

# Logic and Modality in Quine

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In his works on logic and epistemology, W. V. Quine makes several meta-logical comments about the role of logic. Perhaps more famously, he also makes an important metaphysical claim about the status of modality, namely that there is no real ‘necessity’ or ‘possibility’ in the sense of logical or metaphysical necessity. The result is a view in which first-order predicate logic with identity and set theory is taken as sufficient. Modal logics, on the other hand, are superfluous, and have no import to a scientific understanding of the world. In this paper, I will examine Quine’s views on logic and modality, considering why Quine arrives to his rejection of modal logic and whether or not common uses of modal logic are acceptable to him. I will show that although some features of modality and modal logic do have a place for Quine, they do not depend on the application of modal or modal-style logics, and are therefore superfluous in the scientific language of the world that Quine hopes to establish.

Before examining Quine’s position on any one system of logic, it helps to understand what he sees logic as and how he sees it fitting into our understanding of the world. On the first question, it is clear that Quine sees logic as a fundamental feature of how the world is. Of the logical truths, tautologies and any rules of inference, Quine says that they are true trivially “by virtue of any circumstances you care to name – the

language, the world, anything” (Quine, *Philosophy of Logic* 96). So, for Quine, logic is fundamental and does not require a foundation. There is little sense in asking why logical truths are true, for just about any answer will suffice.

As for the role of logic, Quine sees it as essential to developing and expressing the observations and conclusions of science. In order to effectively do this, Quine asks for a single “canonical notation”, an “algorithmic” and “conceptual” framework as a language for science (Quine, *Word and Object* 161). The motives for such a framework are “the same motives that impel scientists to seek ever simpler and clearer theories adequate to [their] subject matter” (161). Further, the resulting framework is not merely conventional; just as “one physical theory will get us around better than another [...] similarly for canonical notation” (161).

As his canonical notation, Quine uses first-order predicate logic with identity, along with set theory. Set theory is taken to be “another, higher branch of mathematics” (Quine, *From Stimulus to Science* 52). Quine favours first-order logic partly because it has “no objects [and] no predicates [that] it can call its own” (52), and therefore is not committed to the existence of anything. Further, logic “admits of complete proof procedures” as demonstrated by Gödel (52), that is, everything that can be said to be true in first-order logic can be proven in it. This is a feature of first-order logic, but not of second-order logic, leading Quine to favour first-order with the addition of set theory.

Despite his goals of extreme reduction, Quine’s attempts to create such a canonical notation do include some extra features for the sake of ease of use. It has been shown by Charles Sanders Peirce, Henry M. Sheffer and others that propositional and predicate

logics require only one basic operator, either a joint denial (not or) or an alternative denial (not and). From either of these, the operators of negation, disjunction, conjunction, material conditional and biconditional can be defined. Similarly, the universal quantifier can be defined by negation of an existential quantifier and the sentence over which it quantifies ( $\forall xFx \equiv \neg \exists x \neg Fx$ ); the existential quantifier can also be defined by the same operations on a universally-quantified statement ( $\exists xFx \equiv \neg \forall x \neg Fx$ ). Quine acknowledges this but regularly uses the additional operators and quantifier for the purpose of clarity.

Commitment to the existence of objects was mentioned as a reason to adopt first-order logic, for it has no objects of its own. Indeed, ontological commitment is a commonly-cited aspect of Quine's views on logic. This statement highlights Quine's view of objects and their existence. According to Quine, "a theory is committed to those and only those entities to which bound variables of the theory must be capable of referring in order that the affirmations made in the theory be true" (Quine, "On What There Is" 14). That is, a theory is committed to an object  $x$  if and only if  $\exists xFx$  follows from the theory for any predicate  $F$ . For any object not existentially quantified over by the theory, one who holds the theory need not commit themselves to the existence of that object. On the other hand, one is committed to the existence of any object quantified over, whether that object be physical or abstract; it exists or the theory is false. This also provides a definition of "what it is to be an object" (Hylton 257); objects are whatever can be quantified over in a theory, and hence ontological views are "inseparably bound up with his canonical notation" (257). Notably, Quine expresses some dissatisfaction with interpretations of his claims about ontological commitment when he writes that the

“solemnity of [his] terms ‘ontological commitment’ and ‘ontological criterion’ has led [his] readers to suppose that there is more afoot than meets the eye” (Quine, “Responses” 175). The issue of ontological commitment is obvious and trivial for Quine. However, it does show the importance of instituting a proper canonical notation for our descriptive framework. If there were “basic departures from the logic of truth functions . . . we may find that the very notion of existence . . . has had its day” (Quine, *Pursuit of Truth* 36). These are questions of “terminology” (36) but the terminology nevertheless commits us to certain views of the world.

