The relevance of ontological commitments

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Abstract

In this introductory note, I describe my particular view of the notion of ontological commitments as honest and pragmatic working hypotheses that assume the existence (out there) of certain entities represented by the symbols in our theory. I argue that this is not naive, in the sense that it does not entail the belief that the hypotheses could ever be proved to be true (or false), but it is nevertheless justified by the success and predictive power of the theory that contains the concepts assumed to exist. I also claim that the ontological commitments one holds (even if tacitly so) have a great influence on what kind of science is produced, how it is used, and how it is understood. Not only I justify this claim, but I also propose a sketch of a possible falsification of it. As a natural conclusion, I defend the importance of identifying, clarifying and making explicit one’s ontological commitments if fruitful scientific discussions are to be had. Finally, I compare my point of view with that of some philosophers and scientists who have put forward similar notions.

Keywords: ontological commitment, realism, positivism, quantum mechanics

1 Introduction

In some physics textbooks the importance of ontology (i.e., what is assumed to exist) is strongly emphasized (Dürr and Teufel, 2009), while in some others ontology is banished out of physics (Peres, 2002). Some physicists declare themselves fervent believers in this or that ontology, while some others allege complete agnosticism and call it a virtue.

In this note, I discuss a middle point which is closer to the first kind of positions, but only if properly qualified and not held in a naive way. Although I am certainly not introducing any new idea, I hope that the personal nuances that configure my particular view of the issue can serve the reader to see it in a new light, and perhaps open a debate which I consider very necessary.
2 My view of the concept

2.1 Ontological certainty vs. ontological commitment

Our access to reality is, in general, indirect. That much is obvious. Hence, it seems very
difficult that we could ever be completely sure about the ontological status of the concepts
to which our symbols refer. That is, about whether or not what we collectively mean by,
say, “electron” actually exists out there, or if it simply denotes some complicated way that
we humans have found to summarize certain information that we might obtain about an
unknown underlying reality. Of course, since the “electron” concept is very useful, it has
enormous predictive power, and it fits nicely and consistently with a myriad of other concepts
that are also useful and predictive, even if the answer was the latter, the information that
“electron” summarizes must be strongly correlated with whatever exists out there. It is in
this sense that the information that we bookkeep under the “electron” label can be said to
be about the underlying reality; even if it is not made of “electrons” at all.

Maybe this is the moment to remark that it is obvious to me that something exists,
i.e., that it is not the case that nothing exists. Therefore, there is (to me) some underlying,
external, objective reality. The only questions are of the type of: What is it? Is it in principle
possible to find out what it is? Do humans have what is required to actually find out what it
is? In this particular and very restricted conversation, are “electrons” a part of it? Etcetera.

These are very difficult questions indeed, and I don’t know what the correct answers
might be; nor I think that anyone does. As I said, it is conceivable to me that ontological
certainty could even be unattainable in principle (or in practice, which, in this case, looks
very much like the same thing). If this is so, then the actual truth value of ontological
statements such as “the electron exists” will be forever beyond our reach, and therefore it
could be argued that it is irrelevant. This might be so, but even in such a case what is not
irrelevant is our commitment to the truth of such statements; a powerful concept that I first
found in (Maudlin, 2007), and which now I take the opportunity to put in my own words.

2.2 Ontological commitments in everyday life

Everyday life is full of concepts whose existence (out there) is very questionable but the fact
that humans are ontologically committed to it is nevertheless incredibly important: God,
democracy, free markets, beauty, afterlife, are some examples from a very long list.

These commitments are important mainly because they guide behavior (individual and
collective), and we can even drop the adverb “mainly”; after all, there is hardly anything
more important than behavior for us humans. At least in everyday life, pragmatically, and
understood in a wide sense (talking, even thinking, is behavior too; we don’t have to move
limbs to do things), it seems clear that what we do, what we say and what we think have
an enormous influence in our lives. Even if natural phenomena such as the weather, most of
our own biological processes, and the behavior of other humans and other animals are more
or less independent of what we do (and thus quite independent of what we are ontologically
committed to), we can sometimes anticipate these external events, we can certainly react to
them, and we can even modify them in some occasions. The nature of these interactions and
their likelihood of being beneficial to us or to others is again strongly dependent on what we
believe to exist.
2.3 And in science

We could think that science is different from everyday life in this respect, but we would be wrong. Despite the sometimes grandiose statements that come from it, the almost mythological image that some of its practitioners have acquired, and the fact that it often seems to be worried only with the most abstract of abstractions, science is still done by scientists (for the moment), and scientists are still humans (really). Then, my main claim should come as no surprise: What one is ontologically committed to is extremely relevant regarding what kind of science one produces. I will try to justify this in what follows, but first.

