particular attitudinal objects

Object-based truthmaker semantics accounts for the fact that it may depend on the particular attitudinal or modal object what the satisfiers in question are. Thus, Searle (1983) has pointed out that intentions and requests do not take just actions as satisfiers, but rather actions ‘by way of’ realizing or fulfilling the intention or request, that is, actions with a particular gloss that makes reference to the intention or request itself. Thus, to use Searle’s example, doing something that accidentally kills my neighbor is not an action that fulfills my intention to kill my neighbor, rather only an action with the intention of doing so is. Other attitudinal or modal objects (hopes, beliefs, or epistemic modal objects, for example) do not require their satisfiers or truth makers to be of that sort.

6.4. The distinction between heavy and light permission

The distinction between heavy and light permissions shows a particular way in which truthmakers may depend on the type of modal object, which is elaborated in Moltmann (2018). Briefly, given object-based truthmaker semantics, heavy and light permissions are two different types of objects. Heavy permissions generally are the products of particular acts of permitting, whereas light permissions are states of what is explicitly or implicitly permitted. Heavy permissions have different satisfaction conditions from light permissions. Heavy permissions have as satisfiers only actions meeting what is explicitly permitted, whereas light permissions have as satisfiers also actions that are just not in violation of what is obligatory. Such actions are in that sense implicitly permitted. It thus depends on the type of modal object in question what actions count as satisfiers.

The distinction between the two sorts of permissions is well-reflected English, in the contrast between simple predicates (*be* + impersonal adjectival passive) as in (21a), which

¹⁴ In fact, a rudimentary truthmaker semantics for mental states and products has been put forward by Searle (1983), for whom intentions and decisions (which come with a world-word/mind direction of fit) have actions as satisfiers, and beliefs, judgments, desires etc. have states of affairs as truthmakers or satisfiers.

display the light reading (as well as a heavy one), and complex predicates (light verb + nominal), as in (21b), which displays the heavy reading:

- (21) a. Mary *is permitted to* take a walk.
 b. Mary *has permission 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 (21b) to be true, the clausal complement would have to be true in *some* world compatible with the obligations of the relevant agent. 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 with 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. The complex predicate *has permission* in (21b) involves explicit reference to a permission, the product of an act of permitting, and the complement clause serves to give the content of that product. By contrast, (21a) contains a stative predicate *is permitted* 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 (21b), and the light reading with that of a simple stative predicate as in (21a).¹⁵

6.5. The underspecification of content by the complement clause

Another important advantage of object-based truthmaker semantics concerns the possibility of underspecification of the content of certain types of attitudinal or modal objects by the complement clause or associated sentential unit. One case that has been discussed in the literature is the underspecification of a desire as in the desire report below (Fara Graff 2014):

¹⁵ Also propositional attitudes display such contrasts:

- (i) a. John *thought* that S.
 b. John *had the thought* that S.
 (ii) a. John *assumed* that S.
 b. John *made the assumption* that S.

Whereas (ia) and (iia) may just describe dispositional states of John, (ib) and (iib) describe actions leading to cognitive products.

(22) Fiona wants to catch a fish.

Fiona's desire, according to (22) is not satisfied if she catches any fish whatsoever, but, most likely, only a fish she can eat. Note that the speaker uttering (22) need not know what the exact constraints are that Fiona's desire may impose on what satisfies it.

Also certain types of modals allow for this sort of underspecification, in particular teleological and deontic modals as below:

- (23) a. Fiona needs to catch a fish (in order to have something for dinner).
 b. John needs to write a letter (and therefore cannot be disturbed).

The need reported in (23a, b) may exhibit the very same underspecification as the desire reported in (22). The speaker need not know about the particular conditions imposed on the satisfaction of the need, the kind of fish Fiona needs to catch in (23a) and the sort of letter John has to write in (23b).

