The Role of Existential Quantification in Scientific Realism

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Abstract

Scientific realism holds that the terms in our scientific theories refer and that we should believe in their existence. This presupposes a certain understanding of quantification, namely that it is ontologically committing, which I challenge in this paper. I argue that the ontological loading of the quantifiers is smuggled in through restricting the domains of quantification, without which it is clear to see that quantifiers are ontologically neutral. Once we remove domain restrictions, domains of quantification can include non-existent things, as they do in scientific theorizing. Scientific realism would therefore require redefining without presupposing a view of ontologically committing quantification.

Introduction

In modern classical logic we cite the existential (or particular) quantifier ∃ as meaning 'there exists an…' and as such quantification is a mark of ontological commitment. Yet, in the words of Priest, 'the view that the particular quantifier is 'existentially loaded' is a relatively new one historically and… it has become entrenched in modern philosophical logic for less than happy reasons'.[1] Not only is it entrenched in philosophical logic but also in the philosophy of science, where the debate over scientific realism presupposes that quantification is existentially loaded. In this paper I argue that ∃ should be read as 'some' (not 'there exists'), and known as the 'particular' (not 'existential') quantifier, as quantification is existentially neutral. I will do this by using Quine, our exemplar of a realist and naturalist, to show that there is no legitimate justification for treating quantification in this loaded way. I will describe Quine's loading of quantification via domain restriction, and attack elements of the Quinean picture that lead to this restriction. I appeal to quantification in natural and formal languages for evidence of their neutrality in order to show that we should not take our domains of quantification in our scientific theorizing to include all and only existent things. It is

[1] Graham Priest, 'The Closing of the Mind: How the particular quantifier became existentially loaded behind our backs', *The Review of Symbolic Logic* **1.1** (2008), 42.

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inherent in the scientific realist position that we believe the ontology provided to us through the successful reference of scientific terms in our scientific theories, and so, in other words, the domain is supposed to contain our ontology.[2] If quantifying over such domains is not the appropriate method for extracting our ontology, then scientific realism appears to be false, or else is in need of redefining without utilizing existentially loaded quantification. This shows the impact that the philosophy of logic can have on scientific realism.

1. The Quinean Ontological Criterion

Quine, in his seminal paper 'On What There Is' (1948), puts forward a criterion for how to recognise the ontological commitments of a discourse, manifested via translation into classical first order predicate calculus. Quine believes that we speak in an ontologically committing way in natural language by the use of (what he sees as quantificational) idioms like 'there exists' or 'there are'. He is careful to stipulate that it is only those uses of quantificational idioms made seriously with regard to our *best scientific theory* that will be the assertions to whose ontology we ought to regard ourselves as committed. And he then requires that best scientific theory to be regimented into first order predicate logic in order to reveal its ontological commitments. Science speaks of things and as such they are members of the domain of quantification, and the Quinean (and the scientific realist) move is to say that whatever is in this domain will provide our ontology. Thus quantification is said to be the means to display ontological commitment.

Quine takes all statements in natural language to be (in principle at least) regimented into a quantified first order logical statement which will manifest its ontological commitments. After specifying which sentences are fit for ontological commitment in natural language, namely those in our best scientific theorizing, the next step in Quine's strategy is to search through terminological resources in formal language to

[2] I take that this is standard scientific realism. For examples that follow this definition see J.J.C. Smart, *Philosophy and Scientific Realism* (London: Routledge & Kegan Paul, 1963); R.N. Boyd, 'On the Current Status of the Issue of Scientific Realism', *Erkenntnis* **19** (1983), 45–90; M. Devitt, *Realism and Truth* (Oxford: Blackwell, 1991); A. Kukla, *Studies in Scientific Realism* (Oxford: OUP, 1991); I. Niiniluoto, *Critical Scientific Realism* (Oxford: OUP, 1999); S. Psillos, *Scientific Realism: How Science Tracks Truth* (London: Routledge, 1999); A. Chakravartty, *A Metaphysics for Scientific Realism: Knowing the Unobservable* (Cambridge: CUP, 2007).

determine what should carry and manifest such ontological commitment. Quine stipulates that the bearer for ontological commitment is the quantifier ∃ in first order logic, after eliminating all other candidates. So, in stating '3 is a prime number' one is *actually* stating Na∧Pa which entails ∃x(Nx∧Px), which for Quine is read as '*there exists* something that is a number and is prime'. This is how commitments are derived from natural language – through regimentation, which is intended to display the underlying logical form of our language. We can thus deduce our ontology from the regimentation of our best scientific theory, by looking to what is quantified over in the domain. Therefore, to be quantified over in science is the Quinean realist ontological criterion.

