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Truthmaker Semantics for Natural Language: Attitude Verbs, Modals, and Intensional Transitive Verbs

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Abstract

This paper gives an outline of truthmaker semantics for natural language against the background of standard possible-worlds semantics. It develops a truthmaker semantics for attitude reports and deontic modals based on an ontology of attitudinal and modal objects and on a semantic function of clauses as predicates of such objects. The semantics is applied to factive verbs and response-stance verbs as well as to cases of modal concord. The paper also presents new motivations for 'object-based truthmaker semantics' from intensional transitive verbs such as *need*, *look for*, *own*, and *buy* and gives an outline of their semantics based on a further development of truthmaker semantics.

Keywords

situations, truthmaker semantics, situation semantics, propositional attitudes, modals, deontic modality, intensional transitive verbs, embedded clauses, factivity, response-stance verbs, modal concord

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, the approach 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 promised more specific advantages, such as being a suitable basis for accounting for various sorts of connections between modals and attitude reports, and for how utterances of sentences relate to the discourse context, which is standardly construed as a 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, commonly construed as 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 the semantic composition of complex expressions of different sorts.

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 (Barwise and Perry 1983, Kratzer 2014). One recent version of a situation-based approach is truthmaker semantics, as developed by 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 notions of subject matter and of partial content. Truthmaker semantics has been applied to a range of semantic and logical topics. However, it has not been applied to natural language more generally and in particular not to the various sorts of intensional predicates in natural language.

This paper gives an outline of a development of truthmaker semantics 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 truthmakers or satisfiers. However, it applies the truthmaking/satisfaction relation (and the corresponding falsification/violation relation) not just to sentences, but also to objects of a certain sort. For modal sentences and attitude reports those objects are what I call *modal* and *attitudinal objects*, entities quite distinct from propositions. Modal objects are entities like obligations, permissions, and needs; attitudinal objects are entities like claims, judgments, beliefs, requests, promises, decisions, intentions, desires, and hopes. Modal and attitudinal objects are typically (but not necessarily) the denotations of nominalizations of modal predicates or attitude verbs. They are characterized by a range of properties that jointly distinguish them from other categories of entities. Most importantly, they carry truth or satisfaction conditions, yet display properties of concreteness.

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. It also has specific advantages in being able to give a better account of certain sorts of modals in attitudinal contexts (harmonic modals), of the distinction between weak and strong permissions, of the semantics of response-stance verbs and factive verbs, and of the distinction between descriptive and performative modals.

Object-based truthmaker semantics can be extended to the semantics of intensional transitive verbs, such as *look for* and *owe*, and explain particular semantic phenomena involving them: the interpretation of weak quantificational NPs as complements and restrictions on the sharing of the semantic object associated with different intensional verbs. The application of object-based truthmaker semantics to intensional transitive verbs requires extending the domain of bearers of truthmaking conditions to entities such as searches, purchases, and debts. An additional motivation for object-based truthmaker semantics from intensional transitive verbs comes from entities like searches and purchases requiring a causal connection to their satisfaction situations. Overall, the semantics of intensional transitive verbs gives significant further support for object-based truthmaker semantics, as opposed to possible-worlds semantics or even sentence-based truthmaker semantics.

This paper will first give a general outline of object-based truthmaker semantics against the background of the standard semantic approaches to 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. Third, it will apply object-based truthmaker semantics to attitude reports and modal sentences of various sorts, to factive and response-stance verbs, and to intensional transitive verbs. The paper will focus on the general picture

and just present the general ideas for a compositional semantic analysis of the relevant data, rather than fully elaborating such an analysis itself.

1. Standard views of propositional attitude and modals

1. 1. The Relational Analysis of attitude reports and the Quantificational Analysis of 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.¹ 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. $\forall w(w \in f(w_o) \rightarrow [John\ leave]^w = true)$
 (3) a. John is allowed to leave.

¹ Stalnaker (1984) is a representative of the possible-worlds view, Cresswell (1985) of the structured-propositions view.

b. $\exists w(w \in f(w_0) \ \& \ [John \ leave]^w = \text{true})$

The contextually given function f maps the world of evaluation w_0 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. (4a), on that view, has the truth conditions in (4b), where $\text{bel}_{w,j}$ is the set of worlds compatible with what John believes in w :

(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 as below, 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 has been applied only to attitude verbs that are taken to involve universal quantification over worlds, such as belief and knowledge.² 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) and *hope*. This is supported by the observation that such verbs go with *may* or *might* as modals of concord (or 'harmonic modals') rather than *must*, as will be discussed in Section 11.2. There are obvious examples among speech act predicates as well, those 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

² Some attitude verbs have been considered imposing an ordering of preference along worlds such as *want*, *wish*, *be happy* (Heim 1992).

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 (Cresswell 1985).

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 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 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:³

(6) You must leave.

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.

³ 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).

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 5.2.).⁴

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 the semantics of various sorts of implicit attitudes, and sometimes even for explicit attitudes. For example, the order of disjuncts or of complements should not generally lead to a difference in the content of the reported attitude (John's belief that Mary gave Joe a book is not necessarily distinct from John's belief that Mary gave a book to Joe). 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, namely those with verbs of saying.⁵ The sensitivity of verbs

⁴ 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).