The underspecification of desire reports constitutes a serious problem for the standard view according to which the clausal complement of an attitude verb gives the full truth or satisfaction conditions for the reported attitude (Fara Graff 2014). By contrast, it is unproblematic for the present analysis of attitude reports within object-based truthmaker semantics. The underspecification exhibited in (22) as well as in (23a, b) simply means that what the satisfiers in question are depends on the particular attitudinal or modal object in question, not the sentence used to characterize it (which may give only necessary, not sufficient conditions for its satisfaction). That is, the reported desire or need itself may come with constraints as to what will satisfy it, constraints that may be given only partially by the complement clause (or sentential unit).¹⁶

¹⁶ It is not clear whether all attitudes and modals permit such underspecification. There are intuitions according to which with *claim* and *believe*, the clausal complement must give the full truth conditions of the reported belief or claim (possibly together with particular 'unarticulated constituents', which have to be part of the speaker's intended meaning):

- (i) a. John believes that Fiona caught a fish.
 b. John claimed that Fiona caught a fish.

(ia,b) tend to be understood such that John's belief or claim is true just in case Fiona catches any fish whatsoever (at the relevant time). The belief or claim could not be false, say, because Fiona caught a dead fish. Such intuitions also seem to obtain for epistemic modals:

7. Sentences as predicates of modal and attitudinal objects

We can now turn to the formal semantics of clauses as predicates of content bearers (attitudinal or modal objects), specifying their truth or satisfaction conditions. For the semantics of attitude reports, I will make use of Davidsonian event semantics (Davidson 1967). Davidsonian event arguments of an attitude verb will be the events, acts or states described by the attitude verb. I will assume, certainly simplifying, that there is a unique attitudinal object *att-obj*(*e*) associated with a Davidsonian event argument *e* of an attitude verb. The clausal complement of the attitude verb will then be predicated of the attitudinal object associated with the event argument as below:

(24) a. John claimed that S.

b. $\exists e(\text{claim}(e, \text{John}) \ \& \ [\text{that S}](\text{att-obj}(e)))$

The semantics of attitude reports in (24b) is (almost) overtly reflected in the corresponding complex-predicate construction in (25), which involves explicit reference to an attitudinal object (or a kind of attitudinal object):¹⁷

(25) John made the claim that S.

Clausal modifiers of nominalizations of attitude verbs will act as predicates of the attitudinal object described by the nominalization, as in (26b) for (26a):

(26) a. John's claim that S

(ii) Fiona must have caught a fish.

There is an intuition on which the epistemic state reported in (ii) is correct just in case Fiona caught some fish or another, not just in case she catches a suitable one.

What distinguishes the latter attitude verbs and modals from the former (which clearly allow for underspecification) is that they have truth conditions rather than fulfillment conditions. Fulfillment and truth conditions go along with different directions of fit, to use Searle's (1969, 1983) term. Desires (and deontic or teleological modal objects) have a world-word/mind direction of fit, whereas claims and beliefs (and epistemic modal objects) have a word/mind world direction of fit (Moltmann 2018). The challenge then is to explain why a particular direction of fit does not permit the relevant sort of underspecification, something which I will leave for future research.

¹⁷ In fact, languages tend to show an alternation between the simple and the complex-predicate construction, which further motivates the semantics in (31b) (Moltmann 2017a, 2018a).

b. $\text{id}[\text{claim}(d, \text{John}) \ \& \ [S](d)]$

What is the property that sentences as predicates of modal or attitudinal object express? In the case of modal and attitudinal objects with a world-word/mind direction of fit, the clause will give a partial specification of satisfaction conditions. This means that it would express the given property below, where \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):

$$(27) [S] = \lambda d[\forall s(s \Vdash d \rightarrow \exists s'(s' \Vdash S \ \& \ s < s')) \ \& \ \forall s'(s' \Vdash S \rightarrow \exists s(s \Vdash d \ \& \ s < s'))]$$

According to (27), 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 satisfier of S and every satisfier of S contains a satisfier of d as part, which just means that the content of S is a partial content of the content of d (Yablo 2015, Fine 2017a).

(27) cannot yet be adequate, though, since it would not allow distinguishing necessity and possibility semantically. Given (34), 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 are distinguished in that way. An offer or an invitation has only satisfiers, but no violators. By contrast, a request or an order has both satisfiers and violators.