Quine does not provide any reason for ontologically loading the quantifier ∃, nor argues for his criterion of ontological commitment, claiming that it is 'trivial and obvious'.[3] I explore two possible reasons why such a realist may conclude that the quantifier carries ontological commitment: (1) because ∃ is a regimentation of the ordinary language 'there exists' idiom and this already carries ontological commitment; (2) because ∃ is ontologically loaded by virtue of its semantics. These reasons correspond to the two issues I clarify in this paper: (1) whether quantification in natural language is ontologically committing; and (2) whether quantification in formal language is ontologically committing. I argue that quantification in both English and first order logic are ontologically neutral in section 3 and 4 respectively. In the next section 2, I explore if there is anything nearing an argument in Quine for ontologically loading quantification, looking to other elements of his philosophical picture for clues or justification. In particular I will look to Quine's set theory, and his slogans about entities and identity.

2. Domain restrictions from SET, NE, and TB

Quine's commitment to set-theoretic model theory (described as 'SET' below) and the following two slogans[4] NE and TB contribute to loading quantification:

SET: Domains are sets
NE: 'No entity without identity'
TB: 'To be is to be the value of a bound variable'

[3] W. V. O. Quine, *Pursuit of Truth* (Harvard University Press, 1992, revised edition), 26.

[4] Willard Van Orman Quine, 'On What There Is', *Review of Metaphysics* **2.5** (1948), 33.

Quine's slogan TB is intended as a descriptive tool to find out what exists – our ontology will be made up of those things bound by variables in the best scientific theory. 'To be' is for Quine to be an existent entity, and to be a 'value of a bound variable' is to be quantified over in the domain. So TB states that to be existent is to be in a domain of quantification. I reject TB as it entails loaded quantification. The way to evaluate TB is thus to evaluate what it means to be included in a domain, to see whether domains are restricted to existent things. I show how the domain may be restricted using SET and NE in turn, and I reject these in favor of unrestricted domains. With a neutral domain, we get neutral quantification.

2.1. Restriction from SET

For Quine, and in the standard set-theoretic version of model theory, domains are seen as sets. Domains therefore will for Quine be restricted in the same way that sets are restricted. Sets are restricted by identity, since sets are required to have determinate identity conditions. To have determinate identity conditions is for there to be a determinate answer as to whether one set *a* is identical to another set *b*. Set theory also tells us that sets are identified extensionally by their members, and as such their members must also have determinate identity conditions – for every member of the set, there is a determinate answer as to whether it is identical to another member of the set. Since the set-theoretic version of model theory states that domains are sets, domains thus take on these same conditions. Domains, and members of domains, therefore also have determinate identity conditions. This is the restriction from SET on what can go in a domain: *all members must have determinate identity conditions*.

2.2. Restriction from NE

Quine's slogan NE states that there is no entity without identity. So all entities must have determinate identity conditions. This may sound similar to the restriction imposed by SET as having identity, but this restriction posed by NE applies to only certain kinds of thing. An 'entity' for Quine means an existent entity, as there are no other entities for Quine. As such, his NE states that there can be no *existent entity* without determinate identity conditions. Whereas, SET states that there can be no member of the domain (existent or not) without determinate identity conditions. So the restriction

from NE on what can go in a domain is: *all the existents must have determinate identity conditions*.

