Semantics and Ontology: On the Modal Structure of an Epistemic Theory of Meaning

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In this paper I shall confront three basic questions.

First, the relevance of epistemic structures, as formalized and dealt with by current epistemic logics, for a general Theory of meaning. Here I acknowledge M. Dummett’s idea that a systematic account of what is meaning of an arbitrary language subsystem must especially take into account the inferential components of meaning itself. That is, an analysis of meaning comprehension processes, given in terms of epistemic logics and semantics for epistemic notions.

The second and third questions relate to the ontological and epistemological framework for this approach. Concerning the epistemological aspects of an epistemic theory of meaning, the question is: how epistemic logics can eventually account for the informative character of meaning comprehension processes. “Information” seems to be built in the very formal structure of epistemic processes, and should be exhibited in modal and possible-world semantics for propositional knowledge and belief. However, it is not yet clear what is e.g. a possible world. That is: how it can be defined semantically, other than by accessibility rules which merely define it by considering its set-theoretic relations with other sets-possible worlds. Therefore, it is not clear which is the epistemological status of propositional information contained in the structural aspects of possible world semantics. The problem here seems to be what kind of meaning one attributes to the modal notion of possibility, thus allowing semantical and syntactical selectors for possibilities. This is a typically Dummett-style problem.

The third question is linked with this epistemological problem, since it is its ontological counterpart. It concerns the limits of the logical space and of logical semantics for a of meaning. That is, it is concerned with the kind of structure described by inferential processes, thought, in a fregean perspective, as pre-conditions of entensional treatment of meaning itself. The second and third questions relate to some observations in Wittgenstein’s *Tractatus*. I shall also try to show how their behaviour limits the explicative power of some semantics for epistemic logics (Konoigie’s and Levesque’s for knowledge and belief).

1. Relevance of epistemic modal notions and inferences for a Theory of meaning

Dummett’s basic idea is that a systematic and non-modest theory of meaning must account for what it means to understand a statement. In Dummett’s view, this account must possibly support a constructive metaphysical option. But as stated in *The logical basis of Metaphysics*, metaphysical questions and statements themselves depend on semantic assumptions and pre-semantics ways of considering formal structures relevant for meaning (thus, also on syntactical ways of accounting for combinatorial aspects linked to compositionality).

Dummett assumes that molecularism, as opposed to holism, allows for a heuristically interesting treatment of modalities of meaning, taken to be similar to fregean *Sinne*. He approaches this by asking a question concern-
side: what happens when I take possibility to be a meta-
semantical structure, therefore defining the limits of logical
space. As we shall see, both these questions directly
determine the heuristic and expressive capacity of epis-
temic systems. But let us first give a brief account of how
the epistemological-ontological pair can be treated.

2. Wittgenstein and Carnap on possible worlds: ontology and semantics

Traditionally, there are two basic ways of confronting the
question. The first is suggested by the essentialist
approach found in the Tractatus; the second is typically
Carnap’s view on deductive logics and its abstract
ontology.

Wittgenstein’s Tractatus offers an important account of
how modality as a pre-semantic tool should be viewed.
The account is based on a quasi-reduction of
epistemology (how we should understand contextual
meaningful structures) to metaphysics.

It then reduces the question concerning the structure of
our epistemic access to meaningful configurations to the
question of the latter’s real structure – thus defining the
notion of possibility as a realistic notion based on real
(physical?) combinatory modalities.