This difference between modal forces requires modifying (27) by adding a condition on the falsification or violation of the modal or attitudinal object, namely that every falsifier of the sentence also be a falsifier or violator of the modal or attitudinal object. The modified

meaning of a sentence S then is as follows, where the relation of falsification or violation \Vdash now also obtains between actions or situations and modal or attitudinal objects (Moltmann 2018a):

$$(28) [S] = \lambda d[\forall s(s \Vdash d \rightarrow \exists s'(s' \Vdash S \ \& \ s < s')) \ \& \ \forall s'(s' \Vdash S \rightarrow \exists s(s \Vdash d \ \& \ s < s')) \ \& \ (\text{neg}(d) \neq \emptyset) \rightarrow \forall s(s \Vdash S \rightarrow s \Vdash d)]$$

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 every falsifier of S is a violator of d , should there be a violator of d .

On this account, sentences conveying necessity and sentences conveying possibility will have exactly the same logical form; but they involve different sorts of modal or attitudinal objects with different satisfaction and violation conditions. This is given for (29a) and (29b) in (30a) and (30b) respectively, based on the same meaning of the complement clause (which is, syntactically simplified, taken to be *Mary to leave*):

(29) a. John asked Mary to leave the house.

b. John allowed Mary to leave the house.

(37) a. $\exists e(\text{ask}(e, j, m) \ \& \ [Mary \ leave \ the \ house](att\text{-}obj(e)))$

b. $\exists e(\text{allow}(e, j, m) \ \& \ [Mary \ leave \ the \ house](att\text{-}obj(e)))$

Similarly, modal sentences involve predication of the sentential unit associated with the modal predicate of the modal object. Taking the modal object to be the event argument itself, (38a) and (39a) will then have the logical forms in (38b) and (39b) respectively:

(38) a. John needs to leave.

b. $\exists d(\text{need}(d) \ \& \ [John \ to \ leave](d))$

(39) a. John is permitted to leave.

b. $\exists d(\text{is permitted}(d) \ \& \ [John \ to \ leave](d))$

Unlike possible-worlds semantics, this gives an adequate account of heavy permissions (and obligations). If the object d is a permission, the sentential unit will specify which sorts of

actions will be exact satisfiers of d , it will not just say what is true in some world in which the permission is satisfied.

8. Object-based truthmaker semantics and contextual updating

Besides for a unified semantics of attitude reports and modals, possible worlds are generally used to represent the common ground, the target of updating with the utterance of sentences, given a dynamic semantic perspective. Thus, possible worlds are generally used to represent the context set, the target of updating with declarative sentences, as well as a to-do list, the target of updating with the utterance of imperative or deontic modal sentences on a performative use.¹⁸ Such a dynamic perspective can be recast within the terms of object-based truthmaker semantics. I will just briefly indicate of how that may look.

The common ground can now be identified with an attitudinal object of acceptance as the target for updating by declarative sentences, or perhaps rather a modal object (Geurts 2018). Such an attitudinal or modal object will have a collective agent (the interlocutors). A *to do*-list is naturally considered a (deontic) modal object that has future possible actions or situations involving the relevant agent as satisfiers. Just as there may be various to do-lists as part of the common ground (Portner 2007), there can be various modal objects as targets of imperatives or modal sentences of different strengths and forces. The set of issues (the target for updating with questions) may be construed as an attitudinal or modal object whose satisfiers are, say, attitudinal objects of assertion. The common ground will thus consist of various attitudinal and modal objects (with collective, generic, or particular agents), and they will be the target for updating with the utterance of sentences of different types.

With the utterance of an independent sentence S a speaker produces an attitudinal or modal object d whose truth or satisfaction conditions are given by S . Updating the common ground C with the attitudinal object d will then consist, roughly, in the fusion of d with the relevant modal or attitudinal object in C .^{19, 20} If S carries presuppositions, then before applying

¹⁸ Possible worlds are also used in dynamic semantics (of the nonrepresentational sort), that is, theories according to which the meaning of sentences is a function from contexts to contexts. I will set dynamic semantic theories aside for present purposes.

¹⁹ See Moltmann (2018a) for more on the operation of fusion applied to attitudinal or modal objects.

²⁰ Updating the common ground, may first require mapping d onto a closely related object d' with same satisfaction conditions as d , but that matches the modal or attitudinal force of d' . This is needed in particular for assertions, which can undergo fusion only with an attitudinal object of the same force, say acceptance.

fusion with an object o from the common ground, it needs to be verified that the presuppositions of S are entailed by o (that is, are partial contents of o). Note that the common ground may contain attitudinal objects of explicit and of implicit acceptance, for different sorts of (anaphoric and non-anaphoric) presuppositions.