We are trying to find motivation or justification for TB, where the whole domain is restricted to only existent things. So far, from SET and NE we only have the domain restricted to those things with identity. What the Quinean realist must do to get domain restrictions out of the identity condition requirement, is to hold a biconditional reading of NE, so that the identity restriction selects all *and only* existent things to be possible members of the domain.[5] That way, all things with identity must be existent, and thus restricting the domain to those with identity also restricts to existents. The biconditional is between 'being an entity' and 'having identity', and is read as going in both directions – not only do all existent entities require identity, but all entities with identity require existence. So we read NE as saying both 'no entity without identity' and 'no identity without entity' (where entities exist). These are the two directions for the biconditional:

> *Left-Right*: X cannot exist without having determinate identity conditions as in order to exist it must be determinately distinct from other existents.
>
> *Right-Left*: X cannot have determinate identity conditions without existing as existence is required for completeness or determinacy.

From the biconditional NE we bridge the gap between SET and TB: SET provides us with the restriction that domains can only contain things with determinate identity conditions, and the biconditional NE provides us with the restriction that the only things with determinate identity conditions are existents, which brings us to TB which states that to be in a domain is to be an existent entity. Therefore, we derive that all and only existent things can be quantified over in a domain, hence TB and why ∃ is read 'there exists'. For Quine, this is the natural reading of ∃, and being part of the domain is how we use the term 'exists' as this is just what 'exists' means. Quine's identity constraint on domains ensures this reading of ∃, but this

[5] I am not claiming that Quinean's *do* hold a biconditional reading of NE, but rather that they *need to* in order to motivate TB or else there is a lack of argument for why quantification is taken to be existentially committing. It does nevertheless seem that they may hold the biconditional reading given that they seem to hold that non-existents lack determinate identity conditions *and* things with determinate identity conditions are existent things. I discuss this further in section 2.3.

constraint is unnecessary. I will go on to reject this constraint by rejecting the restriction that SET imposes (that all members of domains require determinate identity conditions) and by rejecting the restriction that NE imposes (that all things with identity are existent).

2.3. Rejecting TB via SET or NE

To burn the bridge that leads us to TB we can deny the biconditional reading of NE, in particular by denying the direction Right-Left by showing that non-existents can have identity and can go in a domain, and thus we quantify over non-existents, so ∃ is neutral. To do this we need to find non-existents which meet the determinate identity conditions imposed by SET. Or, we can simply reject SET by denying the set-theoretic version of model theory that requires domains to be sets with determinate identity conditions. To do this we need to show that we can quantify over things that lack determinate identity conditions. In the rest of this section I explore these options of rejecting either SET or NE.

Quine's NE is motivated by his issue with the possible fat man in the doorway.[6] The problem with this man is that there is no determinate answer as to whether he is identical to the possible tall man in the doorway. Without there being a determinate answer as to whether one is identical with another is for those things to lack determinate identity. For Quine, not having determinate identity goes against what it is to be an object or an existent entity. So the possible fat man doesn't qualify. For Quine this may be just a plea to stop talking about possibilia, but it has the effect of restricting domains. The question is whether NE is motivated by the possible fat man being an illegitimate thing to talk about or by such talk problematically introducing him as an object into the domain as existent. If being in the domain has no ontological significance and only signifies that we talk of that thing then it seems unproblematic to talk of possibilia – it seems only problematic if quantification is loaded to give you existent possible fat men. Yet Quine's identity constraint on domains and its entities is defended as he thinks it affords our resultant theory a degree of clarity and definiteness. But I hope to demonstrate that it is not necessary to impose such a constraint, and so quantification without Quine's add-ons is naturally ontologically neutral.

[6] W. V. O. Quine, *From A Logical Point Of View* (Harvard University Press, 1961), 4.

The biconditional NE ensures that all and only existents have determinate identity conditions, and this is a substantial and controversial claim which makes Quine's logic heavily theory-laden. We needn't accept such a heavy load with our logic though, and in rejecting NE we can reject Quine's ontologically loaded logic. Firstly, it is not clear that *all* existent things meet Quine's identity conditions (and as such the conditions are not necessary), and secondly, some *non*-existent things may meet those identity conditions too (and as such are not sufficient). By not being necessary we deny the direction Left-Right by showing that we can have an entity without identity, and by not being sufficient we deny the direction Right-Left by showing that we can have non-existents with identity. So even if the domain is restricted by SET to include only those things with determinate identity conditions, this set of things need not be a set of existent things, and thus we cannot look to the domain to provide us with an ontology. Determinate identity may not be necessary nor sufficient for existence, and so would not pick out all and only existents, and so even if the domain is restricted by SET to have determinate identity this may not restrict the domain to all and only existents.