2.4 The radical positivist complains

At this point, the radical positivist may rise his hand and say something like “Only what is measured is important!”, or “You can only be committed to the existence of what you measure!”, or even “Only quantities that can be measured should enter the formalism of your theory!” The debate has been running for many centuries, and a lot of qualifications would be in order if I were to provide a balanced and thorough account of the different positions. However, I have no intention to do so. The radical positivist viewpoint is so weak, so naive, that even an amateur philosopher like myself with only a superficial knowledge of the issues involved can easily refute it.

The basic point is that radical positivists do not speak about how things are, but about how they think they should be. Perhaps the ultimate theory of nature contains no unmeasurable concepts, but every theory we know of today contains them. Perhaps a superior race of aliens thinks only in terms of concepts they can measure, but humans don’t. Perhaps we should strive very strongly to eliminate everything that cannot be measured from our language and from our scientific theories, but we seem extremely far from achieving that feat. As things stand today, both everyday life and science are absolutely full of unmeasurable concepts, and in both fields these concepts have proved extremely useful.

Thus, let us simply dare our radical positivist friend to decide what kind of toothpaste he should buy next week without using any unmeasurable concept—such as “next week”—and let us move on while he struggles endlessly with the challenge.

2.5 Measurements are not the whole story

Measurable concepts in a theory have of course the crucial function of being the loci at which we can compare it to experimental data, and thus possibly falsify it (or produce useful predictions and technologies). However, this is by no means the end—nor the beginning—of the story.

In order to have a theory to begin with, we have to create it first. In order to make testable predictions with it (once created), we need to know what manipulations of the concepts in the theory are valid and which aren’t, what counts as a prediction and what as an intermediate result, what can be in principle observed. Sometimes we also need to know how to interface the theory with some other part of the theoretical corpus that uses very different concepts (e.g., quantum mechanics and thermodynamics). In order to devise a new theory or modify the existing one, if it is in fact falsified by experiment, we need to be able to decide—more often to guess!—what kind of equations could be written or which ones could be tweaked, what parts of the theory look dispensable and what parts look indispensable.

To achieve any of these ends, we certainly have to take into account measurable concepts (after all, agreement with experiment is compulsory), but this is not typically enough to
clearly illuminate the correct way forward. We often have many options—or none at all—and we need other kinds of inputs to break the *impasse*. They could come from mathematical considerations, such as consistency; aesthetic ones, such as simplicity; from other well settled theories; or from ontological commitments. The commitment to the existence of atoms in the explanation of Brownian motion, or of light quanta in the explanation of the photoelectric effect, are clear examples of the latter kind of input.

I am not an experimentalist, but I have the strong suspicion that also when designing, performing and analyzing experiments, what researchers do, say and think, what course of action is chosen, and what is published, are all very much influenced by their ontological commitments regarding whatever piece of the physical world is sitting on the laboratory table, or is being observed in the field or in a distant galaxy. It seems obvious to me that experiments are informed by theory, and I have just argued that theory is dependent on ontological commitments. So the conclusion follows.

2.6 In a nutshell

In sum, to commit to an ontological statement such as “electrons exist out there and not only in my theory and in my mind” is not equivalent to naively asserting that we will be able (some day) to prove the statement true (or false). On the contrary, it is a pragmatic and honest recognition that thinking that electrons actually exist is a powerful *working hypothesis*; i.e., that making such ontological commitment will help us write more predictive, simpler theories with a wider range of application, or to understand and apply the ones we already have more soundly and faster.

This is a true commitment and not just a mask that one *only* wears for pragmatic reasons because, if we happen to be right, and we *are* in fact led to better theories or we *are* able to use the ones we have more efficiently by assuming that electrons exist, then we will be justified to think that the electron concept is closer to the ultimate underlying reality than the old concepts the real existence of which suggested the previous, less powerful theory. We will be justified to think that, even if we cannot prove it.