⁵ Verbs of saying arguably include *think* when describing occurrent thought (Moltmann 2017b).

of saying to the syntactic structure and perhaps even choice of words in their complement can be enforced by the use of *literally*:

(10) John literally said that Sue was greeted by Mary.

However, if for verbs of saying, the particular choice of words as well as the syntactic structure of the complement clause may matter, this may not so much motivate a particular conception of sentence meaning as such (structure propositions as opposed to sets of worlds). Rather may motivate 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 (2012, 2014, 2017a, b, c, 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, the content of a sentence is not taken to reflect syntactic structure in the way a structured proposition does. The following is a very brief outline of Fine's sentence-based truthmaker semantics, which should suffice for the present purposes.

Truthmaker semantics is based on situations (and actions) rather than entire worlds, as well as on 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 include anything that fails to bear on the truth (or satisfaction) of S . A situation (or action) s is an falsifier (or violator) of a sentence S just in case S is wholly relevant for the falsity (or violation) of S .

The use of the notion of exact truthmaking distinguishes truthmaker semantics from older situation-based semantic theories such as that of Barwise and Perry (1983) and Kratzer (2014), which are based on the relation inexact truthmaking or verification between situations

and sentences. The notion of an exact truthmaker of a sentence is distinct from that of a minimal situation supporting a sentence, a notion defined in terms of inexact truthmaking in Kratzer (2002, 2014). There are two important reasons for using the notion of an exact truthmaker rather than that of a minimal truthmaker (Fine 2017). First, there are sentences that have exact verifiers, but lack minimal verifiers, for example *there are infinitely many natural numbers*.⁶ Second, a sentence such as *it is windy or it is rainy and windy* has two exact verifiers, a situation in which it is (just) windy and a situation in which it is (just) windy and rainy, but it would have only one minimal verifier (a situation in which it is windy) (Fine 2017).

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 imperative sentences, rather than making them 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-whole relation $<$ (a partial order) and is closed under fusion. Formally it forms a complete lattice.

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 sentence S , $s \Vdash \exists x S$ iff $s \Vdash S[x/d]$ for some individual d .

Truthmaker semantics assigns to sentences not only truthmakers or satisfiers, but also falsifiers or violators. Making use of the relation of (exact) falsification or violation allows a

⁶ See also Kratzer (2002, 2014) and Yablo (to appear) for discussion.

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

straightforward formulation of the truthmaking conditions of negative sentences: a truthmaker for $\neg S$ is a falsifier for S . With \Vdash as the relation of (exact) falsification or violation, the condition on negation is given below:⁸

(12) $s \Vdash \textit{not } S$ iff $s \not\Vdash S$

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

(13) a. $s \Vdash S \textit{ and } S'$ iff $s \Vdash S$ or $s \Vdash S'$

b. $s \Vdash S \textit{ or } S'$ iff for some s' and s'' , $s = s' \oplus s''$ and $s' \Vdash S$ and $s'' \Vdash S'$

A sentence S then has as its meaning a pair $\langle \textit{pos}(s), \textit{neg}(S) \rangle$ consisting of a *positive denotation*, the set $\textit{pos}(S)$ of verifiers of S , and a *negative denotation*, the set $\textit{neg}(S)$ of falsifiers of S .

In truthmaker semantics, logically equivalent sentences will have different semantic values whenever 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 reasonable 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 exact truthmaker (or satisfier) of A contains an exact truthmaker (or satisfier) of B and every exact truthmaker (or satisfier) of B is contained in an exact truthmaker (or 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

⁸ (12) also applies to imperatives that are prohibitions: *Do not smoke!* is satisfied by actions that violate the imperative *Do smoke!*, thus actions incompatible with the addressee smoking.

sentence and a modal object). It is also reflected in the adverb *partly* when modifying attitude verbs (Section 9). Given the notion of partial content, that it is cold is part of John's belief that it is raining and it is cold (since every situation in which it is just cold is part of a situation in which it is raining and it is cold, and every situation in which it is cold and it is raining has a situation as part in which it is just cold). However, that two is greater than one is not a part of that belief, unlike on a possible-worlds account of inference. Moreover, unlike on a possible-worlds account, that two is greater than one or it is cold need not be part John's belief that it is cold given (14). For Fine (2018a), partial content also plays a central role for the validity of inferences. For example, it explains the invalidity of the inference with imperatives in (15), which is a problem for possible-worlds semantics (Ross' paradox):

(15) Mail the letter!

Mail the letter or burn the house down!

For Fine, $p!$ implies $q!$ only if q is a partial content of p , which is not the case in (15).

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.⁹ 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 (16a) would have the logical form in (16b):

(16) 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 that this paper will discuss. Another reason is that (16b) would fall under the Relational Analysis of attitude reports, which is associated with a range of philosophical and linguistic difficulties, as will be discussed in the next section.

⁹⁹ Fine (2018 a, b) applies truthmaker semantics to deontic modality, focusing on logical, rather than linguistic aspects.

5. 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.¹⁰ 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 (going back to Brentano) 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.

[2] Abstract propositions raise a number of conceptual problems, which have been a major issue contemporary philosophy of language. They 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 2003b, 2014, 2017a).