Also the updating conditions of complex sentences can be recast in terms of object-based truthmaker semantics. Thus, updating of a common ground C with an attitudinal or modal object a with conjunctive content S and S' will involve fusion of the relevant object o in C with first d and then fusion of the result with d' , where d is that part of a whose content is given by S and d' is that part of a whose content is given by S' .²¹

While a more detailed and formal development of this way of updating and a comparison with the standard account will have to await another occasion, one overall advantage of the present approach is that the common ground will now consist in modal and attitudinal objects whose content is more fine-grained (in the sense of preserving subject matter) than the possible worlds-based notion of a context set.

9. The semantics of response stance-verbs and factive verbs

Not all attitude verbs have a semantics on which their clausal complement is just predicated of the attitudinal object associated with the event argument of the verb. In particular, there is a class of attitude verbs with which the clausal complement in addition serves as a predicate of a contextually given attitudinal object. The involvement of two different attitudinal objects in the semantics of those verbs gives further support for the semantics of attitude reports based on attitudinal objects.

The class of verbs consists in what Cattell (1978) called *response-stance verbs* and include *repeat*, *confirm*, *agree*, and *remind*, as in the sentences below:

- (40) a. John repeated that it will rain.
 b. John confirmed that it was raining.
 c. John agreed to surrender.
 d. John reminded Mary to return the keys.

²¹ See Moltmann (2018a) for more on content-based parts of attitudinal or modal objects.

In general, response-stance verbs have a clausal complement that serves to characterize both the reported attitudinal object and a contextually given attitudinal object. Thus, in (40a) the complement clause gives the content of two attitudinal objects: John's assertion (or perhaps just act of saying) and a contextually given claim, which may be John's or another person's previous claim. In (40b), the clausal complement gives the satisfaction condition of John's assertion as well as a previous act of assertion or acceptance with a much weaker illocutionary force. In (40c), the infinitival complement specifies actions as satisfiers of John's statement of intent as well as, say, a previous request. In (40d), the complement clause gives the satisfaction conditions of Mary's decision or intention that John's locutionary act aims to trigger, as well as those of a previous thought, decision, or intention of Mary's. The lexical meaning of the verb constrains the nature of the contextually attitudinal object and its relation to the attitudinal object of the reported agent.

The logical form of a sentence with a response-stance verb cannot simply be as in (41b) for (41a), where *d* is the contextually given attitudinal object:

(41) a. John agreed that S.

b. $\exists e(\text{agree}(e, \text{John}) \ \& \ [\text{that } S](\text{att-obj}(e)) \ \& \ [\text{that } S](\text{att-obj}(d)))$

That is because an act can be an act of agreeing not by itself, but only in relation to a contextually given speech act. A better analysis of (41a) is the one in (43), where *agree* is now a three-place predicate taking the contextually given attitudinal object as a third argument:

(42) $\exists e(\text{agree}(e, \text{John}, d) \ \& \ [\text{that } S](\text{att-obj}(e)) \ \& \ [\text{that } S](d))$

There is specific support for (42), and that is the general substitutability of the clausal complement by an NP explicitly referring to the contextually given attitudinal object (plus sometimes a preposition):²²

²² Further support for the analysis may come from the possibility of extraposition from object position, which is available for at least certain response-stance verbs as well as factive verbs:

(i) a. John agreed with it that S.

b. John realized it that S.

The *it* here seems to stand for the object argument of the verb.

- (43) a. John agreed with the request to leave.
 b. John repeated the claim that it is raining.
 c. John confirmed the speculation that it was raining.
 d. John reminded Mary of the requirement / request to return the key.

Additional support for (42) comes from the reading of the modifier *partly* with response-stance verbs. With verbs such as *mention* and *think*, that is, with what Cattell (1978) calls *volunteered-stance verbs*, *partly* fails to have a reading on which it relates to the content of the clausal complement:

- (44) a. ??? John partly mentioned that the house needed to be renovated.
 b. ??? John partly thought that the students were talented.

