Quantified modal logic and Quine’s epistemology of ontology

Antti Keskinen, MA
Researcher
Dept. of history and philosophy
University of Tampere
(Possibility of Metaphysics in 20th Century and Contemporary Philosophy)
“Everything is what it is, ask not what it may or must be.”

Willard Van Orman Quine
W.V.O. Quine (1908-2000)

- Writings on alethic modal logic
  - ”Whitehead and the Rise of Modern Logic” (1941)
  - ”Notes on Existence and Necessity” (1943)
  - ”The Problem of Interpreting Modal Logic” (1947)
- A Response to Ruth Barcan’s (Marcus) pioneer paper on quantified modal logic: ”A Functional Calculus of First Order Based on Strict Implication” (1946)
W.V.O. Quine (1908-2000)

– ”Reference and Modality” (1953; 1961; 1980)
– ”Three Grades of Modal Involvement” (1953)
– Word and Object (1960): §41
– ”Worlds Away” (1976)
– ”Intensions Revisited” (1977)
Three grades of modal involvement

1. Modal propositional logic with single occurrences of a modal operator
   - Formulas such as $\Box p \Downarrow$ ‘It is necessary that $p \Downarrow$, understood on the model of ‘‘All bachelors are single’ is necessarily true/analytic’
   - Semantic predicate: *Metalinguistic* predicate attached to *names* of object-language statements
   - The quotation paradigm (Orenstein 2002): accommodation into extensional language
• What are the criteria of ascribing this metalinguistic property to a sentence?
• Analyticity, truth by meaning
• The first grade can be construed as having to do with *linguistic* necessity
  → Quine’s critique of analyticity
2. Modal propositional logic with iterated occurrences of modal operators

- Formulas such as $\Box (\Diamond p \rightarrow \Box \Diamond p)$:
  「It is necessary that if it is possible that $p$ then it is necessary that it is possible that $p$」
  (a theorem of $S5$)
- Difficult to accommodate into the quotation paradigm
- We must take the modal operators as attaching to statements, not to names of statements $\rightarrow$ object-language operators
• ‘Genuine violation of extensionality’ in the second grade of modal involvement
• Modal operators as *sentential operators* – towards combination of quantification and modality
3. Quantified modal logic

- The "classical" example
  i. $\square(9 > 7)$
  ii. $9 = \text{the number of planets}$
  iii. $\square(\text{the number of planets} > 7)$
  iv. $\exists x \square(x > 7)$ (existential generalization)
Quantified modal logic

- Quantification as the paradigmatic way of talking about objects
  - Objectual interpretation of quantification
- Quine’s view of the criterion of ontological commitment
  - Not primarily singular terms, but quantification and predicates
Quantified modal logic

- According to Quine, all singular terms are eliminable from primitive notation
- Quine (1953/61/80): The problem of interpreting quantified modal logic can be put in terms of uniquely specifying conditions
Quantified modal logic

- (i) There are exactly $x$ planets
- (ii) $x = \sqrt{x} + \sqrt{x} + \sqrt{x} \neq \sqrt{x}$
- Specifying $x$ by means of (ii) makes $\lceil x > 7 \rceil$ necessary, while (i) does not
  - The object $x$ can be uniquely specified in different ways, not all of which necessitate satisfaction, by $x$, of the condition $\lceil x > 7 \rceil$
  - Cf. Føllesdal (2004a): Quine’s challenge does not depend on singular terms
Quantified modal logic

- Specified one way, the object seems to be necessarily greater than seven; specified another way, the very same object seems not to be necessarily greater than seven
- Unlike the first grade of modal involvement, first-order modal logic involves a nonlinguistic view of necessity – ”Metaphysical necessity”
Quantified modal logic

– Necessity involves objects and their *mode* of satisfying predicates
– Quine challenges *intelligibility* – does this make *any sense*?
– *Which* object are we talking about here?
Quantified modal logic

• The "which object" -problem
  – Objectual quantification into modal contexts does not have a clear interpretation
    • "Interpretation": *intended* interpretation of formulas (not "interpretation" as in formal semantics)
  – Quine’s challenge to quantified modal logic is misunderstood, if it is construed as a deductive argument involving singular terms (e.g., Ray 2000)
Quantified modal logic

• In 1947, Quine suggested that quantified modal logic accommodates only intensional objects ("individual concepts")
  – Carnap (1947)

• Quine (1960): leads to a "collapse of modal distinctions"