2.7 The importance of being explicit and clear

If you agree with me that ontological commitments are *this* important, then you should also agree that it is advisable that they are made explicit—and clear—in any presentation (or more or less subtle application) of the theories that depend on them.

Unfortunately, this is rather uncommon, and many discussions are muddled because of the omission. In fact, what brought me to the present reflections was the realization that, in quantum mechanics—a specially muddled field—some authors are committed to the existence of the wave function, some prefer to think that observables are the real thing, and some others assume that neither of them are really out there. Most of the times, these ontological commitments are tacit, but they are nevertheless there; you can read them between the lines and in the equations that are written explicitly. In the worst cases, the authors are simultaneously committed to the existence of contradictory entities (typically without knowing it), which is the perfect breeding ground for the infamous “paradoxes”.

To make things even more complicated, sometimes all of this is combined with explicit statements about the necessity of *not making* any ontological commitment (which could be seen by some physicists as a sign of weakness, a sign that you might be a covert philosopher trying to sabotage physics from the inside). Of course, this recommendation is extremely
difficult to follow and very tiresome; much like “don’t think about a pink elephant” or even “don’t think about anything at all”. Making ontological commitments is just something that our human brains do automatically, and I apologize for the repetition but scientists are humans, and yes, they have brains. When somebody recommends not making ontological commitments, what they really mean is a creative combination of (i) try very hard not to make them (even if this means that you move very slowly), (ii) if you catch yourself making them feel ashamed and try harder, and (iii) in any case, never ever make them explicit—if you cannot avoid it, at least keep it for yourself. In that way, nobody could argue in a trial that you have in fact made such a terrible mistake, and maybe you could even maintain (for yourself) the self-reassuring fiction that your agnosticism is pure.

Caricatures aside, it is my opinion that clearly stating these important ingredients (the ontological commitments which you certainly make—like it or not—and which strongly influence how you do science) could be very useful to put some order in the field of foundations of quantum mechanics; a field which is teeming at the moment with tens of versions of the theory (sometimes called “interpretations”), and with researchers talking past each other in specialized journals and conferences (Echenique-Robba, 2013). However, it is worth pointing out that the general argument in favor of the importance of ontological commitments—and therefore of stating them explicitly and clearly—does not apply only to quantum mechanics, but across the scientific board.

2.8 A sketch of a falsification

To me, it is obvious that ontological commitments (i) are unavoidable features of human thought, and (ii) they affect what you do, what you say and what you think, in everyday life and in science. However, these are claims about the psychology of human beings, not about any underlying reality. Hence, they are in principle open to experimental falsification. You don’t have to take my word for it—or reject it. We can check who’s right.

I am no experimental psychologist, but I have already proved that my condition of amateur doesn’t deter me from irresponsibly exploring philosophy or experimental physics. Thus, I will continue along my foolish line and I will provide a very rough sketch of some experiments that may be done to actually falsify the two claims in the previous paragraph. Of course, these are just the germ of the beginning of a proper brainstorm which should be conducted, ideally, by a collaboration between philosophers, theoretical physicists and experimental psychologists. I am only writing this up to provoke and to (hopefully) jumpstart a useful discussion.

- **Are ontological commitments unavoidable features of human thought?** A proper falsification of the claim would maybe amount to finding at least one human who at least in a given field of knowledge can be shown not to make any ontological commitments. It seems clear that we make them all the time in everyday life, so we can’t look there. To begin our search, we can take some physicist who declares himself a complete agnostic, say, about what the ontological elements in his view of quantum mechanics are. If he is right, he constitutes a counterexample. However, his mere statement that this is the case is definitely not enough; humans are famous for not knowing themselves very well. Maybe we should look in his conscious behavior for clues that signal the existence of unconscious ontological commitments—or the absence of them. Perhaps we could look in the language he uses when he talks informally about the theory, or in his reaction to carefully crafted sentences that (subtly) imply an
ontological commitment as compared to others that don’t. It doesn’t seem easy to do it in a careful, controlled and convincing way, but it doesn’t seem impossible either.