[3] The Relational Analysis has difficulty accounting for the Substitution Problem, the problem of the unacceptability of (17b) as an inference from (17a), and the Objectivization Effect, the semantic difference between (18a) and (18b) (Moltmann 2003b, 2013):

(17) a. John assumed that S.

b. ?? John assumed the proposition that S.

(18) 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, where the *that*-clause does not syntactically or semantically appear to act as an argument (Moulton 2015):

(19) John's request that S

¹⁰ See Moltmann (2003b, 2013 chap. 4, 2014) and reference therein.

Semantically, the *that*-clause in (19) seems to stand for what the entire NP stands for (a request), rather than providing an object entering into 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 complied with or ignored, but a proposition cannot (at least not in the same sense) (See Section 5.3.).¹¹

[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).

6. 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.¹² Object-based truthmaker semantics assigns very different logical forms to attitude reports and modal sentences than the standard approaches. On the standard view of attitude reports, clauses when 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 a predicates of modal or attitudinal objects by giving their truthmaking or satisfaction conditions.¹³

¹¹ The syntactic status of clausal complements of nouns is not obvious. In fact, there is a significant syntactic controversy surrounding it. Some researchers assimilate them to relative clauses (Arsenevič 2009, Moulton 2015, Kayne 2010). Others have argued against such assimilation (de Cuba 2017). The present view that clauses semantically act as predicates would go along well with either view, as long as it permits them to be in some way interpreted as properties.

¹² In what follows, I take attitude reports to include speech act reports and attitude verbs to include speech act verbs such as *claim*.

¹³ In this paper, no semantic distinction is made between *that*-clauses, infinitival clauses and the sentential units associated with modals.

Object-based truthmaker semantics is based on 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 definite NPs whose heads are nominalizations of attitude verbs 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, but also in various general 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'), 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 engaging either in attitudinal objects that are closely similar or 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. Moreover, they display properties that could hold neither of actions (and states) nor of propositions (which I will turn to shortly). Attitudinal objects 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, that is, abstract artifacts in the sense of Thomasson's (1999) sense, meaning they lack a material or physical realization (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. Strong permissions are generally the products of illocutionary acts, but not so for weak permissions (Section 7.4.). Modal objects share the characteristic properties of attitudinal objects and 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.

6.1. 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. Here are some of their properties of concreteness.

First of all, attitudinal objects are involved in various forms of content-based causation. 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* implies that the excitement was due to the content of Mary's claim, but not so for *Mary's making a claim / 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. In addition, some attitudinal objects can be objects of perception, for example remarks and claims, which can be heard.

Attitudinal objects also act as the targets of content-related memory. We remember thoughts, beliefs, decisions and intentions, rather than propositions. We may also 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 produced 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 deontic modal objects that represent universal ethical laws).

6.2. 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.¹⁴

[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 pick out only a partial content, 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

¹⁴ Types of action may also mean actions that may be realized in different way. John's obligation as a soldier and Mary's obligation as a defense minister may be the same in the sense that it is fulfilled by both serving their country. But serving one's country can be done in different sorts of ways. Thanks to Hans-Martin Gaertner for pointing this out to me.

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), at least according to general and linguistically reflected intuitions. Attributive limitations are an issue in descriptive metaphysics that needs to be much further explored (Moltmann 2019b).

6.3. 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:

(20) 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:¹⁵

- (21) a. John kept / broke his promise.
 b. ??? John kept / broke a proposition.¹⁶
 c. ??? John kept / broke his promising / his act of promising.

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

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).¹⁷

7. Motivations for object-based truthmaker semantics

¹⁵ The observation about satisfaction predicates not applying to nominalizations of illocutionary verbs was made by Ulrich (1976), who also argued for a third category of entities distinct from propositions and actions. Twardowski (1911) made the point with different sorts of attitudinal objects, arguing for products as distinct from actions.

¹⁶ One might object that *proposition* is a technical term and therefore should not be used for intuitions about ‘keeping’ and ‘breaking’ (Hans Martin Gaertner p.c.). But then this should hold for any intuitions we may have regarding that notion including the applicability of *true* to a proposition.

¹⁷ In that respect, the theory of attitudinal objects differs from the act-based conceptions of propositions of Soames (2010) and Hanks (2015).

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.

7.1. 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.

7.2. Extending truthmaker semantics to the mental

Object-based truthmaker semantics gives a semantics of mental objects as well. By applying to attitudinal objects, object-based truthmaker semantics allows linking truthmaker semantics to the intentionality of the mind. Truthmaker semantics is particularly suited for attitudinal objects such as intentions and decisions, which come with inherent satisfaction or realization conditions and are satisfied or realized not by worlds or world states, but rather by actions.¹⁸

7.3. 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 just take 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. 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) do not require their satisfiers or truthmakers to be of that sort.

¹⁸ 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.

7.4. The distinction between strong and weak permission

The distinction between strong and weak permissions shows a particular way in which truthmakers may depend on the type of modal object (Moltmann 2018a).¹⁹ For object-based truthmaker semantics, strong and weak permissions are two different sorts of objects. Strong permissions generally are the products of particular acts of permitting, whereas weak permissions are states of what is (explicitly or implicitly) permitted. Strong permissions have different satisfaction conditions from weak permissions. Strong permissions have as satisfiers only actions meeting what is explicitly permitted, whereas the satisfiers of weak permissions include those that are just not in violation of what is obligatory. The reason is that strong permissions are individuated by the act that creates them, whereas weak permissions are individuated in connection with what is obligatory (Moltmann 2018a).