(44a) has a conceivable reading on which it means that John mentioned that part of the house needed to be renovated, and (44b) on which it means that John thinks that only some of the students are talented. But such readings are not available. By contrast, response-stance verbs do permit a reading of *partly* on which it relates to part of the content of the contextually given attitudinal object:

- (45) a. John partly agreed that the house needs to be renovated.
 b. John partly denied that the students are lazy.

In (45a) *partly* means ‘part of the content of the claim that the house needs to be renovated’ (which may be that part of the house needs to be renovated). In (45b), *partly* picks out a partial content of the claim that the students are lazy, which may be that part of the students are lazy. The same sort of reading of *partly* is generally available with transitive verbs:

- (46) a. John partly ate the chicken.
 b. John partly liked the concert.

Given Davidsonian event semantics, the general meaning of *partly* can be taken to be that of a relation between an event *e* and a type of event *E* which holds in case *e* instantiates part of *E*. The logical form of (46a) will then be as in (47a) and the one of (46b) as in (47b):

- (47) a. $\exists e'(\text{partly}(e', \hat{e}[\text{eat}(e, \text{John}, \text{the chicken})]))$
 b. $\exists e'(\text{partly}(e', \hat{e}[\text{agree}(e, \text{John}, d)]) \ \& \ [\text{that } S](\text{att-obj}(e')) \ \& \ [\text{that } S](d))$

With a verb like *eat*, the part structure of the event is inherited from the part structure of the object argument. Analogously, with a verb like *agree*, the part structure of the event of agreeing is inherited from the partial-content-based structure of the attitudinal object. *Partly* then says that the event argument of the verb instantiates part of the type of the event argument described by the VP.

Response-stance verbs pattern together with factive verbs with respect to their syntactic behavior (for example adjunct extraction) (Cattell 1978). Factive verbs also exhibit the same reading of *partly*:

- (48) a. John partly recognizes that he failed.
 b. John partly acknowledges that the students are lazy.

In (48a, b), *partly* relates to part of the content of a fact (partial failure in (48a) and part of the students being lazy in (48b)). This further supports the same semantics for factive verbs as for response-stance verbs. But with factive verbs the clausal complement will characterize not an attitudinal object, but a fact -- in addition to characterizing the content of the described mental state or act.

The relevant notion of a fact should not be that of an actual situation in the sense of truthmaker semantics, on which a fact would be fully specific part of the actual world. Rather it should be a notion of a non-worldly fact, which can be quantificational or disjunctive. Non-worldly facts exist independently of anyone's mental attitudes and thus are certainly not attitudinal objects. Yet, they do have a part structure based on partial content (given how *partly* is understood). Non-worldly facts in the required sense then are best conceived as modal objects, namely modal objects whose satisfiers are situations that are part of the actual world. A sentence *S* true in a world *w* can then be mapped onto a factive modal object $f_w(S)$, a modal object whose satisfiers are just the situations that are part of *w* and make *S* true:

(49) Truthmaking condition for factive modal objects

For a sentence *S* and world *w*, for any *s*, $s \Vdash f_w(S)$ iff $s \Vdash S$ and $s < w$.

The logical form of a sentence with a factive verb such as (50a) will then be as in (50b):

(50) a. John realized that S.

b. $\exists e(\text{realize}(e, \text{John}, f_w([S]) \ \& \ [\textit{that S}](\text{att-obj}(e)))$

Note that reference to the entire actual world in the characterization of modal objects means that truthmaker semantics cannot do without the notion of a world as such.

We can summarize, object-based truthmaker semantics naturally extends to response-stance-verbs and factive verbs, by positing an additional verbal argument that is a contextually given attitudinal modal object or a particular type of modal object, a fact. In the reading of the modifier *partly*, such an attitudinal or factive modal object displays a part structure based on partial content, which specifically supports the truthmaker-based approach.

10. Subject clauses

There are also good reasons to assume that clausal subjects with a predicate like *is true* or *is correct* give the content of a contextually given content-bearer (a claim, rumor, or suggestion) (Moltmann 2018b). Thus, a sentence like (51) is generally understood in such a way that *that S* serves to give the truth conditions of a contextually given attitudinal object, a claim or speculation (note that *correct* does not apply to a proposition, referred to as such):

(51) That S is correct.