At last we can examine Quine’s take on modality. Quine describes the modal statements ‘possibly’ and ‘necessarily’ in two ways. First, there is a common usage of these terms in which is not a metaphysical or a logical claim. Rather, these versions are propositional attitudes. That is, they express an attitude of the speaker. In this ordinary context, statements like ‘possibly  $x$ ’ amount to ‘for all that I know,  $x$ ’. Necessity is used more loosely, with ‘necessarily  $x$ ’ meaning anything from ‘I feel that  $x$  must be the case’ to ‘ $x$  is important to me’ (Quine, *Word and Object* 195). However, there is also the more relevant account of possibility and necessity from the standpoint of logic, where they have technical meaning. Quine begins by accepting the putative account of analyticity and providing a definition based on that of C. I. Lewis and Rudolf Carnap. Quine summarizes analyticity by saying that “a sentence is analytic . . . when it is true by virtue of the meanings of its words” (Quine, *Pursuit of Truth* 55). He explains that “a statement of the form ‘Necessarily ...’ is true if and only if the component statement which ‘necessarily’ governs is analytic” (Quine, “Reference and Modality” 142). Similarly, statements of

possibility are “false if and only if the negation of the component statement which ‘possibly’ governs is analytic” (142). He uses the example of “9 is necessarily greater than 7”, which translates to “ $9 > 7$  is analytic” (142). In this fashion, modal claims are only a shorthand declaration of whether or not certain statements are analytic.

Of course, Quine is well known for his scepticism over the importance of the analytic-synthetic distinction, and so a definition that depends on analyticity is questionable. Central to Quine’s rejection of an *important* analytic-synthetic distinction is that he holds the concept of meaning to be unnecessary. That is, for Quine we can describe language naturalistically, with “no appeal to an unreconstructed notion of meaning” (Hylton 51). However, what is here important for Quine is not an abandoning of analyticity in general but a rejection of the appeal to mentalistic meaning; that is, the “truth by convention” of analytic statements “does not mark a clear *epistemological* difference” (74). In the case of understanding Quine’s conception of modality and the association between analytic and putatively necessary statements, the epistemological concern is unimportant. What matters instead is that a necessary statement cannot be false in the language due to the structure of that language and the semantics it entails. Thus, ‘Necessarily  $9 > 7$ ’ amounts to saying that ‘ $9 > 7$ ’ is true by the definitions of ‘9’, ‘7’, the ‘>’ operator and the syntax of our mathematical language. Such notions of analyticity, under careful definition, are allowed in Quine’s work. For *example*, he similarly describes an analytic-synthetic distinction for observational categorical in Chapter IV of *From Stimulus to Science*.

In his approach to highlighting an important problem of modality, Quine first

describes a problem with some interpretations of propositional attitudes. He uses a number of examples to illustrate how logically acceptable substitution of synonyms results in changes to truth values. One of those examples considers an agent's misinformation about the capital of Honduras, Tegucigalpa:

Philip believes that Tegucigalpa is in Nicaragua (Quine "Reference and Modality" 141).

From this, he substitutes 'Tegucigalpa' for its synonym, 'capital of Honduras' to obtain the sentence:

Philip believes that the capital of Honduras is in Nicaragua (141).

Even if the first sentence is true, it is unlikely that the second is. As Quine explains, this is because the name 'Tegucigalpa' in the first sentence is not "purely referential" (142).

Rather, the sentence resembles one in which the phrase 'Tegucigalpa is in Nicaragua' appears in quotes, such that Philip believes the statement read as an entire phrase rather than something about the object that the name 'Tegucigalpa' designates. Hence, the substitution is invalid because the contexts of propositional attitudes are "referentially opaque" (142). The first consequence of this is that the attitude is about a complete proposition or sentence and not about the objects in that sentence. Secondly, the opacity of these sentences means that quantifiers cannot penetrate them and quantify over any variables within them.

