Quantification and Existence in Natural and Formal Languages

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Abstract

Quantification and existence have an intimate yet complicated relationship, which has bearing on important issues for philosophers, linguists, and logicians alike. This paper focuses on the interface between philosophical logic and linguistics regarding the 'particular' quantifier as it is used in natural and formal languages. In classical logic, the 'particular' quantifier is symbolized as ∃ and has now more widely come to be known as the 'existential' quantifier. True to its name, ∃ has been interpreted as the logical notation for existence, drawing the connection between quantification and existence. I challenge this interpretation through a formal study of the semantics of quantification in natural and formal languages, to deny the connection. I put forward a linguistically motivated view of how the semantics of existence works and how it interacts with quantificational expressions, to show that quantification should have nothing to do with existence. I argue that the ontological loading of the quantifier is smuggled in through the restriction of domains of quantification, without which it is clear to see that ∃ is not existential in any way. Once we remove domain restrictions, domains of quantification can include non-existent things, and quantification and existence can be separated once and for all.

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'. Quantification is thus the means by which we display ontological commitment. In stating '3 is a prime number' one is *actually* stating $Na \wedge Pa$ which entails $\exists x(Nx \wedge Px)$, which for Quine is read as '*there exists* something that is a number and is prime'. 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."[1] I will explore two possible reasons why a Quinean 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

[1] Quine (1992) p26

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[2] 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"

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.*

[2] Quine (1948) p33

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 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. 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 (which non-existents are said to lack).

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 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 possible fat men in doorways.[3] The problem with the possible fat man in the doorway is that there is no determinate answer as to whether he is identical to the possible tall man in the doorway, or the possible smelly man in the doorway etc. Without there being a determinate answer as to whether one is identical with another is for the things to be lacking determinate identity conditions. 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

[3] Quine (1961) p4

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.

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 conditions do not pick out all and only existents, so even if the domain is restricted by SET to have determinate identity conditions this doesn't restrict the domain to all and only existent things. It thus seems that determinate identity is neither necessary nor sufficient for existence. Therefore the biconditional NE cannot be a constraint on domain specification, leaving logic naturally neutral.

As stated before, to have determinate identity conditions means that for all *a* and all *b* there must be a definite answer as to whether $a=b$. Benacerraf[4] takes issue with this claim with regard to numbers and sets, by showing how there is no definite answer as to which sets the numbers are. Benacerraf notes there are many potential reductions from numbers to sets but since there is no principled way to choose between them then numbers aren't reducible or identical to sets. If numbers exist then they require determinate identity (according to NE), but without there being a fact of the matter as to which, if any, sets they are identical to, then they do not meet this condition. Many philosophers of mathematics, particularly in the structuralist tradition, take the lesson of this to be that numbers exist but without determinate identity conditions, denying NE. Azzouni[5] denies NE using fictional characters to show that determinate identity is not sufficient for existents as non-existent fictional things may meet the condition by stipulation. Other examples showing that determinate identity is not necessary for existents include things like rainbows or heaps. There are also examples in modern science of existents without determinate identity, such as fermions and bosons in Bose-Einstein statistics.[6] Thus the biconditional NE is too strong: by rejecting it in some direction we break the argument that leads to TB.

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

[4] Benacerraf (1965) p62
[5] Azzouni (2004) p101
[6] This is an example borrowed from Cie and Stoneham (2009) p87-88

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[7] 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.

I now turn to examples. 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.[8] 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'.[9] Here, the 'something' cannot mean 'some existent thing' as it would be

[7] 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 more global scope across other languages too.

[8] Burgess and Rosen (1997) p224

[9] Priest (2005) p152

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 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,[10] 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 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, $\exists$ 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 $\exists$ 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.

[10] Strawson (1967) p13. Here, 'a good proportion' and 'most' mean 'some'.

4 Formal language quantification is neutral

Reading ∃ as 'there exists' is incorrect, as 'there exists' is *not* a quantificational phrase. ∃ properly understood is '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. '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*. Therefore, the word 'some' is fit for numerical quantificational use, and 'there exists' is not (as it is a predicate). ∃ 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)[11]. 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 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 ontologically neutral can be strengthened by looking at the logical connection between the two quantifiers ∀ and ∃. Berto asks, "why existential? The dual of 'universal' is not 'existential', but 'particular'."[12] As such, the dual of 'all' should be '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 miraculously 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

[11] Hofweber (2007) p23 and see Gamut (1991) for details.
[12] Berto (2012) p21

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 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"[13] 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 criterion for existing (to be in the domain) and a criterion for being in a domain (to exist).

5 Conclusion

Quantification becomes ontologically loaded when the domain that is being quantified over is restricted to include only existent things. In this way, the Quinean 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. Without such a restriction, quantification ceases to have anything to do with

[13] Azzouni (2004) p55

existence, and the quantifier ∃ should be read as 'some' and known as the 'particular' rather than 'existential' quantifier. Quineans may think that quantification in formal languages is ontologically committing because of the model theoretic machinery, the set theory, or the Tarskian semantics. I have shown that these specifications only give us an ontology if domains are not allowed to contain non-existent things, and so a domain restriction is needed. This restriction is not something that has been argued for successfully by Quine, and ∃ certainly is not trivially or obviously loaded, as Quine initially states. The model theoretic, set theoretic, and Tarskian semantics can be adopted just fine without ontological commitment, since there is no good (non-question-begging) argument for why domain membership (even as sets) requires existence. I thus conclude that we can have classical objectual quantifiers without existence, and that ∃ is the 'particular' quantifier as there is nothing existential about it at all.[14]

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[14] Special thanks goes to Mary Leng and Franceso Berto for helpful comments, and the audiences of the 'Epistemology of Metaphysics' workshop at the University of Helsinki and the 'Mind and Reason' research group at the University of York at which I presented versions of this paper.