In contesting whether NE is true, by seeing if determinate identity is necessary for existence, we must cite existent things without determinate identity. As stated before, to have determinate identity means that for all a and all b there must be a definite answer as to whether $a=b$. Let us consider numbers as an example. Benacerraf[7] notes there are many potential reductions from numbers to sets, but since there is no principled way to choose between them then there is no definite answer as to which, if any, sets the numbers are. So if numbers exist they do not meet the condition from NE. Many philosophers of mathematics in the structuralist tradition take the lesson of this to be that numbers exist but without determinate identity, denying NE. Other examples to show that determinate identity is not necessary for existents may include vague objects.[8] There are also examples in modern science of existents without having determinate identity conditions, such as fermions and bosons in Bose-Einstein statistics.[9] Azzouni[10] denies NE by showing that determinate identity

[7] Paul Benacerraf, 'What Numbers Could Not Be', *Philosophical Review* **74** (1965), 62.

[8] See Gareth Evans, 'Can There Be Vague Objects?', *Analysis* **28** (1978), for arguments against this.

[9] Cie & Stoneham 'Let the occult quality go', *European Journal of Analytic Philosophy* **5.1** (2009) 87.

[10] J. Azzouni, *Deflating Existential Consequence* (Oxford: Oxford University Press, 2004), 101.

is not sufficient for existents as non-existent *fictional* things may meet the condition by stipulation. Thus the biconditional NE may be too strong and would not be a constraint on domain specification, and by rejecting the biconditional in some direction we break the argument that leads to TB, leaving logic naturally neutral.

But if we feel compelled to allow for the biconditional NE, then in order to prevent the restriction on our domains to only existents we would thus have to reject SET. This would allow for things *without* determinate identity conditions into the domain, and NE would merely state that those things in the domain *with* determinate identity conditions will also be those things in the domain that exist. To reject SET is to deny the set-theoretic version of model theory, and so is to deny that domains are sets. It is standard to take domains as sets however this leads to problems that may motivate its rejection anyway. For example, when domains are sets we cannot have unrestricted universal quantification. This is because unrestricted quantification requires an unrestricted domain, and if the domain is a set then this requires the set to be unrestricted. Such an unrestricted set is a set of everything, which will therefore contain itself, opening the way to Russell's Paradox. So, treating domains as sets can lead to paradox. If one wants to allow for unrestricted quantification or an unrestricted domain, as Quine seems to (as he answers the question of what exists with 'everything!'), then one needs to deny SET to avoid ending up in Russell's Paradox. This allows for us to quantify over things without determinate identity conditions, and prevents the move from SET to the biconditional NE that leads us to TB which loads ∃ in turn.

2.4. Rejecting TB via quantification

If Quine has an argument for TB it's a poor one, depending on a biconditional reading of NE, a paradoxical acceptance of SET, or an unmotivated statement that quantification being loaded is simply 'trivial and obvious'. We can deny SET or NE as done above to block getting to TB, or we can provide independent reasons for neutral quantification to show that not only is Quine's loaded reading unmotivated but also is not at all trivial or obvious. I will now deny TB by looking at what quantification is in natural and formal languages. As described earlier, there could be two reasons why one may hold that quantification is ontologically loaded: (1) because ∃ is a regimentation of the ordinary language 'there exists' and this is already ontologically loaded; (2) because ∃ is ontologically

loaded by virtue of its semantics. These reasons correspond to the two issues I clarify in the next two sections: (1) whether quantification in natural language is ontologically committing; (2) whether quantification in formal language is ontologically committing. I argue that quantification in both English and first order logic are ontologically neutral, and that examples of uses of quantification in natural and formal languages provide evidence against TB and do not support Quine's triviality thesis, whereas neutral quantification is consistent with the evidence.