Wittgenstein’s modal atomism, as Bradley among others
has defined it, plays on the notion of logical form, and on
the general framework used to explain this notion, that is:
a picture theory of language. In this account, logical form
exhibits modality as the fundamental property of language,
a property that (opposite to Frege’s analysis of meaning as
sense in indirect contexts, where modality turn up to be the
new denoted) cannot be denoted because it defines the
limits of denotation. As it is said in the Notebooks, giving
the “nature of the proposition” can be equally thought as
“giving the nature of all being” (January 22th 1915). In the
Tractatus, propositions (information expressed by
statements) are concatenations of names. Combinatory
conditions of an object (thus of its denoting term) are
assumed as a basic structure. Because of the shift of
combinatory calculus from syntactic to semantical level,
such conditions are the possibility conditions of factual
structures in which an object can enter as a constituent.
Logical form is thus a possibility of structure bear by
objects. Objects are then defined by modal relations
constituting “states of affairs”. Possibility attains to states
of affairs themselves (Tlp 2.061-062). A proposition (a
propositional context) shows a formal partition on the set of
all possible states of affairs relevant for object-name’s
meaning. It exhibits which states of affairs are made actual
(as a meaning context for the atom-expression considered)
and which ones are not. Consequently, “a proposition
shows how things are, and says that they are so and so”
(Tlp 4.022). Here the formal structure shown is the limiting
pre-condition for what is said; therefore no analysis is
possible on which criteria we have for selecting sub-
structures relevant at each stage for the meaning of the
language sub-systems considered. These criteria are not a
matter of stipulation.

Thus if understanding a proposition means knowing what
happens if it is true (if the assertion expressing it is
ture), the meta-semantical conditions on “what happens”
cannot be represented and analysed in logical terms. This
is because the analysis would then have as its object the
set of possibility conditions one of whose sub-sets is the
possibility condition of analysis itself.

Logical statements take as their object this formal
structure, which is also their form. Thus, it is a non-sense,
in Wittgenstein’s terms, to proceed from the level of mere
showing (e.g. a tautology shows that it is a tautology) to
that of representing (the conditions because of which the
tautology is a tautology). The information context expressed
by a proposition is then given in structural and non-
epistemic terms. Its comprehension is at the same time
the very limit of inferential process constituting meaning com-
prehension. Modality is here a tool for selection of possible
sub-systems inside a universe-set, and it says nothing
about itself (about the criteria for selecting). One may
say that this depends partly from a fregean heritage (con-
sisting in taking generality as the object of logical analysis),
partly from a biased metaphysic view (assigning to
generality a non-constructivistic status). However, how
strange as this might seem, similar problems are at issue
also in a conventionalist approach like Carnap’s, suggest-
ing that something very important concerning the opera-
tional structure of modality (thus its epistemic properties)
remains problematic. Better said, suggesting that a non-
traditional ontological treatment of modality is strongly
needed - one able to overcome classical distinctions
between realism and anti-realism for what concerns the
informative character of possibility-selection structures as
basic modal structures for meaning comprehension
processes. Thus, for the truly epistemic component of
meaning.

Carnap’s treatment of modality can be viewed as a sub-
set of semantic and syntactic analysis for mathematical
and logical propositions. Since traditional empiricist criteria
for significance cannot applied to denoted abstract entities
of mathematics, the question arises of what constitutes a
significance truth-functional criteria for abstract semantics.
One needs to ask what kind of reality is desired by
syntactical constructions, e.g. to explicit the ontology
underneath treatment of derivations and proofs and
formulate hypothesis on what kind of status attains to
epistemic structures and inferences (to the semantic
selectors of possibilities relevant for comprehension of a
language sub-system, since they also exhibit meta-
semantical properties). Carnap’s idea is that meaning is
given by inferential connections from statements to
verification or truth conditions, and that truth and falsity
of mathematical statements is built into the very structure
constuitive of these connections. So mathematics and
logics study the articulation of inferential consequences
admissible from systematic premises. Such premises are
defined as merely conventional.

Consequently, modality is a property attaining to this
epistemic (syntactical) structure. It therefore does not
describe anything, since it contributes to define the way we
to refer to anything, which is exactly what is described by
logics. In a way, all logic is epistemic, and its meta-
semantical pre-conditions are not a matter of ontology or
epistemology, but rather a pragmatic one. So structural
necessity in meta-semantical terms, and concerning
questions of foundation, is not ontological. It is an arbitrary
criterion for conditionalization of possibilities inside the
chosen logical net. Possibilities are then merely inferential
tools, and completely de-substantialized.