As was previously mentioned, in *Word and Object* Quine likens common uses of the terms 'necessarily' and 'possibly', outside of a logical context, to disguised propositional attitudes. It turns out that even the logical modalities bear a striking

resemblance to propositional attitudes in exactly the way that was just seen. This leads Quine to characterize modalities as “obscure idioms” that mirror propositional attitudes but lack the actual reference to a person (Quine, *Word and Object* 195). Like propositional attitudes, statements of necessity are about referentially opaque sentences. Recall that the statement, ‘necessarily  $9 > 7$ ’, can be recast as “‘ $9 > 7$ ’ is analytic’. That is, the claim of necessity is not about 9, 7 and the relation between them. Rather, it is about the sentence ‘ $9 > 7$ ’.

The difference between referential opacity and referential transparency is ultimately the difference between *de re* and *de dicto* readings of the claims. *De re* (“of the thing”) refers to sentences in which the modal or attitudinal operator applies to the actual objects of the sentence. That is, when the claim is made that ‘bears are necessarily mammals’, the *de re* reading makes ‘necessarily’ part of the predicate. Under this interpretation, bears have the modal property of being necessarily mammalian. The alternative *de dicto* (“of the word”) reading puts the necessity outside of the predicate, so it is the entire sentence that is predicated. The *de dicto* reading states that it is necessary that ‘bears are mammals’. It is this distinction which becomes central to Quine’s account of where claims of modality are appropriate, and where they are incoherent.

Examining propositional attitudes, Quine showed that problems arise under *de re* interpretation. When substituting ‘Tegucigalpa’ for ‘the capital of Honduras’, as is warranted in the referentially transparent *de re* reading, a truth was turned into a falsehood. With the opacity of the *de dicto* reading, truth values were preserved because the substitution could not occur. The same is the case for modality. Quine uses a classic

example from Frege to illustrate the point:

9 is necessarily greater than 7 (Quine “Reference and Modality” 143).

When interpreted *de re*, the term ‘9’ is available for substitution with the phrase ‘the number of planets’<sup>1</sup>:

The number of planets is necessarily greater than 7 (143).

Normally, this would be taken as a contingent matter. Quine’s definition of logical necessity by way of analyticity also highlights the falsehood of this sentence, since it is not true to say that ‘the number of planets is greater than 7’ is analytic. So, as it was with propositional attitudes, the referential opacity of *de dicto* readings of modal claims produces a consistent claim for evaluation. On the other hand, the *de re* reading is vulnerable to substitution of identicals, and therefore unacceptable in a robust scientific language.

Quine’s description of the referential opacity of both propositional attitudes and modality already favours the *de dicto* reading of these claims. Under *de re* readings, logically valid identity substitutions cause sentences to change their truth values, and as a result, if modal claims were about those things, it would lead to an absurdity. The result is that modal claims cannot be about objects, and hence there cannot be such things as modal properties. Returning to the example, Quine clarifies that “to be necessarily greater than 7 is not a trait of a number” (Quine, “Reference and Modality” 148). Instead, a sentence’s being “necessarily or possibly thus and so is in general not a trait of the object concerned, but depends on the manner of referring to the object” (148).

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<sup>1</sup> This, of course, predates the 2006 reclassification of Pluto as a dwarf planet.

To drive home this point, Quine offers one more illuminating example. In the case of a game in which the outcome cannot be a tie, it can safely be said that the outcome of a player winning the game is necessary (the *de dicto* reading,  $\Box \exists x Wx$ , where  $\Box$  is the modal operator for ‘necessarily’ and  $Wx$  means ‘ $x$  will win the game’). What cannot be said for any player is that he or she will necessarily win the game (*de re*:  $\exists x \Box Wx$ ).

Counterfactuals present for Quine an alternative challenge. Counterfactuals, or counter-to-fact claims, are often taken to be true. For instance, intuitively it seems that the claim ‘if the sun hadn’t risen this morning, it would be dark outside’ is both true and meaningful. If evaluated as a material conditional, the statement is true because the antecedent is false, and any material conditional is true unless it has a true premise and false conclusion. The result is that this sentence seems meaningless. Under the same interpretation, the claim ‘if Quine had been born in Australia, he would have been a rodeo clown’ is similarly true, despite its apparent ridiculousness. The question remains how truth values can be applied to counterfactual claims if those claims are meant to actually represent insight about the world.