  – $y = z \rightarrow (p \rightarrow \Box p)^\uparrow$
  – (argument not valid against contemporary intensional semantics)
Quantified modal logic

• Føllesdal (1966, 41-42; 2004a):
  – Restricting the values of variables is, as Quine showed, not a good idea
  – The problem is the *singular terms and their semantics*, not the objects
  – Giving up "one-sorted semantics" in favor of a "two-sorted" one
Quantified modal logic

– The idea of rigid designation: *genuine singular terms* designate the same object in every possible world
– Føllesdal (1966; 2004b)
– Individual variables as unproblematic ”devices of pure reference” (1985); ”archetypical kinds of genuine singular terms” (2004b)
– The restricted notion of *reference*
Quantified modal logic

– Reference is not based on descriptive content
– Objects can be picked out by means of genuine singular terms
  • Solution to the ”which object” problem
– The required combination of referential transparency and extensional opacity
Quantified modal logic

– In his (1966/2004b), Føllesdal does not discuss the question how genuine singular terms are related to their objects
  • Theories of reference
– Føllesdal’s own (1966/2004b) characterization of a genuine singular term does not answer Quine’s which object -problem:
  • $\Box_1 \ldots \Box_m \exists y \Box_1 \ldots \Box_n \forall x (Fx \leftrightarrow x = y)$
  • $(\exists x) (Fx)$
Quantified modal logic

- Quine does make some sense of a "relative" notion of necessity
  - "Relative to a particular inquiry, some predicates may play a more basic role than others, or may apply more fixedly; and these may be treated as essential" (1977, 121)

- Relative to a given way of specifying an object, some predicates may be more basic than others
Quantified modal logic

• \( x = \sqrt{x} + \sqrt{x} + \sqrt{x} \neq \sqrt{x} \rightarrow x > 7 \)
  – Greaterness than seven is quite a basic property of the object in the context of mathematical inquiry, which is fixed in the antecedent – *taken as* such and such, it is firmly held that 9 is greater than seven

• There are exactly \( x \) planets \( \rightarrow x > 7 \)
  – \( x \)’s greaterness than 9 is not similarly basic in the context of astronomical inquiry, which is fixed in the antecedent
Quantified modal logic

- Quine’s holistic model:
  - The statement \( \forall x \ (x = \sqrt{x} + \sqrt{x} + \sqrt{x} \neq \sqrt{x} \rightarrow x > 7) \) is fairly centrally located in our ”theory of the world”: rejecting it would result in massive reorganisation of our theories
  - The statement \( \forall x \ (\text{There are exactly } x \text{ planets } \rightarrow x > 7) \) is not as central: rejecting it would be easier to accommodate
  - ”Conservatism”, ”maxim of minimum mutilation”
Quantified modal logic

– Given the notion of analyticity (or synonymy), the relative notion of necessity could be explained in linguistic terms
Quantified modal logic

- But the modal logician’s notion of essence is *not* relative in this way – she has to make sense of some attributes being necessarily true of an *object*, no matter how this object is specified.
Quantified modal logic

• ”An object, of itself and by whatever name or none, must be seen as having some of its traits necessarily and others contingently, despite the fact that the latter traits follow just as analytically from some ways of specifying the object as the former traits do from other ways of specifying it.” (1980, 155; my emphasis)
  – ”Aristotelian essentialism” (perhaps a badly chosen name)
Quantified modal logic

- "The way to do quantified modal logic, if at all, is to accept Aristotelian essentialism." (ibid., 156)
- Føllesdal (1966/2004b): "To make sense of Aristotelian essentialism and to make sense of open sentences with an ’□’ prefixed are one and the same problem."
- By using genuine singular terms to specify objects independently of descriptive content (predicates), we make sense of Aristotelian essentialism
Quantified modal logic

• "Just insofar as we are talking referentially of an object, with no special bias toward a background grouping [of the object as being of this or that sort], there is no semblance in sense in rating some of [its] attributes as necessary and others as contingent." (Quine 1960, 199, my emphasis)
Quantified modal logic

• With the help of a genuine singular term, we are purporting to be "talking referentially of an object, with no special bias" just in the way described in the quotation from Quine

• But Quine says that this does not make any sense to him
Quantified modal logic

- "My logical point about essentialism was that he who accepts quantification into modal contexts as making good sense should not balk at essentialism[. ] […] That was not an argument against essentialism. But it happens further that I do not myself make sense of essentialism, or of metaphysical necessity." ("Reply to Barcan Marcus" (1990), 244, my emphasis)
Quantified modal logic