The distinction between the two sorts of permissions is well-reflected English, in the contrast between simple predicates (*be* + impersonal adjectival passive) as in (22a), which display the weak reading (as well as a strong one), and complex predicates (light verb + nominal), as in (22b), which display the strong reading:

- (22) 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 (22b) 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 involve a change not in the set of worlds compatible what the agent is obliged to do, but rather in the set of options to act that are at the agent's disposal.

The complex predicate *has permission* in (22b) involves explicit reference to a permission, the product of an act of permitting, and the complement clause serves to give the content of

¹⁹ The distinction is roughly that between what is explicitly and what is implicitly permitted. See von Wright (1963) for the distinction between strong and weak permissions, as well as Fine (2017b, c) in the context of sentence-based truthmaker semantics.

that product. By contrast, (22a) 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 strong reading thus will go along with the compositional semantics of a complex predicates as in (22b), and the weak reading with that of a simple stative predicate as in (22a).²⁰

7.5. 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 below (Fara 2014):

(23) Fiona wants to catch a fish.

Fiona's desire, according to (23) is not satisfied if she catches any fish whatsoever, but, most likely, only a fish she can eat. The speaker uttering (23) need not know what the exact constraints are that Fiona's desire may impose on what satisfies it.

Also modals allow for this sort of underspecification, in particular teleological and deontic modals:

- (24) 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 (32). 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 (24b).

²⁰ 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.

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 (23) as well as in (24a, 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).²¹

8. Sentences as predicates of modal and attitudinal objects

We can now turn to the formal semantics of clauses as predicates of content bearers, that is, attitudinal or modal objects. For the semantics of attitude reports, I will make use of Davidsonian event semantics (Davidson 1967). That is, an attitude verb will have an additional argument position for events, acts, or states. 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:

²¹ 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:

- (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 would be to explain why a particular direction of fit does not permit the relevant sort of underspecification.

(25) a. John claimed that S.

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

The semantics of attitude reports in (25b) is (almost) overtly reflected in the corresponding complex-predicate construction in (26), which involves explicit reference to an attitudinal object (or a kind of attitudinal object):

(26) John made the claim that S.

The fact that languages show an alternation between the simple and the complex-predicate construction further motivates the semantics in (25b) (Moltmann 2017a, 2018a).

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

(27) a. John's claim that S

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

Given the possibility of underspecification, the property that sentences as predicates of modal or attitudinal object express will consist in a partial specification of satisfaction conditions, as 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):

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

This simply means that the content of S is a partial content of the content of d in the sense of (14).

(28) cannot yet be adequate, though, since it would not allow distinguishing necessity and possibility semantically. Given (27), 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 invitation has only satisfiers, but no violators. By contrast, a request or order has both satisfiers and violators.

This difference between modal forces requires modifying (28) 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):

$$(29) [S] = \lambda d[\forall s(s \Vdash d \rightarrow \exists s'(s' \Vdash S \ \& \ s' < s) \ \& \ \forall s'(s' \Vdash S \rightarrow \exists s(s \Vdash d \ \& \ s' < s)) \ \& \ (\exists s \ s \Vdash d \rightarrow \forall s(s \Vdash S \rightarrow s \Vdash d))]$$

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 (30a) and (30b) in (31a) and (31b) respectively, based on the same meaning of the complement clause (which is, syntactically simplified, taken to be *Mary to leave the house*):

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

b. John allowed Mary to leave the house.

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

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

In (30a) and (30b) the function *att-obj* maps the Davidsonian event argument of the verb onto the attitudinal object associated with that event. The complement clause acts as a predicate of

that attitudinal object, with the property of (attitudinal or modal) objects in (29) as its meaning.

Similarly, modal sentences involve predication of the sentential unit associated with the modal predicate of the relevant modal object. Taking the modal object to be the event argument itself, (32a) and (33a) will then have the logical forms in (32b) and (33b) respectively:

(32) a. John needs to leave.

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

(33) a. Mary is permitted to take a walk.

b. $\exists d(\text{is permitted}(d) \ \& \ [\textit{Mary to take a walk}](d))$

In (32b) and (33b), the sentential units *John to leave* and *Mary to take a walk* will have the very same sort of property in (29) as their meaning and attribute that property to the respective modal objects, the need and the permission.

Unlike possible-worlds semantics, this gives an adequate account of strong (explicit) permissions (the only reading of *Mary has permission to take a walk*). If the modal object d is an explicit permission, the sentential unit will specify which sorts of actions will be exact satisfiers of d , and not just what is true in some world compatible with what is obligatory. The latter may count as satisfiers only of a state of weak permission which is individuated in relation to what is obligatory (Moltmann 2018a).