This means that (51) has the logical form in (52), for the relevant contextually given attitudinal object d:

(52) $\text{true}([S](d))$

Other clausal subjects may instead be predicated of an object that is an implicit argument of the verb or closely related to it. Thus, the clausal subjects of *is possible* is best viewed as acting as a predicate of the modal object, itself here considered the Davidsonian event argument. This gives the logical of (53a) as in (53b):

(53) a. That John will be late is possible.

- b. $\exists e(\text{possible}(e) \ \& \ [\text{that John will be late}](e))$

Of course, a particular semantic role of a clausal subject would have to be based on particular semantically identifiable features. In the present context of an outline of object-based truthmaker semantics, the aim, though, was simply to show the plausibility of clausal subjects serving particular semantic roles which are not that of standing for a proposition.

11. Object-based truthmaker semantics and connections between modals and propositional attitudes

11.1. Inferential connections between modals and attitude reports

The present approach accounts straightforwardly for inferential connections between attitude reports and modal sentences. That is because attitudinal objects may entail the existence of a modal object and attitudinal and modal object and they may share their satisfaction conditions. Thus, (54a) and (54b) repeated below are valid on the relevant reading because the command entails the existence of an obligation with the same satisfiers and violators, and the offer entails the existence of a permission with the same the same satisfiers:

- (54) a. John asked Mary to leave.
 Mary must leave.
 b. John offered Mary to use the house.
 Mary may use the house.

Similarly, imperatives and performatively used modal sentences stand in inferential relations under suitable conditions.²³ Thus in suitable contexts, both (55a) and (55b) are valid:

- (55) a. Leave the room!
 You must leave the room.
 b. Take an apple!
 You may take an apple.

²³ See Portner (2007) for discussion.

The request or permission produced by the utterance with an imperative entails, under suitable normative conditions, the existence of a modal object of obligation or permission with the very same satisfaction conditions. Thus by producing a request, the speaker also produces a modal object of obligation, with the very same satisfiers and violators, and by producing a permission, the speaker also produces a modal object of permission with the very same satisfiers.

11.2. Harmonic modals

Object-based truthmaker semantics has a particular application to modals in embedded contexts which exhibit modal concord with the embedding verb, that is, *harmonic modals*, to use Kratzer's (2016) term.²⁴ With its use of modal and attitudinal objects, object-based truthmaker semantics provides a straightforward account and avoids difficulties that arise when applying the standard semantics of modals to the phenomenon.

Harmonic modals occur in clauses embedded under speech act verbs, where they do not contribute to the content of the reported speech, but rather appear to just reflect the inherent modality associated with the embedding predicate:

(56) a. John insisted that Mary *should* leave.

b. The general demands that the troops *must* leave. (Zeijlstra 2007)

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

(57) a. John suggested that Bill *might* leave.

b. The document indicates that Bill *might* be guilty.

c. John thought the package *might* have been for him (when he opened it).

For Kratzer (2016), harmonic modals spell out the inherent modality of the content-bearing object of which the clause is to be predicated (an insistence, suggestion, indication, though in the examples above). Her account of harmonic modals is based on a possible-worlds-based property of the meaning of clauses. Focusing on modals of necessity as in (56), she proposes that the 'harmonic' modal in the embedded clause spells out universal quantification over the possible worlds that make up the content $f(d)$ of the content-bearing object d , as below:

²⁴ See also Portner (1997) and Zeijlstra (2007). Yalcin (2007) discusses harmonic modals for *suppose/believe – may*, Yanovich (2007) for *hope – might*.

(58) $\lambda d[\forall w(w \in f(d) \rightarrow [Mary\ leave]^w = \text{true})]$

The problem for such a possible-worlds-based account, though, and that is that it is inapplicable to modals of possibility, as in (57) (Moltmann 2019b). Thus, (61) does not make sense as the meaning of the clauses in (57a-c), with the existential quantifier spelling out the contribution of *could* or *might*:

(59) $\lambda d[\exists w(w \in f(d) \ \& \ [S]^w = \text{true})]$

In (59a), the *that*-clause does not just specify what is the case in some world in which John's offer is taken up; it specifies (at least) what is the case in all the worlds in which the offer is taken up. Similarly in (59b), the *that*-clause does not just say what is the case in some world compatible with what document says, but what is the case in all such worlds.