- **Do ontological commitments affect what you do, what you say and what you think when producing or applying science?** This is easier to check, at least if one is willing to use students as guinea pigs. Take two groups of students of similar level, attitude and proficiency but who have never been formally exposed to quantum mechanics. Teach one of them one “interpretation” of quantum mechanics with a given ontological import [say, Bohmian mechanics (Dürr and Teufel, 2009)], teach the other a different “interpretation” [say, some version of instrumentalism such as the one in (Peres, 2002)]. Then, ask the two groups the same set of questions about quantum mechanics, explain to them some subtle result (such as Bell’s inequalities), propose to them a number of exercises, and measure the quality of the answers, the depth of their understanding and the ability to solve problems. Finally, compare the two sets of results and see whether they are significantly different.

You might argue that Bohmian mechanics and Peres’ instrumentalism are not only distinct at the ontological level, but also at the formal one (which could contaminate the conclusions). You could also object that neither of them requires to make any specific ontological commitments, i.e., that you can commit to anyone of them while remaining agnostic about ontology. I might answer to both objections at the same time by proposing that you feed the same formalism to both groups, adding, for each one of them different and explicit ontological viewpoints. However, as I said, my aim here is just to open the door to a possible falsification of my claims, not to fix every detail of the experiments. So I will stop the analysis here and move on.

3 **Others’ views**

As with any philosophical concept, that of **ontological commitment** can take many different forms and depths; even if they are, of course, very much related. The version that I have just presented here also has its idiosyncratic characteristics; mainly stemming from the fact that it is my version: it is rather naive and superficial from the philosophical point of view, it is eminently pragmatic, and it is focused on the business of doing science (specifically, physics).

My notion is very similar to the version that Sean Carroll briefly mentions in this blog post (Carroll, 2012), and it also has much in common with Tim Maudlin’s view, which I have already mentioned (Maudlin, 2007). I am sure that Carroll’s version is not as naive as mine, but since his post is really short, we cannot tell. Maudlin’s version, on the other hand, is certainly not naive or superficial, and we can tell by the length and the depth of the analysis.

In chap. 3 of (Maudlin, 2007), we can find a cogent discussion about ontology that includes the concept of ontological commitment as traditionally conceived in philosophy, i.e., as the question about what is the ontology that a given theory commits us to if we accept the latter. Maudlin discusses the celebrated proposal by Quine and also further developments, and he concludes that they are insufficient. The main claim by Maudlin is that:

...metaphysics, i.e. ontology, is the most generic account of what exists, and since our knowledge of what exists in the physical world rests on empirical evidence, metaphysics must be informed by empirical science.

6
In particular, and as he exemplifies later, it must be informed by the best physical theories we have. The prevalence that Maudlin assigns to physical theories over philosophical speculation is clearly stressed in the following paragraph at the end of the same chap. 3:

Fiber bundles provide new mathematical structures for representing physical states, and hence a new way to understand physical ontology. For example, modern electromagnetic theory holds that what we call the ‘electromagnetic field’ just is the connection on a fiber bundle. Such an account evidently carries with it quite a lot of ontological commitments: there must be a base space, and internal degrees of freedom at each base point represented by a fiber, and a unified object that corresponds to all of the fibers with a connection. But if one asks whether, in this picture, the electromagnetic field is a *substance* or an instance of a *universal* or a *tropes*, or some combination of these, none of the options seems very useful [something which he proved in the previous sections]. If the electromagnetic field is a connection on a fiber bundle, then one understands what it is by studying fiber bundles directly, not by trying to translate modern mathematics into archaic philosophical terminology. If an electromagnetic field is a connection on a fiber bundle, then there are more things in heaven and earth than dreamt of in Plato’s or Aristotle’s philosophy. And surely this is to be expected: it would be a miracle if the fundamental ontological structure of the universe fit neatly in the categorical pigeonholes handed down to us from two millennia ago.

In my naive account of ontological commitment, I have also focused on science in general and physics in particular, and I agree with Maudlin that scientific theories are one of the most important sources of ontological insight. However, my words also suggest that I also count intuition among my sources—which I do. Although this might seem to run counter to the previous criticism by Maudlin against philosophical speculation, this impression is short lived. As I see it, the most important thing you must do in order to arrive to an ontology that might be useful (and thus possibly closer to the ultimate underlying reality) is indeed to look at the best scientific theories we have; exactly as Maudlin claims. However, this is (i) difficult and (ii) maybe not enough. I.e., when you are confronted with a theory (say, quantum mechanics), you might conceive of several different ways of inferring an ontology from it—or none at all. In fact, this seems to be exactly what is happening nowadays in the field. This suggests, as I say, that the program of deriving your ontological commitment from scientific theories is sensible, but also very difficult and perhaps underdetermined. Exactly the kind of problem where good, informed intuition can become handy.