3. Natural language quantification is neutral

In this section I attack the assumption that quantification in natural language can be ontologically committing. I will explain why it is incorrect to say 'there exists' is synonymous with 'some' in English[11] to show why 'there exists' is not quantificational and how 'some' (along with other quantified idioms) is ontologically neutral. ∃ cannot represent the meaning and logical role of both 'some' and 'there exists' in English (and cognates in other natural languages) since 'exists' is not quantificational (but rather is a predicate). Quantified sentences have nothing to do with existence – they shouldn't require existence for their truth or meaning, and they shouldn't imply ontological commitment.

If 'some' is to mean 'at least one existent thing', then there will be no difference between 'some' and 'there exists'. Burgess and Rosen for instance argue it is not easy to understand what the difference can be.[12] Priest responds that they could simply reflect on the sentence 'I thought of something I would like to give you as a Christmas present but I couldn't get it for you as it doesn't exist'.[13] Here, the 'something' cannot mean 'some existent thing' as it would be contradictory. However, other quantified 'some' sentences do appear to be ontologically loaded, like 'some beers are in my fridge', which will be true only if there *exists* beer in my fridge. Here however, it is not the 'some' that is giving the appearance of

[11] Though I focus on English, since quantificational logic is meant to be a formalization of idioms in a range of natural languages, my discussion has a global scope across other languages too.

[12] J. P. Burgess and G. Rosen, *A Subject With No Object* (Oxford: Clarendon Press, 1997), 224.

[13] G. Priest, *Towards Non-Being* (Oxford: Clarendon Press, 2005), 152.

ontological loading, rather the 'in my fridge' is. 'Some' needn't require existence, but to be physically 'in my fridge' does. Furthermore, 'some' *cannot* require existence since that would entail that we cannot talk truly of some non-existent things without contradiction. For example, '*some* mice have American accents' is arguably true due to Mickey Mouse, yet we do not feel that the truth of this commits us to his existence. This is contrasted with '*there do not exist* mice with American accents' to articulate lack of ontological commitment.

Priest's example is a variant of a famous example of Strawson's,[14] who points to a dictionary of legendary and mythical characters and says, with regard to the characters, 'some of these exist and some of them don't exist'. The seemingly loaded word here is 'exist', and 'some' must be considered neutral, to prevent the contradiction in the second disjunct – 'there exist some characters that don't exist'. To account for sentences such as this without contradiction, we must be able to use 'some' in an ontologically neutral way. This points towards the ordinary usage of quantification in natural language to be ontologically neutral. Furthermore, there may be no way of making sense of our fictional practice but to quantify over fictional entities, and as such we must ensure that quantification is neutral to avoid commitment to such fictional entities. Treating the quantifier as ontologically neutral, and distinguishing 'some' as a quantifier and 'exists' as a predicate, will gain expressive resources for sentences which contain both 'some' and 'not exist' (like the examples above) in order to prevent contradictions.

One may protest that 'some' just by definition means 'at least one existent thing' and these examples can thus be dealt with by being not strictly speaking true. They could argue that all such examples are a misuse of language that is parasitic on their use of 'some', and are properly interpreted as involving a cancelling prefix to create a more accurate sentence such as 'in Disney there exists at least one mouse that has an American accent' to make it true. Those who adopt such a reading will argue that all uses of 'some' are loaded until it is cancelled by such a prefix, otherwise the sentence will just be false if it involves non-existent things. However such a strategy will not work for Priest and Strawson's examples, which involve a true sentence and a neutral use of the word 'some', where no prefix will easily fit. These examples give cases when you quantify over a domain of objects some of which are existent and some are not, so you cannot prefix your quantification to explain what is going on. This is since only part of the sentence will pertain to non-existents

[14] Peter Strawson, 'Is Existence Never A Predicate?', *Critica* **1** (1967), 13.

and another part of the same sentence pertains to existents, and so an overarching cancelling prefix for the whole sentence will not do since only part of the sentence will require the commitment to be cancelled.

