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**A Truthmaker Semantics for Modals with Modal Objects**

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**1. Modals as quantifiers and as predicates**

The standard quantificational account of modals

Modal logic: Modals represent quantifiers ranging over (accessible) possible worlds

Kratzer (1977): contextually given modal base (set of worlds) and ordering source (set of ideal worlds inducing ordering among worlds)

(1) a. John may leave.

 b. ∃w (w ∈ f(wo) & [*John leave*]w = true)

(2) a. John must leave.

 b. ∀w(w ∈ f(wo) → [*John leave*]w = true)

Kinds of modal predicates

(3) a. might, may, must, should (modal auxiliaries)

 b. ought to, need to, have to (modal verbs)

 c. is possible that, is necessary that, is able to (modal adjectives)

Nominalizations of modals, nouns corresponding to modals

*need, permission, obligation, offer, invitation, ability, essence*

Two semantic issues regarding modal predicates

[1] What do nominalizations of modal predicates describe?

[2] What if any is the Davidsonian (event) argument of modal predicates?

The present approach

Answers to 1 and 2 shed light on the semantics of modal verbs and motivate the view that

modals are predicates of ‘modal objects’, the Davidsonian arguments of modal predicates.

Modal objects

Particulars, features of concreteness (come into and go out existence), dependent on particular individual

Share a range of characteristics:

* satisfaction conditions
* similarity relations based on shared content
* part structure based on partial content

Deontic modal objects

abstract artifacts that may be produced by an illocutionary act

Modal objects not produced by actions

(certain) needs, abilities, essences, natures

Kinds of modal objects,

The obligation to help’, ‘the need to work’, ‘the ability to walk’, ‘the nature of human beings’

The logical form of modal sentences

(4) a. John needs to leave.

 b. John has a need to leave.

 c. ∃d(need(d) & [*John to leave*](d))

(5) a. John is permitted to leave.

 b. John has a permission to leave.

 c. ∃d(is permitted(d, John) & [*John to leave*](d))

How can clauses act as predicates of modal objects?

They specify the satisfiers and violators of the modal object (in roughly the sense Kit Fine’s (to appear) Truthmaker Semantics)

Difference between modals of necessity and of possibility

Modal objects of necessity: have satisfiers and violators

Modal objects of possibility: have only satisfiers

No difference in terms of quantifiers at logical form

Attitudinal objects

Beliefs, intentions, fears, desires, thoughts, judgments, decisions claims, requests, promises

Are particulars, features of concreteness

Share characteristics of modal objects:

* Truth or satisfaction conditions
* Similarity relations based on being the same in content
* Part structure based on partial content (in the sense of Yablo 2014)

Cognitive products : thoughts, judgments, decisions

Illocutionary products: claims, requests; promises

Abstract artifacts produced by cognitive or illocutionary acts

Semantics of attitude reports

(6) a. John claimed that S.

 b. John made the claim that S.

 c. ∃e(claim(e, John) & [*S*](prod(e)))

Modal objects share satisfiers with illocutionary products produced by the same act:

Obligation – request

Permission (as a modal product product) – permission (as an illocutionary product)

Offer (as a modal product) – offer (as an illocutionary product)

Difference between modal and illocutionary products

Endurance conditions, reflected in the choice of tense in specificational sentences

Situation: Yesterday John requested that Mary leave today.

(7) a. John’s request was / ??? is that Mary should leave today.

 b. Mary’s obligation (resulting from John’s request) is / ??? was to leave.

Situation: Yesterday John offered Mary to use the house today.

 c. The offer was / is for Mary to use the house.

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**2. The Davidsonian argument of modal predicates**

Davidsonian event semantics

The semantics of (VP-) adverbials

(8) a. John walked slowly.

 b. ∃e(walk(e, John) & slow (e))

 c. John’s slow walk.

Adverbials applicable to modal verbs

Temporal adverbials, causal adverbials, degree adverbials (predicates of strength of force) (*completely impossible, highly able, somewhat necessary*)

Applicability of the same sorts of modifiers to nominalizations

(9) a. the need today to leave early, the obligation last year to help Mary

 b. the complete impossibility, the slight possibility / ability

Modal objects as the implicit Davidsonian arguments of modal predicates.