• "If you have notations consisting of simply propositional functions (that is to say, predicates) and quantifiable variables, and truth functions, the whole problem remains. The distinction between proper names and descriptions is a red herring. So are the tags." (Quine in discussion with Marcus, Føllesdal, Kripke, in 1962)
Quantified modal logic

• Why is Quine unable to make sense of quantified modal logic with the help of the notion of a genuine singular term?
  – (Why does Quine not see that individual variables (and assignment functions) handle the problem - Føllesdal’s prime example of genuine singular terms)

• Quine’s grounds for his charge of unintelligibility can be found in his epistemology of ontology
Naturalized epistemology of ontology

- Naturalized epistemology
  - The study of the relation between evidence and theory
  - Given our "meager channels of information", how can we have achieved our science (in a broad sense of "science")
    - "As an empiricist I continue to think of the conceptual scheme of science as a tool, ultimately, for predicting future experience in the light of past experience."
    - Rudimentary science ("primitive induction") also in nonlinguistic animals
Naturalized epistemology of ontology

- “Science tells us that our only source of information about the external world is through the impact of light rays and molecules upon our sensory surfaces. Stimulated in these ways, we somehow evolve an elaborate and useful science. How do we do this, and why does the resulting science work so well? These are genuine questions, and no feigning of doubt is needed to appreciate them. They are scientific questions about a species of primates, and they are open to investigation in natural science, the very science whose acquisition is being investigated.” (Quine 1975, 288)
Naturalized epistemology of ontology

- "Observation" replaced with "observation sentence"
  - Speaking about language at the theoretical as well as the observational end
- "The verification theory of (cognitive) meaning"
  - "The meaning of a sentence lies in the observations that would support or refute it"
Naturalized epistemology of ontology

• An associationist model of learning
• A view about the process of language acquisition
  – Based on acquisition of observation sentences - ”the child’s entering wedge into language”
  – Can be learned by direct association, based on a primitive capacity for induction; ”standard animal training”
Naturalized epistemology of ontology

• "We see, then, a strategy for investigating the relation of evidential support, between observation and scientific theory. We can adopt a genetic approach, studying how theoretical language is learned. For the evidential relation is virtually enacted, it would seem, in the learning. This genetic strategy is attractive because the learning of language goes on in the world and is open to scientific study. It is a strategy for the scientific study of scientific method and evidence. We have here a good reason to regard the theory of language as vital to the theory of knowledge." (1975)
Naturalized epistemology of ontology

• How much of cognitive language can be acquired inductively, based on the association of observation sentences with ranges of neural input (according to standards of perceptual similarity)

• Talk about objects is already theoretical, part of our ”net contribution”
Naturalized epistemology of ontology

- Study of the positing of objects ("psychogenesis of reference", "reification")
  - Given our limited access to the world via the action potentials in receptors, how can we have acquired a conception of the world as consisting of objects?
  - Quine: a "Kantian" question - how is reification possible (1990, "Reply to Parsons", 291)
Naturalized epistemology of ontology

• "Natural science tells us that our ongoing cognitive access to the world around us is limited to meager channels. There is the triggering of our sensory receptors by the impact of molecules and light rays. Also there is the difference in muscular effort sensed in walking up or down hill. What more? [...] The very notion of an object at all, concrete or abstract, is a human contribution, a feature of our inherited apparatus for organizing the amorphous welter of neural input." (1992, 6)
Naturalized epistemology of ontology

- Focus on language in the study of reification
  - Quine’s demand for ’scientific standards’ and evidence
  - Quine’s view of thought as developing together with language - ”no disentangling” (1997)
The assuming of objects is a mental act, and mental acts are notoriously difficult to pin down -- this one more than most. Little can be done in the way of tracking thought processes except when we can put words to them. For something objective that we can get our teeth into we must go after the words. Words accompany thought for the most part anyway, and it is only as thoughts are expressed in words that we can specify them.