There is a further important argument for the truthmaker account and against the possible worlds account and that is that possible worlds semantics would not permit a single property of clauses that could hold of attitudinal and modal objects of necessity and of possibility. Moulton (2015), who (following talks by Angelika Kratzer) proposes the property in (34a) as the meaning of *that*-clauses, based on the notion of the content $\text{cont}(x_c)$ of a content bearer x_c (e.g. an attitudinal object) in (34b):

(34) a. $[\textit{that S}] = \lambda x_c \lambda w [\text{cont}(x_c)(w) = \lambda w' [S \text{ is true in } w']]$

b. $\text{cont}(x_c)(w) = \{w' \mid w' \text{ is compatible with the intentional content determined by } x_c \text{ in } w\}$

One problem with this account is of course that it is based on possible worlds, leading to the usual problems of a too coarse-grained semantics for various sorts of attitudes. The second

problem is that it treats content bearers with the force of possibility and with the force of necessity exactly the same. This makes it impossible to account for the connections between attitude reports and modals as mentioned earlier (see also Section 11.2.). In fact it is not clear how the account could apply to modals such as *must*, *can*, or *need* in the first place, since modals need not involve an object associated with a specific propositional content, for example when they convey weak permission or obligation.

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. With one class of attitude verbs, the clausal complement in addition serves as a predicate of a contextually given attitudinal object, which 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 includes *repeat*, *confirm*, *agree*, and *remind*, as in the sentences below:

- (35) 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.

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 (34a) the complement clause gives the content of two attitudinal objects: John's assertion (or perhaps just his act of saying) and a contextually given claim, which may be John's or another person's previous claim. In (34b), the clausal complement gives the satisfaction condition of John's assertion as well as that of a previous assertion or acceptance with a much weaker illocutionary force. In (34c), the infinitival complement specifies actions as satisfiers of John's statement of intent as well as, say, a previous request. In (34d), 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 response stance verb constrains the nature of the contextually given attitudinal object and its relation to the attitudinal object of the reported agent.

What is the logical form of a sentence with a response stance verb? A first option is (36b) for (36a), where *d* is the contextually given attitudinal object:

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

However, this cannot be right because an act can be an act of agreeing not on its own, but only in relation to a contextually given speech act. A better option is (37), where *agree* is now a three-place predicate taking the contextually given attitudinal object *d* as a third argument:²²

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

There is specific support for (37), 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):²³

- (38) 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 (37) comes from the reading of the modifier *partly* with response stance verbs (Moltmann 2017c). 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:

- (39) a. ??? John partly mentioned that the house needed to be renovated.

²² This analysis is very similar to the one Moulton (2015) gives for attitude verbs in general, with the exception that for Moulton the clausal complement is predicated only of an internal content argument of the attitude verb.

²³ Further evidence for (37) may come from the possibility of extraposition from object position, which is available for at least certain response-stance verbs as in (i) as well as for factive verbs as in (ii), discussed later:

- (i) a. John repeated it that it will rain.
 b. John confirmed it that it was raining.
 (iii) John realized it that S.

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

b. ??? John partly thought that the students were talented.

(39a) has a conceivable reading on which it means that John mentioned that part of the house needed to be renovated, and (39b) 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:

(40) a. John partly agreed that the house needs to be renovated.

b. John partly denied that the students are lazy.

In (40a) *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 (40b), *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:

(41) 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 just in case *e* instantiates part of *E*. The logical form of (41a) will then be as in (42a) and the one of (41b) as in (42b), where $\hat{\ }^{\wedge}$ is an abstractor for event types:

(42) 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 described by the VP.

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

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

In (43a, b), *partly* relates to part of the content of a fact (partial failure in (43a) and part of the students being lazy in (43b)). 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 a 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 not attitudinal objects. Yet, they do have a part structure based on partial content (given how *partly* is understood in (43a, b)). Non-worldly facts in the required sense 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 be mapped onto a corresponding factive modal object $f_w(S)$, namely a modal object whose satisfiers are just the situations that are part of *w* and make *S* true:

(44) 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 $s < w$.

Making use of factive modal objects, the logical form of a sentence with a factive verb such as (45a) will be as in (45b):

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

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.

To sum up, object-based truthmaker semantics can naturally be extended to response-stance-verbs and factive verbs, by positing an additional verbal argument that is a contextually given attitudinal object or a factive modal object. In the reading of the modifier *partly*, those attitudinal or factive modal objects display 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 (46) 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:

(46) That S is correct.

Correct does not apply to propositions, referred to as such, but only to attitudinal objects such as claims (*The proposition that S is correct* hardly makes sense, as opposed to *the claim that S is correct*). This means that (46) has the logical form in (47), for the relevant contextually given attitudinal object *d*:

(47) $\text{correct}(d) \ \& \ [\text{that } S](d)$

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 that is an implicit argument of the modal *possible*, as in (48b) for (48a):

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

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

Of course, a particular semantic role of a clausal subject will have to have a syntactic basis. But in the present context, the aim 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, sharing the same satisfaction conditions. Thus, (49a) and (49b) 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:

(49) 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.²⁴ In suitable contexts, both (50a) and (50b) are valid:

(50) a. Leave the room!

You must leave the room.

b. Take an apple!

You may take an apple.

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

²⁴ See Portner (2007) for more on performatively used modals.

modal object of obligation, with the very same satisfiers and violators. 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.²⁵ 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:

- (51) 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:

- (52) 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 $\text{cont}(x_c)(w)$ of the content-bearing object x_c , as below, where w is the actual world:

- (53) $\lambda x_c[\forall w'(w' \in \text{cont}(x_c)(w) \rightarrow \text{Mary leaves in } w')]$

²⁵ See also Portner (1997) and Zeijlstra (2007). Yalcin (2007) discusses harmonic modals for *suppose/believe – may*, Yanovich (2007) for *hope – might*.