Carnap’s state descriptions are based on this approach.
Think for example of the definition of L-equivalence as
equivalence of an informational content which is defined
by mapping inferential structures onto the formal syntacti-
cal criteria adopted for defining state descriptions. So, they
are actually mapped onto themselves. The heuristic
capacity of Carnap’s modal logic seems to be none. It
cannot give any account of the criteria for defining what
What we need here is a semantical tool to specify how the syntactic aspect of combinatory rules relates to the semantical notion of possibility, and how this relation tells the syntactic structures. The notion of information conveyed by selection of relevant possibilities is here fundamental. It is clear that a condition for expliciting this notion is to adopt a propositional treatment of modality, on which epistemic structures are mapped. So that “possible states of the worlds” are in some way distinguished and related to epistemic inferential ways of having access to them. Classical examples of this approach are given by Hintikka’s game theoretic semantics, by Fine’s analysis of e.g. propositional disjunction, and finally by cluster-models for possible world semantics – where the latter directly takes into account the epistemological space in which semantics is viewed.

Generally, propositional semantics seem to be much more interesting than merely syntactical approaches. We shall better see this in viewing Konolige’s in logics and Levesque’s system for implicit and explicit belief.

Before turning to these, just a brief observation. Ontological problems concerning possible worlds semantics have traditionally been treated in two different ways. One is typically Kripke’s: ontology is given in terms of definition of identity and rigidity of designators. This is, however, an approach trying to fix the semantical space of modality from an ententional point of view. The second approach consists in saying what a possible world is directly in metaphysical terms: this is typically David Lewis’ approach.

It seems that definitions in terms of semantics, which only as a second step tie semantics to ontology, are rather problematic. Even if we say that a possible world is a counterfactual, this does not tell us anything about the semantic and ontological structure of “counterfactuality”. Nor, of course, can we give credit to the idea that a purely infra-systemic notion of a possible world as a maximal consistent set of well formed propositions is sufficient.

One might reply that this cluster of problems simply does not make sense. The idea would then be to leave out any meta-semantic option, and go for an interpretation of possible worlds as merely useful tools for logical analysis of correct and valid inferences in an axiomatized logical system. However, this will not do if the aim is to use possible world semantics for an epistemic theory of meaning. Here it seems essential to investigate the structure onto which epistemic inferences are built, taking seriously Frege’s idea about links between Sinn and \textbf{Sinn} and \textbf{Bedeutung}, both in terms of model-theoretic properties and of formally ontological assumptions. The question then becomes: since propositional modality carries the (formal) information about meaning, as well as its epistemic conditionalization to the structure exhibited by modality itself, then how is this conditionalization to be investigated? (Different ways of having access to what is denoted actually determine the structure of the process of information building implied by comprehension).

3. Two epistemic logics and relevant ontological questions

The concept of semantic information has been at the core of knowledge basis representation in AI. Two paths have traditionally been followed. The first one is given by attempts to represent conceptual links through semantic web and frames. This one we shall leave out, mostly because it is concerned with a specific way of tracing the link from semantics to ontology, linked to Carnap’s meaning postulates and Putnam’s basic properties of what is denoted, only secondarily concerned with the inferential structures of epistemic meaning comprehension processes. Instead, we shall briefly follow the path of formal ontology for epistemic structures, although in a way the two paths are obviously linked.

From the viewpoint of epistemic logic, modality is to be treated as the meta-semantical conditionalization of epistemic structures (knowledge and belief), functions and operations defined on semantics – the latter describing reasoning processes inside the logical modal space. A possible world can then be defined in terms of a state of information in propositional terms, and epistemic relations are mapped onto this structure to account e.g. for belief or knowledge semantical conditions from the viewpoint of set-theoretic semantics. Here a central notion seems to be that of propositional indeterminacy, for the treatment of which a non-normal modal approach to possible worlds is obviously required. The definition of propositional indeterminacy in epistemic logic has been a fundamental tool against logical omniscience. The notion of indeterminacy is parasitic on that of possibility, so again we are confronted with our basic problem. There are mainly two basic ways of treating indeterminacy and thus possibility, in formalizing information acquisition processes.