So far I have thus argued that, against Quine, ∃ cannot be a regimentation of the ordinary language 'there exists' in virtue of it carrying ontological commitment, since quantificational terms in natural language like 'some' are ontologically un-committing. In the next section I further argue against Quine that ∃ cannot be ontologically loaded in virtue of its semantics either, since the semantics of the quantifier in formal language are ontologically neutral. I show quantification in formal languages like first order predicate logic to be ontologically neutral, and therefore unregimented quantification in natural language is neutral too.

4. Formal language quantification is neutral

Reading ∃ as 'there exists' is incorrect, as 'there exists' is *not* a quantificational phrase. ∃ properly understood is simply 'some'. The difference between 'some' and 'there exists' is that 'some' is an ontologically neutral quantificational term, and 'there exists' is not a quantificational term at all. 'Some' is about the *number* of things (namely only some of them), and so is *quantitative*, whereas 'there exists' describes the *way* things are (namely as existing things), and so is *qualitative*. The word 'some' is fit for numerical quantificational use, and 'there exists' is not. As a suggestion, 'exists' may be better understood as a predicate, as ∃ cannot be the logical regimentation of the non-quantificational 'there exists'.

The reason 'there exists' is not quantificational can be motivated by looking to Generalized Quantifier Theory (GQT)[15]. According to GQT a quantificational noun phrase is made up of a determiner and noun. Determiners are words like 'some', 'all', 'a', 'most', 'five'. (Determiners, I argue, can be taken as ontologically neutral since we can talk about five unicorns for example). Nouns include words like 'numbers', 'cats', 'objects'. So, it is true that the sentence 'there is a number that is prime between 2 and 4' is a quantified sentence, but it is false that the quantifier is 'there is'. Actually, the quantifier is 'a number', with 'a' being a determiner and 'number' being a noun. The 'there is' is part of the existential construction, and is not

[15] Thomas Hofweber, 'Innocent Statements and their Metaphysically Loaded Counterparts', *Philosophers' Imprint* **7.1** (2007), 23, and L. Gamut *Logic, Language and Meaning* (Chicago, 1991).

part of the quantification, and sometimes is not even existential, for example 'there are many clever detectives, some of which do not exist', where 'there are' and 'some' are both ontologically neutral. The quantification itself is neutral, located in the determiner and noun. Therefore ∃ in logic translates to the neutral quantifier 'some' in English, rather than the non-quantificational 'there exists'.

The argument for quantifiers being neutral can be strengthened by looking at the connection between the two quantifiers ∀ and ∃. Berto asks, 'why existential? The dual of "universal" is not "existential", but "particular"'.[16] As such, the dual of 'all' is 'some', and not 'there exists'. This can be demonstrated by considering the inter-translatability between ∀ and ∃ where one quantifier is defined in terms of the other: $\forall x(Cx) = \sim\exists x(\sim Cx)$ and $\exists x(Cx) = \sim\forall x(\sim Cx)$. Furthermore, when we look to the numerical quantities of such words, we can see that ∃ is $0\% < n \leq 100\%$ ('some') and so ∀ as $n = 100\%$ ('all') is an *instance* of ∃. Therefore, $\forall x(\varphi)x \rightarrow \exists x(\varphi)x$ should be a valid inference, since whatever is true of all of the x is true of some of the x. For example, when I have eaten all the cakes it is true that I have eaten some of the cakes. What is true in the universal case ought to carry over to the particular case. However when the particular case is ontologically loaded in virtue of reading ∃ (incorrectly) as 'there exists', then when we infer the particular case from the universal we therefore can prove that something exists. We can thus somehow derive ontology from logical inferences if we accept $\forall x(\varphi)x \rightarrow \exists x(\varphi)x$ as valid and take ∃ to be ontologically loaded."