The problem for such a possible-worlds-based account, though, and that is that it is inapplicable to modals of possibility, as in (52) (Moltmann 2019a, to appear b). In (52a-c) the modal *could* or *might* should spell out existential quantification, giving as the meaning of the clauses (54):

(54) [*that* S] = $\lambda x_c[\exists w'(w' \in \text{cont}(x_c)(w) \ \& \ S \text{ is true in } w')$]

But in (52a), the *that*-clause does not just specify what is the case in some world in which John's suggestion is taken up; it specifies (at least) what is the case in all the worlds in which the suggestion is taken up. Similarly in (52b), the *that*-clause does not just say what is the case in some world compatible with what the document says, but what is the case in all such worlds, and likewise for (52c).

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.²⁶ In object-based truthmaker semantics, sentences with a performative use of a modal such as (55a, b) will express properties of modal products meant to be produced by uttering the sentence, as in (56a, b) (Moltmann 2017a, 2019):

(55) a. You must leave!

b. You may leave!

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

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

With a harmonic modal acting as a performative modal in an embedded context, (51a) will simply have logical form in (57b) based on the meaning of the embedded clause in (57a), and (52b) the one in (58b), based on (58a):

(57) a. [*that Mary should leave*] = $\lambda d[\text{should}(d) \ \& \ [\textit{Mary} \ \textit{leave}](d)]$

²⁶ Modals can be used performatively also in other contexts, most obviously in sentences embedded under verbs of saying. Thus, (i) can report a demand by John, uttering *Mary must leave* and using *must* performatively:

(i) John said that Mary must leave.

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

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 with the very same satisfaction conditions. An act of permitting produces an illocutionary and a modal product of permission with the same satisfaction conditions.

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. The semantics of intensional transitive verbs

Object-based truthmaker semantics is particularly suited for the semantics of intensional transitive verbs, once it is expanded so as to include not just attitudinal and modal objects as bearers of truthmakers or satisfiers, but also objects like searches, purchases, and debts. Since those objects are associated with intensional transitive verbs, I will call them ‘intensional objects’, a term that is used differently in other contexts, but in the present context matches the choice of the terms ‘attitudinal object’ and ‘modal object’.

Object-based truthmaker semantics has two important advantages over possible-worlds semantics for the semantics of intensional transitive verbs. First, it can explain the particular readings of NPs with weak quantifiers (*a*, *exactly two*, *at most* etc) as complements of intensional transitive verbs. Second, it can account for the constraints on the sorts of ‘semantic objects’ that different intensional verbs can share. An additional motivation comes from the observation that certain intensional objects require a causal connection to their satisfiers, for example purchases.

First of all, a few clarificatory remarks about intensional transitive verbs in general. I take intensional transitive verbs to comprise a larger class of verbs than is common, including the following types of verbs (Moltmann 1997, 2008):

- (59) a. Verbs of absence: *need*, *look for* (*three readings*), *want*,
- b. Verbs of possession: *own*, *buy*, *sell*, *offer*, *give*, *have*,

- c. Verbs of recognition: *recognition*, *see*
- d. Verbs of nomination: *nominate*, *hire*
- e. Verbs of imagination and depiction: *imagine*, *see*, *paint*,

Verbs of possession allow for intensional readings involving a nonspecific reading of their complement, e.g. *John offered Mary a glass of wine* (but not particular one), *John bought a bottle of wine on the internet* (but no particular one), *Bill owns half of the estate* (but no particular half) (Moltmann 1997, Zimmermann 2001). An example of an intensional reading of *recognize* is *John recognized a genius* (when he saw his daughter calculate) and of *hire* *Mary hired an assistant* (giving Bill his first job).

Also the verb *find* can be used as an intensional verbs, either as a verb of nomination (*Mary needs a secretary*) or a verb of recognition (*John found a wife*). *Need* and *look for* share the same two intensional readings (*John needs / is looking for a secretary / a wife*), in addition to an object-related one (*John needs / is looking for a pen*).

The general criterion for the intensionality of intensional transitive verbs is not lack of existence-entailment or failure of substitutivity, but rather a particular nonspecific reading of complements with weak quantifiers (on which they could not take scope over the verb) (Moltmann 1998, Zimmermann 2001). What is also characteristic of intensional transitive verbs is that they involve particular semantic objects which special quantifiers (*something*, *what*, *the same thing* etc.) range over when they are in the object position of intensional transitive verbs. I will call those objects ‘variable satisfiers’,

12.1. Intensional transitive verbs with weak quantifiers

Intensional transitive verbs display a particular reading of NP complements with weak quantifiers, which is different from the one such quantifiers display in clausal complements of intensional verbs (Moltmann 1997, 2008). Compare (60a, b) and (62a, b):

- (60) a. John needs exactly two assistants.
- b. John needs to have exactly two assistants.
- (62) a. John needs no assistant.
- b. John needs to have no assistant.