Object-based truthmaker semantics allows for a straightforward account of harmonic modals of both necessity and possibility. On this account, harmonic modals are considered performative uses of modals in embedded contexts.²⁵ In object-based truthmaker semantics, sentences with a performative use of a modal such as (60a, b) will express properties of modal products meant to be produced by uttering the sentence, as in (61a, b) (Moltmann 2017a, 2019):

(60) a. You must leave!

b. You may leave!

(61) a. $\lambda d[\text{must}(d) \ \& \ [(\text{addressee})\ leave](d)]$

b. $\lambda d[\text{may}(d) \ \& \ [(\text{addressee})\ leave](d)]$

With a harmonic modal acting as a performative modal in an embedded context, (59) will simply have logical form in (62b) based on the meaning of the embedded clause in (62a), and (59b) the one in (63b), based on (63a):

²⁵ Modals can be used performatively also in other contexts, most obviously in sentences embedded under verbs of saying :

(i) John said that Mary must leave.

- (62) a. $[that\ Mary\ should\ leave] = \lambda d[\text{should}(d) \ \& \ [Mary\ leave](d)]$
 b. $\exists e(\text{insist}(e, \text{John}) \ \& \ [that\ Mary\ should\ leave](\text{modal-product}(e)))$
- (63) a. $[that\ Bill\ might\ be\ guilty] = \lambda d[\text{might}(d) \ \& \ [Bill\ be\ guilty](d)]$
 b. $\exists e(\text{indicate}(e, \text{the document}) \ \& \ [that\ Bill\ might\ be\ guilty](\text{modal-product}(e)))$

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, 2018a). An act of demanding produces a demand as well as possibly an obligation, and an act of permitting an illocutionary and a modal product of permission.

Harmonic modals are a phenomenon where object-based truthmaker semantics appears to have a significant advantage over possible-worlds semantics with its quantificational analysis of modals.

12. Summary

Possible-worlds semantics has been a dominant approach in formal semantics, despite its obvious shortcomings. Possible-worlds semantics appeared to have particular advantages for the pursuit of compositional semantics of natural language, allowing for a unified compositional semantics of a great range of constructions in a context of discourse and in particular for a unified semantics of modals and attitude reports. The most serious overall shortcoming of possible-worlds semantics is that it fails to give a sufficiently fine-grained notion of content. Truthmaker semantics with its central notion of a situation as an exact truthmaker of a sentence presents a more fine-grained notion of content, and its sentence-based version has been applied a range of issues that provide difficulties for the possible worlds account.

Object-based truthmaker semantics extends sentence-based truthmaker semantics by applying the truthmaking relation not just to sentences, but also to attitudinal objects, as well as the related category of modal objects. It thus connects truthmaker semantics to the ontology of the mind as well as social objects such as obligations and permissions, entities on a par with laws. The paper has given an overall outline of the semantics of attitude reports and modals based on modal and attitudinal objects. On that semantics, a sentence embedded under an attitude verb semantically act as a predicate of the attitudinal object associated with the verb, and the sentential unit associated with a modal as a predicate of the relevant modal

object. This semantics is (almost) overtly reflected in complex predicates of the sort *make the claim*, which alternates with the simple attitude verb *claim*.

The semantics of attitude reports that the paper has presented is able to overcome a range of difficulties for the standard proposition-based Relational Analysis: empirical and conceptual difficulties for the Relational Analysis as such, as well as difficulties with notion of an abstract proposition and the involvement of propositions in the semantics of attitude reports. Applying the same semantics to modals allows for a unified semantics of modals and attitude reports and for accounting for connections between the two, such as inferential connections and harmonic modals. Finally, the semantics is particularly suited for response-stance verbs and can be carried over to factive verbs as well.

There are more specific motivations for object-based truthmaker semantics. An important one is the dependence of truthmakers on modal or attitudinal objects, which manifests itself in the distinction between light and heavy permissions as well as the possibility of underspecification of the content of modal and attitudinal objects by the complement clause or sentential unit.

Of course, the paper has given only a very general outline of object-based truthmaker semantics, which invites various elaborations of empirical and formal detail, as well as more thorough comparisons with standard approaches for particular applications.

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