Many have sought truth values for such claims in the possible world semantics of modal logic. Under these semantics, necessity is taken to mean ‘true in all accessible possible worlds’. The notion of accessibility is unimportant for this paper, as metaphysical necessity typically does not depend on it. As such, it can be recast as ‘true in all possible worlds’. Possibility is similarly ‘true in *some* possible worlds’. The claim of a counterfactual is that if something had been the case, something else must have resulted. Thus, counterfactuals are a claim about necessity. Armed with these semantics, one’s first

instinct is to say that counterfactuals simply say that in all possible worlds, if the antecedent is true then the consequence must be. In other words, the counterfactual ‘if it were such that P, it would be such that Q’ becomes  $\Box(P \rightarrow Q)$ . Interestingly, the strict conditional that results comes closer to the English-language ‘if ... then’ than the material conditional does, because of the aforementioned strange conditional truths. Quine also states that “the contrary-to-fact conditional reduces to the form ‘Necessarily, if p then q’ in some sense of necessity” (Quine, “Reference and Modality” 158). David Lewis gives a competing account, based on a somewhat vague concept of the “closeness” of possible worlds to the actual one, based on the accessibility relation of modal logic rather than on similarity to the actual world (Lewis 11-29).

Of course, even though he himself provides such a formulation, a modal explanation of counterfactuals will not do for Quine. In a response to Saul Kripke regarding rigid designators and possible worlds, Quine quips that he finds amusement in the fact that philosophers like himself, in the face of modal complexity, “welcome the old familiar contrary-to-fact conditionals as a clarification, and are content at last to acquiesce in them” (Quine, “Responses” 173). Indeed, he comes to a simpler explanation for the counterfactual. For Quine, we refer to *dispositions* “when we say what one *would* do, or what *would* happen *if*” (Quine, *From Stimulus to Science* 21). The dispositions themselves have a naturalist explanation. Each disposition is simply “one or another physical property, one or another trait of the internal structure or composition of the disposed object or related objects” (21). In this case, a counterfactual is simply reasoning from false premises, stating what follows from a false assumption given the physical state of an object.

Interestingly, dispositions under this description are a part of the object. The *de re* claim of a necessary property that would result from a counterfactual claim would be resisted by Quine. The claim that some object has a property of being *necessarily* something is unfounded, but the actual properties do give rise to certain circumstances that would, on a *de dicto* reading, logically follow from certain premises based on the actual features of an object.

Quine's problems with modality are with the idea of necessity and possibility themselves, from a metaphysical or logical standpoint. Under the *de dicto* readings, modal claims are not absurd, but are reducible to Quine's version of analyticity and have no metaphysical import. After giving his alternative view of counterfactuals, he concludes that they are to be left "outside the systematic fabric of science as a useful outrider", but that they are "the indispensable vehicle of thought experiment" (98). However, armed with dispositions to account for counterfactuals, Quine readily dispenses with modal logic itself. For Quine, this is "no loss; for in [his] extensionalism [he makes] no sense of necessity as a concept of science or philosophy" (99). Ultimately, these notions can be disregarded in a scientific language. This leaves one wondering whether, given the utility of counterfactuals, there any other uses for modal logic that Quine may admit. If so, it must also be considered whether modal logic or modal language fit into a prevailing scientific language, or if these concepts can be redeveloped into the first-order predicate logic that Quine favours.

As Quine mentions, he is content to ignore modal logic given the fact that it does not correspond to any sense of necessity or possibility that exists in his naturalistic view

of the world. There are inherent problems with *de re* modality for Quine, but reasoning *de dicto* is still admitted. This indicates mainly that Quine's objections are "not purely syntactic" (Hylton 352). Indeed, they are almost entirely concerned with the understanding of modality altogether, and whether or not such a logical system has any metaphysical or logical import beyond Quine's preferred first-order logic with identity and set theory. Syntactically, a modal logic is possible and indeed useful, at least as an intellectual exercise. Quine's rejection of it is one of preference, since it adds nothing to a scientific language.