The above inference $\forall x(\varphi)x \rightarrow \exists x(\varphi)x$ is therefore taken as *invalid* when you allow for domains to include non-existent things, or to be empty, and treat ∃ as loaded. Classical logicians have responded by not allowing for empty domains, and Quineans respond by not allowing for non-existent things in domains, in order to retain the validity of the inference and not prove the existence of the things they do not want in their ontology. This is because if we do allow for an empty domain or for domains to include non-existents, whilst we can hypothesize about what all the x would be like in the universal part of the inference, we cannot say anything about a particular x since this requires existence when we read ∃ as loaded. Yet my response is that we should take ∃ to be ontologically neutral and simply to mean $>0\%$, so that the inference is valid, even when the domain contains non-existents (or is empty). This ensures that we cannot derive

[16] F. Berto, *Existence as a Real Property* (Synthese Library: Springer, 2012), 21.

ontology from logic. We can keep the consistency and inter-translatability between ∀ and ∃ by treating them both as ontologically neutral, which allows them to quantify over domains that contain whatever it is that we speak about. And these domains can be neutrally specified by a meta-language.

Formal languages like first order predicate logic are interpreted with model theory. The model theory for a language is a specification of a model, which consists of a domain and for every 1-place predicate an extension which is a subset of the domain, and for every n-place predicate a set of n-tuples of members of the domain. There are two rules for the quantifiers in our formal language of logic: (∃) when at least one element of the domain is in the extension of the predicate; (∀) when all elements of the domain are in the extension of the predicate. We specify the domain, and specify the extension of the predicates. Thus far there has been no mention of existence or ontology in the meta-language of model theory, and so the model is naturally metaphysically quiet. The metaphysical noise comes through not in the quantification but in the specification of the domain to be quantified over – if the domain is specified in a metaphysical or ontologically loaded way then quantifying over it will also be loaded. Quantification is only committal if the specification of the domain in the model theory is committal. And whether domain specification is committal depends upon whether the meta-language in which the model theory is couched is itself committal. Model theory doesn't require an ontology and ensures that formal languages have no ontological commitments, so that quantification is neutral. Quine's background rules for inclusion in a domain isn't neutral, and this is where ontology is smuggled in, through the back door of domain specification.

In practice, whatever the natural language of English can talk about can go in a domain. Any further restriction (like Quine's) is therefore not part of standard model theory. The point of looking at the model theoretic approach to semantics is to show that it is done in an ontologically neutral way, and that the metaphysics is an addition that is not necessary and may be incorrect. Quine included this addition due to his preconception of what things exist (not including the possible fat man in the doorway). He thus looked to what he thought existed in order to derive his loaded logic which was then used to tell us what exists. So it seems he constructed logic to fit around his premade metaphysical ideas. Quine's method as such is circular (he calls it 'holistic'), as he decides on his ontology and molds identity conditions to fit, then these conditions deliver ontological results. Azzouni makes a similar remark: 'One can't read ontological

commitments from semantic conditions unless one has already smuggled into those semantic conditions the ontology one would like to read off'[17] and this is precisely what Quine does. It's circular to get ontology from logic given how Quine choses his logic – to fit his ontology. We thus get a circular criterion for existing (to be in the domain) and for being in a domain (to exist).

5. Domains in scientific theories

Azzouni argues that Quine is wrong to equate the ontology of a science with the domain of discourse of that science, and as such it is wrong to equate the ontological commitments of the science with its quantificational commitments. Therefore, if TB is applied to the sciences (which for Quine and the scientific realist it specifically is), we will end up with incorrect results. Azzouni clarifies that *sometimes* domains and ontologies overlap for a scientific subject but mostly domains include other things that are not part of the ontology, and also may not include all things that are part of the ontology studied by that scientific subject:

> There isn't anything, I think, that can (or should) be said in general about the nature of the overlap (if any) between the domain of a scientific language Ls and the actual ontology of (or that underlies, i.e., involves the truth-value inducers of) the phenomena being studied.[18]

If this is the case then this shows that being bound by a quantifier is neither necessary nor sufficient for existence in the case of scientific theorizing. Azzouni explains that scientists do not care for domains to contain all and only existents:

> Scientists formulate domains of discourse – and the vocabulary items that refer to the contents of those domains of discourse – in ways that maximize successful applications of scientific doctrine to phenomena studied. That what is in those domains doesn't – strictly speaking – exist, is of no scientific concern.[19]

[17] J. Azzouni, *Deflating Existential Consequence* (Oxford: Oxford University Press, 2004), 55.