Unlike (60b), (60a) does not mean that in any world in which John's needs are satisfied, John has exactly two assistants. If John happens to have four assistants, his needs may still be satisfied. Rather (60a) means that in a situation exactly satisfying John's needs, he has exactly two assistants. Similarly, (61a), unlike (61b), does not mean that in a world in which John's needs are satisfied, he has no assistant. The satisfaction of his needs is compatible with his having an assistant. Rather (61a) means that in a situation exactly satisfying John's needs John has no assistant. Thus the meaning of (60a) can be paraphrased as in (62) (based on Moltmann 1997, 2008):

(63) For every situation *s* exactly satisfying John's need, John stands in R ('have') to exactly two assistants in *s*

NP complements with strong quantifiers do not display the same sort of reading; otherwise (64) would come out trivially true on an intensional reading (Zimmermann 1993, Moltmann 1998):

(64) John needs every assistant.

(64) cannot mean that any situation satisfying John's needs is a situation in which John has every assistant of his. The reason is that strong quantificational NPs carry a domain presupposition, which, roughly, requires their domain to be identified in the actual world or the previous discourse context, not the current situation of evaluation (Moltmann 1997, 2005).

The semantics of verbs of nomination and possession with NPs with weak quantifiers can similarly be stated in terms of satisfaction situations restricting the domain of the quantifier, as in (65b) for (65a) and in (66b) for (66a):

(64) a. John hired at most two assistants.

b. 'In any situation realizing John's hiring, John has at most two assistants.'

(66) a. John bought exactly two bottles of wine over the internet.

b. 'In any situation realizing John's purchase, John has at most two assistants in *s*.'

Verbs of nomination and possession involve an extension of the notion of satisfaction: Situations satisfy an intensional object that is a hiring or a purchase in the sense of realizing it or being its intended result. As such they need to stand in a causal relation to the hiring or

purchase. This is an additional support for object-based truthmaker semantics: only object-based truthmaker semantics makes use of a relation between objects and satisfaction situations, a relation that may include a causal connection.

Perception verbs with naked infinitival complements as in (67a) have been analysed in situation semantics as taking a situation as an argument (Barwise / Perry 1983). This proposal could be combined with truthmaking, as in (67b):

- (67) a. John saw Mary leave.
 b. $\exists s \exists e(\text{see}(e, \text{John}, s) \ \& \ s \Vdash \text{Mary leave})$

However, this could not be used for the semantics of perception verbs with NP-complements. Here the situations will rather be the satisfiers of the perception, the intensional object associated with *see*, as in the paraphrase of (68a) in (68b):

- (68) a. John saw at most ten trees.
 b. In any situation *s* exactly satisfying John's perception, there are at most ten trees in *s*.

A situation satisfying the perception may be the very same situation that would be the argument of *see* with a naked infinitive, but it plays a different semantic role.

The paraphrase in (67b) does not imply veridicality. Veridicality can be enforced by requiring a causal connection between the act of perception and its satisfier(s), with the effect that the situation(s) acting as satisfier(s) will be actual ones.

12.2. Constraints on the sharing of semantic objects with intensional transitive verbs

The second motivation for applying object-based truthmaker semantics to intensional transitive verbs comes from constraints on the sharing of their *semantic objects*, as I will call them (Moltmann 2008, 2013). The semantic objects of transitive *need*, for example, are the sorts of entities that relative clauses such as *what John needs* stand for. The descriptive generalizations about the sharing of semantic objects are as follows. Generally, extensional and intensional transitive verbs cannot share their semantic object:

- (69) a. ??? John met what Bill is looking for, namely a rich heiress.
 b. ??? John talked to what Bill needs, a competent assistant.

c. ?? John weighed what he was looking for, a suitcase.

Intensional transitive verbs can share their semantic object, namely if their intensional objects share satisfaction situations:

- (70) a. John promised Mary only what she really needed, namely a car.
 b. Mary needs what she lacks, a car.
 c. John offered Mary what she wanted (namely a glass of wine—he actually did not get to pour her one).
 d. I now own what I needed (namely half the estate).
 e. He accepted what I offered him (namely a glass of wine, but before I could pour him one, a fire broke out).

In (70a) the satisfaction situation of John's promise, situations in which Mary got a car, are also satisfaction situations of Mary's need (for a car), and similarly for (70b). (70c-e) are examples of intensional uses of verbs of possession and absence whose intensional objects share satisfaction situations.

Sharing of semantic objects is also possible if the intensional objects share types of satisfaction situations.

- (71) a. John promised Mary what Sue really needs, namely a car.
 b. John himself lacks what Mary needs, a car.
 c. John has found what Bill is still looking for, namely a person who can do the job.

In (71a), John's promise and Sue's need share a type of satisfaction situation, namely of someone having a car, and similarly for (71b). A type of situation may be construed either as a set or plurality of situations or else as situation involving unspecific, parametric objects.

Even apparently extensional verbs and intensional verbs can under particular circumstances share their object, namely when the (apparently) extensional verb describes an event resulting in a situation or type of situation that is a satisfier of the intensional object associated with the intensional verb, as is the case for *buy* and *need* below:

- (72) a. John bought what he needed, a car.
 b. John bought what Mary really needs (but John did not buy it for her)

In (72a), an actual situation that results from the purchase is also a satisfaction of the need. In (72b) it is a type of situation that is so shared. In the examples below, the state (or type of state) described by *have* acts itself as a satisfaction situation of the need:

- (73) a. John has what Mary needs. (Thus Mary should ask John for it.)
 b. John has what Mary once needed.