There are uses for systems of modal logic beyond examining logical or metaphysical necessity, so the question remains whether or not those other uses can be captured with Quine's canonical notation, or whether some aspects of modal-style logic need to be admitted to properly reason with and express claims. The notions of modality are very similar, as we have seen, to those of propositional attitudes. On this topic, Quine writes that in "writing off modal logic [he finds] little to regret; . . . [with] propositional attitudes, however, [he] cannot be so cavalier" (Quine, "Intensions Revisited" 121). Epistemic and doxastic logics are essentially modal logics, capable of being done with identical syntax to a modal logic, but are used for reasoning about knowledge and belief of agents. This seems more reasonable than the idea of possible worlds, given the metaphysical baggage that often accompanies the modal semantics. Epistemic logic is meant as a tool to reason from a set of known sentences, or from multiple sets of what is known by various agents. From this, the utility of epistemic logic is in discovering what is compatible with this knowledge. What logically follows from such a set of known

sentences must be the case, given the agent's knowledge. This is analogous to metaphysical necessity. The negation of anything that follows from the given set is impossible when granted the agent's knowledge, and thus such reasoning can produce awareness of the full implications of what propositions the agent actually knows. All such derived sentences are taken as 'known' by the agent, even though the agent may not be conscious of them. That is, epistemic logic assumes that agents always know everything that follows from the propositions that they cognitively take to be true. For instance, if a zoologist observed the characteristics of a newly-discovered animal, cognitively affirming that he knows each fact about this animal that he observes, and those facts correspond to the definition of some genus of animal, then epistemic reasoning would describe the zoologist as knowing of the animal's membership in the genus without he or she ever actually considering that membership. Thus, everything that the agent knows is that which follows from his or her *given* knowledge. This can all be done with first-order predicate logic and set theory.

The value in using an epistemic logic is that it provides a framework for determining what is and what is not compatible with some agent's knowledge. This is analogous to modal possibility, and can be viewed as 'possible as far as is known'.

Doxastic logic works similarly, with reasoning beginning from the beliefs of some agent rather than the agent's knowledge. Quine mentions the possibility of evading his criticism of modal logic in the account of doxastic logic given by Jaakko Hintikka. In reasoning about propositional attitudes, Hintikka argued that paths "of continuous gradation from one belief world to another are not free for the thinking up" (Quine,

“Worlds Away” 128). Instead, the possible worlds given in the semantics of doxastic logic must all be compatible with a set of beliefs that some agent believes. Quine describes the areas outside the agent’s given beliefs as “pretty well behaved” (128), and so the problem with reasoning this way is less pronounced.

However, when it comes to the *de re* and *de dicto* distinction, the problems with *de re* interpretations are once again apparent, and we find ourselves “rejecting *de re* or quantified propositional attitudes generally, on a par with *de re* or quantified modal logic” (Quine, “Intensions Revisited” 122). Again, the *de dicto* case is allowed, and Quine is more comfortable with *de dicto* reasoning about propositional attitudes than modality. He says, “We remain less cavalier toward propositional attitudes than toward modal logic [in the] *de dicto* case” (122).

Though epistemic and doxastic logics are useful tools for quick reasoning about the knowledge and beliefs of agents, they may not be necessary parts of a complete scientific language of the world. Quine comes to this conclusion in his article “Worlds Away”, reasoning that he does not find in modal logic or Hintikka’s logic of propositional beliefs “a proper annex to austere scientific language” (128). Certainly, all statements of knowledge and belief can be rendered into predicates, with any case of ‘*x* believes *y*’ easily translated symbolically as  $Bxy$ . Indeed, Quine has this view, in which “attitudes are taken as dyadic relations between people or other animals and closed sentences” (Quine, “Intensions Revisited” 122). Further, use of logic and set theory, with its notions of consistency and satisfiability, can be used to determine the sets of sentences consistent with some common subset, that subset being an agent’s knowledge or beliefs. The relation

$B_{xy}$  will present a set of ordered pairs, and by means of an equivalence relation and class, all the  $y$  beliefs can be picked out for any agent, producing a set that mirrors a possible world or state of affairs, without the additional baggage of a new language. First-order predicate logic will suffice to perform the reasoning. Although the modal logics provide a straightforward avenue into the same result, they do add unnecessary features to the language. At this point, Quine's most promising candidate for admittance of a sort of modal logic, or modality-inspired logic, seems superfluous. They may be admitted into regular use for the same reason that Quine opts to use two quantifiers or connectives beyond the joint or alternative denial, but the benefits of doing so are less pronounced than a readable syntax.

By the writing of his final books *Pursuit of Truth* and *From Stimulus to Science*, Quine is fully confident that modality is not a meaningful concept and that modal logic has no place in a scientific language. He shows that useful ideas of modality can be recast in naturalistic terms, and the tools of modal logic are not required of a scientific language in order to properly describe the world.

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