[18] J. Azzouni, *Talking About Nothing* (Oxford: Oxford University Press, 2010), 169.

[19] Ibid., 216.

For example, scientists work with idealized situations, as Leng states, in 'dealing with frictionless planes or in treating liquids as continuous substances in fluid dynamics'.[20] Since such things are spoken of in science for the purpose of successful theorizing, they will feature in our domain of quantification. Such a domain should not then be treated as the set of things that make up our ontology, as included in that domain are these idealized non-existent things. If scientific realism takes quantification to be committing in this Quinean way then the realist becomes ontologically committed to too much. But, as Leng describes:

> Quine has a story to tell about the use of such idealizations, in order to explain why their occurrence in our scientific theory doesn't require our belief in their existence. According to Quine, they are linguistic conveniences that can be replaced by literally true paraphrases.[21]

However, if Quine and the scientific realist are to take all successful cases of reference (and thus all true quantified statements) in our best scientific theorizing as being ontologically committing, then every case of idealization and the non-literal will require paraphrasing to prevent being quantified over. And as Maddy has argued for, 'it is clear that the method of Quinean paraphrase will not successfully eliminate idealizations from natural science'.[22] Therefore, I argue that it is also clear that the method of Quinean ontological commitment through quantification will not successfully establish the ontology from natural science. Scientific realism traditionally follows this Quinean methodology, and takes it that we should believe in the ontology from our scientific theories, as our scientific terms will successfully refer to existent things. Scientific realists should drop this Quinean use of quantification, and redefine their position accordingly.

Quantifying over the scientific domain with quantifiers such as 'some' and 'all' is inappropriate for deriving ontology. 'Some' is ontologically neutral since logic is only interested in quantifying over a formal domain, and this has ontological significance only depending on the constraints on (and specification of) inclusion in a domain to restrict the domain. When the domain is restricted, the

[20] Mary Leng, 'What's Wrong With Indispensibility?', *Synthese* **131** (2002), 399.

[21] Ibid., 399.

[22] P. Maddy, *Naturalism in Mathematics* (Oxford: Clarendon Press, 1997), 145.

quantifiers will only be able to quantify over things that made it through the constraint. Logic, without such constraints, is ontologically neutral. The constraint of being part of the best scientific theory will have to be independently motivated to restrict to only the existent things, but as others have argued it seems that the domains in our scientific theories are not fit to be taken as sets of existent things.

Furthermore I have shown that first order logic needn't be existentially loaded by looking to model theory to show how quantification stripped down is ontologically neutral. It is only in Quine's background rules from SET and NE that restrict what can be quantified over to give quantification ontological significance. Model theory has no ontological commitments, showing that the domain is not the set of existents, and as such formal languages are naturally neutral. I have denied TB, via rejecting SET and NE and showing that quantification is neutral, as it's not the logic that supports loaded quantification, it's just Quinean rhetoric about possible fat men motivating restrictions on domains, making them loaded. Without such a domain restriction, quantification ceases to have anything to do with existence. As Berto nicely summarises: '[Neutral] quantifiers had better be called just quantifiers. "Existentially committing quantification" is restricted quantification'.[23] And what I have argued in this paper, is that such restricted quantification to only existent things is unmotivated and incorrect, and certainly is not 'trivial and obvious' as Quine states. Quantification is thus naturally ontologically neutral, and cannot be used to derive ontology from the domain of our best scientific theory.

Conclusion

Quantification becomes ontologically loaded when the domain that is being quantified over is restricted to include only existent things. In this way, the realist can then look to the values of bound variables in scientific theories for their ontology, with the quantifier being the signifier of ontological commitment. ∃ thus becomes ontologically loaded and read as 'there exists', due to this domain restriction. But without such a restriction, quantification ceases to have anything to do with existence, and the quantifier ∃ should be read as 'some' and known as the 'particular' as there is nothing 'existential' about it at all. I therefore conclude that scientific realism, being the position

[23] F. Berto, *Existence as a Real Property* (Synthese Library: Springer, 2012), 72.

that takes quantifying over our best scientific theories to be ontologically committing, is either false or requires redefining without presupposing such a problematic view about quantification.[24]

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