The first way is to use a syntactical approach, and Konolige’s system, proposed in 1986, gives us an interesting example of it. The example is obviously linked with an internalist position such as Moore’s and Hendrix’s hypothesis – thus owing much to the psychologist account of epistemic modality, and very little to the idea that modality should be taken as something contributing to explain how language fits some formal structure of reality. Konolige takes beliefs held by epistemic subjects to be sets of formulas, e.g. statements and not propositions, deductively closed under logically incomplete rules of inferences. Properties of beliefs are operationalized inside deduction structures associated with subjects. A deduction structure is a structure \(d(i)\) made up by a pair \(\langle b(i), p(i)\rangle\) (a sub-set of believed formulas and a set of rules of inferences). Belief relation is then represented as a structure:

\[
\text{Bel}\langle b(i), p(i)\rangle = \{ a \mid b(i) \models a \}
\]

The system is thought as a way to give account of provinciality of belief structures, that is: it is established that the number of premises for every rule application must be fixed and finite. So, every inference from a defined belief sub-set is independent from the whole belief set. Semantically, here you have a classical set-theoretic notion of interpretation for the non-modal sub-subsets, plus the syntactic sieves for the modal formulas.

So, for example, \(M\models p\) (for an atomic \(p\)) iff \(p(p)\); \(M\models a\land b\) iff \(M\models a\) and \(M\models b\), and so on. For the modal belief relation: \(M\models B\ a\) (that is: it is true under interpretation \(M\) that \(a\) “is” believed) iff \(a \in \text{Bel}(d(i))\), where \(d(i)\) belongs to the set of deduction structures or points of view considered. For the axiomatization: the semantics is correct under PC axioms, modus ponens, a specification of a set of deduction rules for every deduction structure and, most important, a linking rule LR for which:

\[
\text{From } B\ a_1 \ldots A\ a_n \text{ and from } a_1 \ldots a_n \models b, \text{ it follows that } B\ b.
\]
The linking rule allows inferences through the link with syntactic structure in the model. Obviously the system does not use the notion of "possible world". It therefore tries to avoid problems concerning propositional possibility. Inferential structures produce a formal partition on the universe-set, dividing statements believed from statements not believed through the sieve given by syntactic consequence relations. These are in turn based on the meaning of logical constants, given in merely combinatorial terms by the underlying meta-linguistic theory. However, here the informative content of meaning is completely left out, precisely because there is no propositional structure onto which inference models are mapped onto. As a matter of fact, in syntactic models the latter are mapped onto themselves. This has in turn a consequence on the formal deduction relations: the only condition posed on a deduction is syntactic consistency, whereas the propositional approach suggests that epistemic modality must in some way be related to some stronger semantical condition specifying the formal structure of our way of believing (and knowing) things. In other words: something concerning the formal partition on reality considered must account for the way we relate to reality (here reality is intended in a weak sense: as a set of objects and links among objects, eventually computable as functions and operations on them). From our point of view, even if syntactical accounts such as Konolige's allow for acquisition of information through application of established deduction rules, this information is not at all an information property (that is: something saying what kind of formal structure of reality should hold if the belief were taken to be true). Also: indeterminacy is taken to be only an inferential limit.