As Hilary Putnam puts it in a nice aphoristic way (Putnam, 2012):

\[ \ldots \text{mathematically presented quantum mechanical theories do not wear their ontologies on their sleeve.} \]

Judging by Maudlin’s critique of Quine’s approach, which emphasizes that some metaphysical heavy lifting is involved in translating a theory into a form in which it can be used to infer ontological commitments, as well as by the fact that he outlines the program but does not take it to an end—what an amazing feat would that be!—I think that he might agree with me (and with Putnam) on this qualification.

Also much related to this point is of course the fact that our different physical theories present distinct levels of formalization and conceptual tidiness. Some are compact, beautifully axiomatized and crystal clear about what they claim and how they work, but some
others are not quite so. The task of extracting ontological commitments from the latter family of theories is probably more difficult than doing the same for the former, and intuition plays a more determinant role in such a case too.

Another philosopher who famously informs his philosophy on science is Daniel C. Dennett. In fact, we can also find in Dennett’s account of the *intentional stance* an idea which is so similar to my justification of ontological commitments through the power of the theory that rests on them that I have strong doubts about whether the idea is mine at all, or I simply got it from him and then forgot its origin. In any case, since Dennett puts it so clearly, and the reasoning also serves as a bridge between Maudlin’s theories prevalence and my moderate intuitionism, let me briefly discuss the issue here.

As we can learn in sec. 18 of the introductory book (Dennett, 2013), and also in the much more detailed (Dennett, 1989), the “intentional stance” is a level of abstraction, a mode of reasoning if you will, which is specially good in dealing with certain kind of systems termed (of course) “intentional systems” or sometimes just “agents”. In his own words (Dennett, 1989):

> Here is how it works: first you decide to treat the object whose behavior is to be predicted as a rational agent; then you figure out what beliefs that agent ought to have, given its place in the world and its purpose. Then you figure out what desires it ought to have, on the same considerations, and finally you predict that this rational agent will act to further its goals in the light of its beliefs. A little practical reasoning from the chosen set of beliefs and desires will in most instances yield a decision about what the agent ought to do; that is what you predict the agent will do.

As Dennett argues, and it is obvious from our everyday application of the intentional stance, this “theory” combines an amazing simplicity with a very significant predictive power. Indeed, it is not evident at all how we can (approximately) predict the behavior of systems as complex as a leopard or a human using such a compact scheme. If we look at the physical and molecular complexity of these systems from a detached point of view, it may seem that saying *anything whatsoever* about what they will do in the next seconds is hopelessly impossible—and yet. The explanation of why the intentional stance works is completely outside the scope of this note, but the truth is that it works remarkably well. In fact, as we can also found in Dennett, it is precisely this success of the theory what justifies our ontological commitment to the actual existence of the entities that the theoretical terms “belief”, “desire” or “goal” refer to. As Viger (2000) clearly puts it:

> ...our ontological commitment to beliefs and desires derives from the success of intentional explanation. There is simply no room, then, to contrast the existential status of entities posited by physics. Beliefs and desires are as ontologically secure as electrons or gravitational fields, for it is nothing more than the predictive success of physics that grounds our commitment to the entities that our physical theories posit.

### 4 Conclusion

To conclude, my notion of ontological commitment (which is very much aligned to that of the mentioned philosophers and scientists, and possibly to that of many others) can be briefly described as a *personal working hypothesis about what really exists out there, which is not arbitrary but partially validated and justified by the success of the scientific theories that contain the corresponding concepts or are suggested by them.*
I have also emphasized the influence of these hypotheses in what kind of science one produces or the skill with which theories are understood and applied, as well as the consequent importance of identifying, clarifying and making explicit one’s ontological commitments if fruitful scientific discussions are to be had. This might seem obvious for the philosophically inclined reader, but it is my experience that it is not quite so among theoretical physicists.

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