Sentential unit associated with the modal as a predicate of the modal object:

(10) a. John must help.

 b. ∃e(must(e) & [*John help*](e))

(11) a. John may leave.

 b. ∃e(may(e) & [*John leave*](e))

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**3. Nominalizations of modal predicates**

**3.1. Nouns for modal objects**

Neutral modal nouns

(12) John’s need to learn more

Modal objects related to directive illocutionary and mental acts

(13) permission, obligation, offer, invitation

Ability modals

(14) ability, capability

Underived nouns for modal objects

(15) a. duty, rule, law, principle, option

 b. essence, nature

Properties of modal objects

Features of concreteness: existence in time, may enter causal relations

Specific existence predicates: *hold, be valid, obtain, exist* (?)

Content-related properties

[1] Satisfaction (and possibly violation) conditions

(16) a. The obligation was fulfilled.

 b. The need was satisfied.

 c. The offer / invitation was taken up.

[2] Similarity relations based on shared content

(17) John’s offer is the same as Bill’s (namely for Mary to use the house).

[3] Part structure based on partial content

Partial satisfaction (Moltmann 2017b)

(18) a. Mary fulfilled part of her obligation / fulfilled partially her obligation.

 b. Part of John’s need was satisfied.

 c. John took up part of the offer / partially took up the offer.

Partial validity / existence (Moltmann 2017b)

(19) a. Part of the obligation still obtains.

 b. The obligation still obtains in part.

(19’) a. Part of the law is still valid.

 b. The law is still partly valid.

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**4. A semantics of modals based on modal objects**

**4.1. Modal objects**

Sentential unit associated with the modal specifies the satisfaction conditions of the modal object, that is, its satisfiers and possibly violators:

*By*-phrases make satisfiers explicit

(20) a. John’s need was fulfilled by having X be done.

 b. The obligation was met by doing X.

 c. The offer was taken up / was accepted by doing X.

**4.2. Fine’s (to appear) truthmaker semantics**

(Exact) truthmaking

A situation s is an exact truthmaker of a sentence S iff s is wholly relevant for the truth of S.

The meaning of a declarative sentence

The pair consisting of the set of its verifiers and the set of its falsifiers

(Exact) satisfaction for the semantics of imperatives

Exact satisfaction as relation between an action and an imperative

The meaning of an imperative

The pair consisting of the set of its satisfiers (actions complying with the imperative) and the set of its violators (actions contravening the imperative)

Standard truthmaking conditions:

(16) a. s ╟ P *and* Q iff for some s’ and s’’, s = sum(s’, s’’) and s’ ╟ P and s’’ ╟ Q.

 b. s ╟ P *or* Q iff s ╟ P or s ╟ Q

 c. s ╟ ∃x S iff s ╟ S [x/t] for some term / object t

(Exact) falsemaking for the truthmaking condition on negative sentences:

s ╢ S: S is false in virtue of s (entirely)

(17) s ╟ *not* S iff s ╢ S

Motivations for truthmaker semantics from imperatives and permission sentences (Fine to appear)

Get inferential relations among imperatives and deontic modals right (Ross’ paradox):

(18) a. Take an apple!

 b. Take an apple or the gold!

(19) a. You may take an apple.

 b. You may take an apple or the gold.

Consequence relation in terms of partial content:

Imperative B is a consequence of imperative A iff every satisfier of A contains a satisfier of B and every satisfier of B is contained in a satisfier of A.

Underspecification

(20) John needs to catch a fish.

(21) Sentence Meanings as Properties of (Attitudinal and) Modal Objects (First Version)

 [S] = λd[∀s(s ╟ d → s ╠ S)]

╟ : the exact satisfaction relation between a situation or action and an attitudinal or modal object

╠ : the relation of inexact truthmaking between a situation or action and a sentence.