Propositional accounts of modal epistemic notions try to do for this; however, they are limited by lack of ontological investigation and semantical specification. Think for example of Levesque's logics for implicit and explicit belief (1985). Here the informative property of modality is accounted for through semantical indeterminacy—that is, by assuming non classical worlds and treating them as situations (where the terminology is an heritage from Barwise and Perry). Situations shape the sub-set of reality taken to be relevant for a subject's believes, and leave everything else as indeterminate. Of course the notion of "being indeterminable" is conditionalized to a determinate background of implicit beliefs. These describe "not what an agent takes to be true, but what reality would be if what he believed were true". Normal possible worlds are used to account for implicit belief; the semantics for explicit belief is given in terms of situations, propositional sub-sets whose intensions may well lack of a proper informative content (for example when situations are inconsistent, that is: there is at least a proposition of the sub-set to which both "t" and "f" are assigned, or incomplete, that is: the truth value assigned is Ø). Here the main interpretation schemes are given by:

\begin{itemize}
  \item i) \( M, s \models E \text{a if } M, s' \models \text{a for all situations } s' \text{ belonging to } B \text{ (set of beliefs)} \)
  \item ii) \( M, s \models E \text{a if } M, s' \models \text{a for all } s' \text{ belonging to } W(B) \text{ (set of possible worlds consistent with beliefs)} \)
  \item iii) \( M, s \models B \text{a if } M, s \models \text{a for all } s' \text{ belonging to } W(B) \text{ (set of possible worlds consistent with beliefs)} \)
  \item iv) \( M, s \models B \text{a if } M, s \models \text{a for all } s' \text{ belonging to } W(B) \text{ (set of possible worlds consistent with beliefs)} \)
\end{itemize}

While \( B \) is closed under implication, \( E \) (explicit belief) is not (we shall leave out examples of this, since they are quite obvious to imagine if we consider inconsistent situations). Also, of course, \( Ea \rightarrow Ba \). The latter is again the obvious precondition for iii), since it states the condition at which possible world can complete incomplete situations for explicit belief. However, our problem turns up again. That is: which is the structure of the process of information acquisition allowing to know criteria for relevancy, so that what is indeterminate can at some point of inferential processes be determined?

Another very simple example of the problem can be found in a very common semantical property assigned to propositional belief relations. That is, the closure property with respect to set-intersection. So:

For every \( w \) belonging to the set \( W \) and for every proposition \( X \) and \( Y \) (thinkable as sets of worlds):

\[ X \models Y \text{ (the latter being the sub-set of possible worlds, or the common sub-set of sets of propositions on which a modal function is considered), then } X \models Y \text{ (and the inverse holds).} \]

In propositional terms, and recalling wittgensteinian terminology, this means: if you know the possible state of affair in which a propositions' conjunction is true, then you know the possible states of affairs in which each one of the propositions considered is true. But what kind of information is given by this "then"? Shouldn't such an information be semantically specified by accounting for semantical properties of the notion of possibility itself? How does the introduction of new ways of defining concepts implies new information? And how is this information to be thought (for example: as an introduction of new state of affairs or as a specification of known ones)? Modal notions convey an information which is in some way ubiquitous.

Some concluding remarks. A way to confront the semantical-ontological question of defining modal notions could be given by a strategic reduction of possibility to probability. Consequently, the notion of necessity would be treated as the conditioning reference term; in Kolmogorov's classical symbolism, necessity attains to the universe-set \( Q \), where Probability (\( Q \))=1. The axioms and formalizations of probability calculus could then be applied to epistemic calculus of belief and knowledge relations; something which would intuitively take up De Finetti's and Carnap's subjective interpretations of probability (De Finetti said that probabilities could be thought of as degrees of belief). This would seem at a first instance a nice way of relating language information-processing to some basic structure of reality, thus taking seriously both Maxwell's general idea that "the true logic of reality is the logic of probability" and Adams' version of probability as the study of propagation of probability in uncertain inferences (where both premises and conclusion are uncertain). The most interesting aspects of such an approach is probably given by what we are told by Kolmogorov's continuity and countable additivity axioms, establishing inversely proportional links between complexity of inferential processes and probabilities of conclusions.

On the other side, however, logical (as opposed to physical) interpretations of probability are confronted by general and specific problems similar to those attaining to the status of possibility and modal notions. So the question would be again: what shall we do with Wittgenstein's remarks, for which modality is to be taken as the very limit of the logical space?
References

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