If we turn our attention to words, then *what had been a question of assuming objects becomes a question of verbal reference to objects*. (Quine 1981, 2; my emphasis)
Naturalized epistemology of ontology

- Some aspects of our "apparatus for organizing the welter of neural input" is inherited (innate), according to Quine
  - Global stimulus, receptual similarity
  - Perceptual similarity, pleasure/discomfort, traces → "the basis of all learning and habit formation", "primitive induction"
  - Innate features shaped by natural selection
  - A behaviorist model of learning
Quantified modal logic

- Reification
  - How can we have developed language, and especially reference to objects, given this model of learning?
  - Observation sentences *can* be learned "purely inductively"
  - If all language *could* be so learned on the basis of observation-sentence learning, epistemological *reduction* to observational language would perhaps be possible
Naturalized epistemology of ontology

- “Our talk of external things, our very notion of things, is just a conceptual apparatus that helps us to foresee and control the triggering of our sensory receptors in the light of previous triggering of our sensory receptors. The triggering, first and last, is all we have to go on.” (1981, 1-2)
Naturalized epistemology of ontology

- "Physical objects are conceptually imported into the situation as convenient intermediaries -- not by definition in terms of experience, but simply as irreducible posits, comparable, epistemologically, to the gods of Homer." (1951, 44)
Naturalized epistemology of ontology

- Observation sentences - stimulus meaning
  - Observation sentence are counterparts of "bird calls and apes’ cries" in humans

- Certain constructions, for example
  - A (is) in B
  - A (and) B, not A "When A, B"
  - A (is) B - predication: a step towards reification, but no full reification yet
Naturalized epistemology of ontology

• Eternal sentences
  – Fido (is a) dog; If dog, animal; When sunrise, birds sing; When raven, black (and) raven…
  – Free observational categorical: «When $A, B$»
    • Expression of an inductive generalization
    • The "first faltering scientific laws"
    • No reification: "albino ravens admissible as long as they keep close company with black ones"
    • Experience still in a "feature-placing stage"
Naturalized epistemology of ontology

- Objects are posited on the basis of observation-sentence learning
- Objects are posited as being of certain kind
  - The qualitative associations of observation sentences: classification by perceived features
  - The **irreducible leap** from "When raven, black (and) raven" to "Whenever a raven, it is a black raven" (focal observation categorical)
Naturalized epistemology of ontology

- Bodies, middle-sized material objects as first and most fundamental reifications; all other sorts of objects are reified "in analogy to them" (1995, 24)
  - Man as "body-minded animal" - perceptual salience
- Full reification also needs the development of "the schematism of space and time"
- Cross-moment individuation makes sense only relative to sortal classification
  - Criteria of cross-moment identity for each sortal predicate in the world theory
Naturalized epistemology of ontology

- Objects are not "given" to us independently of language and our classifications by means of predicates
- Objects are not given to us independently of a "background grouping" (recall Quine’s "relative" sense of necessity)
- Reference is achieved only via qualitative grouping, the "feature-placing stage" of experience
  - Introduction of singular terms is relative to a background grouping
Naturalized epistemology of ontology

- *This* is why Quine considers the distinction between a description and a proper name (or a tag; that is, a genuine singular term/rigid designator) "a red herring"

- Quine’s theory of reification admits of no relation of singular reference that is independent of a descriptive "background grouping"
  - No such relation of singular reference
Naturalized epistemology of ontology

– Variables as archetypical genuine singular terms?
– An assignment is given within a formal semantics for an object language
– This semantic relation of assignment is given, ultimately, from the point of view of a "background language", with a "primitively adopted" ontology
Naturalized epistemology of ontology

– The study of reification is the study of such "primitive adoption" of an ontology (Decock 2002, 167)
Naturalized epistemology of ontology

Compare $\exists x \square Fx$ with $\exists x Fx$

- "There is something that is necessarily a rabbit”
- "There is something that is a rabbit”

– The latter, together with other sentences about rabbits (and other things) in our world theory, implies observation categoricals

- Through its logical relations, ultimately (and indirectly) to observation categoricals, the sentence has empirical content
Naturalized epistemology of ontology

– The first sentence is more problematic for Quine’s holistic view

– What does ”necessarily”, as a nonlinguistic and ”absolute” notion, add to the empirical content of the sentence?
Naturalized epistemology of ontology

– How is an object’s having a trait *necessarily* reflected on the level of observation categoricals?

– Quantified modal logic presupposes that we can inspect an object as such, independently of any background grouping, and sort some of its traits into necessary and contingent ones?
Naturalized epistemology of ontology

• My suggestion:
  – The idea of genuine singular terms/rigid designators presupposes that objects are somehow given to us independently of language and theory, to be used as fixed points in singular-term semantics and empirical evidence - Quine denies this
  – The Quinean debate over intelligibility of quantified modal logic should/can be traced back to differences in epistemology of ontology