**4.3. Truthmaker semantics for illocutionary act reports**

The action-product distinction (Twardowski 2011, Moltmann 2014, 2017a)

Only products, not actions have truth or satisfaction conditions and thus truthmakers or satisfiers.

 (22) a. John’s claim is true.

 b. John’s speech act is ??? true.

(23) a. John’s request was fulfilled / was followed.

 b. ?? John’s act of requesting was fulfilled / was followed.

(24) a. John’s offer was taken up / was accepted.

 b. ?? John’s act of offering was taken up / was accepted.

Similarity relations:

(25) a. John’s claim was the same as Mary’s.

 b. John’s speech act was the same as Mary’s.

 c. ??? John’s claim is Mary’s claim.

(26) John’s belief is the same as Mary’s

Partial content:

(27) a. Part of John’s claim / belief is true.

 b. John’s claim / belief is partly true.

Attitude reports

(28) a. John asked to leave.

 b. John wants to win.

(29) a. ∃e(ask(e) & [*John to leave*] (product(e)))

 b. ∃e(want(e) & [*John to win*](e))

**4.4. Modal objects and their satisfaction and violation conditions**

Modal objects as entities with satisfiers and violators:

John’s obligation to help

satisfiers: actions fulfilling the obligation

violators: actions incompatible with the fulfillment of the obligation

John’s permission to leave

has only satisfiers: actions of John’s leaving

Difference between deontic modals of obligation and permission:

Obligations have satisfiers and violators, permissions have only satisfiers

(30) Sentence Meanings as Properties of (Attitudinal and) Modal Objects (Second Version)

 [S] = λd[∀s(s ╟ d → s ∈ ╠ S) & ∀s(s ╢ d → s ╣ S)]

╣: the relation of inexact falsemaking

Accounting for logical connection between modals of possibility and modals of necessity

Bu restricting relevant domain of modal objects, and having modal objects be generated under particular conditions.

(31) must ¬ S ↔ ¬ may S

Roughly:

There is a relevant modal product whose satisfiers make S false and whose violators make S true. If that is the only modal object around, this means that there is no relevant modal product whose satisfiers make S true and that does not have violators.

Illocutionary acts of obligation and permission

(32) a. John asked Mary to come.

 b. John invited Mary to come.

(33) a. ∃e(ask(e, John, Mary) & [*Mary come*](product(e )))

 b. ∃e(invite(e, John, Mary) & [*Mary come*](product(e )))

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**5. Application to other modalities**

Ability modals

(34) John is able to walk.

Abilities as modal objects

- Satisfaction conditions:

Satisfiers of an ability: its physical manifestations; abilities have only satisfiers, not violators

- Similarity relations:

(35) John’s ability is the same as Mary’s.

Partial content:

(36) Part of John’s ability consists in being able to walk on his hands.

Metaphysical necessity as essential truth (Fine 1994)

Essence as a modal object (or kind of modal object)

Aristotle: essence an entity distinct from the object itself

Satisfaction conditions: Truthmakers of an essence are the situations exactly reflecting essential properties

Similarity relations

Partial content:

(37) To be round is part of the nature of an apple.

(38) a. Socrates is necessarily / essentially a man

 b. ∃d (E(s)(d) & [*Socrates is a man*](d))

 c. ∃d (necessarily(d) & [*Socrates is a man*](d))

Epistemic modals

Evidence, accepted facts, ‘common ground’ ‘generate’ two sorts of modal objects:

- modal objects of possibility (whose satisfiers are situations supported by the evidence, facts, common ground)

- modal objects of necessity (whose satisfiers are situations supported and whose violators are excluded by the evidence, facts, common ground)

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**6. Connections between modals and propositional attitudes**

 (39) a. Yesterday John permitted Mary to leave (today)

 b. Today, Mary has the permission to leave.

 c. Today Mary may leave.

 (40) a. John yesterday promised to help (today).

 b. John today has the obligation to help.

 c. Today, John must leave.

The illocutionary act produces both a (non-enduring) illocutionary product and an (enduring) modal object, which share exactly the same satisfiers (and possibly violators).

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