Buy and *have* are verbs of possession and thus have an intensional interpretation. If they have an intensional interpretation in (72a, b) and (73a, b) as well, that will explain their ability to share their semantic object with an obviously intensional verb. Verbs of possession will then generally be associated with intensional objects of the sort of purchases, ownerships, offers, etc, which may have different situations as satisfiers or just a single, actual situation acting as a satisfier. In (74), sharing is possible with two verbs of possession that may involve different satisfiers.

- (74) John now owns what he bought over the internet (namely some bottle or other of that wine).

The verbs *find* and *look for* display three different readings, all of which permit sharing:

- (75) a. John found what he was looking for, a house. (finding as ‘coming across’)
 b. John found what he was looking for, an assistant. (finding as ‘hiring’)
 c. John found what he was looking for, a role model. (finding as ‘recognizing’)

Satisfaction situations of findings are simply the actual situations resulting from the findings. A finding (in the sense of coming across, of nomination, or recognition) with its resulting situations must be causally connected to the corresponding search. Thus the satisfaction situations involved in (75a-c) require a causal connection to the search.

Not all intensional transitive verbs permit the sharing of their semantic objects, for example not the verbs below:

- (76) a. ?? John painted what Mary needs / recognized / owns / described, namely a castle.
 b. ?? John recognized (when looking at the picture) what Mary needs, a castle.

c. ?? John found what Mary mentioned, a large suitcase.

The reason is that those verbs do not share their semantic objects.

What are the semantic objects that intensional transitive verbs can share, that is, what are the denotations of free relative clauses like *what John needs*? They are what I call *variable satisfiers* (Moltmann 2013), a notion that derives from the notion of a variable embodiment of Fine (1999). A variable embodiment is an entity (of type *e*) that is associated with a partial function from circumstances to manifestations and that inherits existence and location properties as well as circumstance-relative properties from its manifestations (at circumstances). The variable satisfier of an intensional object *o* is an entity associated with a manifestation function *F* that is defined for all and only the satisfaction situations of *o* and that maps any satisfaction situation of *o* to entities in *s* that have the relevant properties in *s*. Thus, if John needs a book, then ‘what John needs’ is the variable satisfier described in (77a):

(77) [*what John needs*] = the object *o* such that for any situation *s* satisfying John’s need, the manifestation of *o* in *s* is the books John has in *s*.

The motivation for the plural ‘books’ in (77) is that a situation that is an exact satisfier may very well contain two books (since it need not be a minimal satisfaction situation) (Fine, to appear).

A few more remarks about (77) are in order. First, the need may impose more specific conditions on a book in a situation of satisfaction (which the speaker need not know about). Second, there may be different situations as part of the same world that contain books that meet the need (all of which count as satisfaction situations). In a given world there may be books John has that are not part of a situation that exactly meets John’s needs. What matters are books in situations wholly relevant for the satisfaction of the need, not entire worlds in which the need is satisfied.

We can then formulate the manifestation of the variable satisfier of John’s need at a satisfaction situation *s* more formally as below, making use of the plural variable *dd*, which can stand for several objects at once:

(77) $F(s) = \max dd[\exists s'(s' < s \ \& \ s' \Vdash \text{HAVE}(\text{John}, dd) \ \& \ \text{book}(d))]$

That is, the manifestation of the variable satisfier of John's need is the maximal plurality of entities dd such that for some part of s' of s , s' is an exact truthmaker of 'HAVE(John, dd) & book(d)'.

The variable satisfiers need not strictly be the same for intensional verbs to share their semantic objects. They just need to share a common part, given the part relation among variable satisfiers below (where F is the manifestation function):

(78) For variable satisfiers d and d' , $d \leq d'$ iff for any situation s for which $F(d)$ is defined, $F(d')$ is defined as well and is $F(d)(s) = F(d')(s)$.

For two intensional transitive verbs to share their semantic object then means that the variable satisfiers of the intensional objects they describe share a common part.

13. 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 present 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 categories of modal and intensional objects. It 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), purchases, offers, and debts.

There are more specific motivations for object-based truthmaker semantics. One of them is the dependence of truthmakers on modal and attitudinal objects, which manifests itself in the distinction between weak and strong permissions, the possibility of underspecification of the content of the attitudinal, modal, or intensional object by the complement clause,

sentential unit or NP complement, as well as causal or other connections in some cases between an object and its satisfiers.

The paper has outlined a semantics of attitude reports and modals on which, a sentence embedded under an attitude verb semantically acts as a predicate of the attitudinal object associated with the verb, and the sentential unit associated with a modal as a predicate of the modal object that is an implicit argument of the modal. This semantics is (almost) overtly reflected in complex predicates of the sort *make the claim*, which often alternate with simple predicates like *claim*.

The semantics of attitude reports is able to overcome a range of difficulties for the standard proposition-based Relational Analysis, which include empirical and conceptual difficulties for the Relational Analysis as such, as well as difficulties with the notion of an abstract proposition and the involvement of propositions in the semantics of attitude reports.

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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