

Review of: "In the doing of science, what is the place for naturalistic philosophy? Implications for the teaching of science"

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I was pleased to see a manuscript focused on some of the philosophical features of the scientific method. I applaud the authors for this work. Yet, as with all aspects of scientific scholarship, there are comments to provide regarding specific content of the manuscript, as well as content that was not included. Thanks to the format of the review process for *Qeios*, I not only have the opportunity review this manuscript, but to also expand on its content in a constructive process. It is with this in mind that the following content was written.

I will provide traditional reviewer comments, and then for each item, where appropriate and suited, will expand on certain aspects of the content that I think are also worthy of critical thought and inquiry across all levels of the pursuit of science.

Abstract

The last 3 lines are important, but I don't think your content in the manuscript does your reference to 'vital' justice or clarifies the differences between science and 'the doing' of science. Given the varied use of the word 'science' and how it is and is not understood by the public, and I would argue even by many scientists, perhaps you should have given a clear definition in the text of what science is (it is not simply a posteriori experimentation), and why the pursuit of science can be polluted by the shortcomings of human behavior.

Introduction

Paragraph 2, Line 1

Note the need for a space between the book title and Carin Robinson.

Lines 1-7

I know you are focusing just on the naturalistic (*a priori*) vs. experimental (*a posteriori*) comparison here, but I find the argument that science is purely experimental, and as such *a posteriori*, to be highly tunnel visioned and lacking in a comprehensive understanding of the process of science. In your manuscript you build an argument that conforms to this criticism, but largely in the context of language and not of purpose, procedure, or practice. I will touch on this again later, but the beginning phase of a scientific endeavour is nested in *a priori* procedure based on the recognition of a research problem, the development of a research question, hypotheses and related research design, sample size and statistical

power estimations, etc.

Paragraph 4, 5 and 6

I think you dilute your arguments against the problem you identify when you ignore the multiple processes of science that are performed *a priori*, and in doing so simply use the concept of language to support naturalistic philosophy. In doing this, you miss the multiple lessons learned from the comparison of the interpretations of Kuhn vs. Popper, which in turn complicates how your manuscript is read and understood. In short, I agree with your net conclusions about the natural affinity (paragraph 5, line 1) between naturalistic philosophy and the pursuit of science, but you undersell this by focussing on language and thereby ignoring the other facets of philosophy that science has developed from.

The A priori And The A Posteriori

Paragraphs 1, 2, 3

Once again, I would argue that *a priori* concerns more than language and such a view of naturalistic philosophy is too constraining. To do science better, scientists must develop the research problem from applications of their knowledge contrasted against prior research evidence, the purpose of the ensuing research and craft suitable methodology that is reproducible, open to falsification and can provide an outcome that is most likely to be true. If this is not done correctly, then no efforts at interpreting the results *a posteriori* will yield correct scientific discovery. One could argue that the success of a scientific pursuit largely lies in the correctness of the *a priori* components of the scientific method. Further, one could comment that if science was only concerned with generating data and interpreting the data, then artificial intelligence would be all that is needed, and the human influence could be removed. Until computerized machine learning advances to the point where it can place human inquisitiveness, creativity and intuition when used in the early phases of the detection of a research problem, then the human influence in science, regardless of all the flaws this brings, will be functional for a long time to come. So once again, yes, there is a natural affinity between natural philosophy and science, but for many more reasons than you address in this manuscript.

Paragraph 4, last sentence

Yes, but as stated above, the connection is far more complicated than this. Furthermore, *even a posteriori* functions are diverse and expand on experimentation based on contrasting how the results compare to prior research, the status of accepted knowledge on the topic, and as Kuhn revealed, if the results present anomalies to previously assumed or accepted conventional interpretations. There is scope for debating the involvement of naturalistic features of scientific practice on the *a posteriori* side of the scientific method as well. Many scientists, due to their inability to clear their own biases, get this part of science wrong as well.

You comment that there is a fuzzy transition between *a priori* and *a posteriori* features of science, but in reality there are also regions of blurry practice evident within each of the two topical foci of this manuscript.

Paragraph 6, last sentence.

Yes, I like your use of the word 'interdependence' here. As such the two components are not mutually exclusive of each other. The majority of scientists get their pursuit of science wrong because the history of scientific discovery reveals that only a small number of scientists have acquired the skills and knowledge, combined with innate talents, needed to confront incorrect paradigms (oppose the conventional acceptance of branches of knowledge), experimentally prove this to be so, and then develop a new line of evidence-based research inquiry that more correctly reveals what we now assume to be the truth. The problematic questions are why is it that so many scientists get it wrong, and in extension, why do so few get it right?

The Human Condition

I do not see the relevance of this section.

The Existential Dimension Of Naturalistic Philosophy In Doing Science

I found this section to be overly traditional and tainted by historical and religious bias. While I recognize the rich philosophical dialogue regarding the purpose of science in society, at its core, science concerns discovery of knowledge. How different cultures view and/or restrain this process should not be encapsulated in the definition of science, or the overarching intent for its being. For example, given your content, why is there the scientific pursuit of the armaments sector that fuels war and reinforces the chasms of this world between those that have socio-economic wealth, and those that do not? How is that morally justifiable? Similarly, is scientific discovery of new machines, equipment and related technologies only worthwhile, and therefore relevant, if it can be entwined within capitalist societies where there is scope for profit?

In contrast to these views, surely science is simply science (the generation of new knowledge). How science is used, or promoted vs. discouraged, is a reflection of the societal control over the process. As such, science can be completed for highly immoral and unethical reasons, just as much as it can be directed and/or intended to serve the good of humanity. A classic example of this multifaceted dilemma pertains to the Manhattan Project (the pursuit of new knowledge of radioactivity and the building of the first nuclear bomb). While we can debate on the ethical or moral imbalance of this historical event, there have been positive outcomes that have been spawned from this endeavor and aided humanity in positive ways (nuclear medicine, nuclear energy, radio-isotopic labelling in research of metabolism and diseases, etc.). Humanity has decided collectively to refrain from using nuclear weaponry in war ever since and to apply this knowledge to beneficial pursuits. The issue of genetic cloning is another example that has led to numerous "positive" outcomes from the advanced knowledge of genetics. As such, you cannot constrain knowledge development as you will never know what beneficial outcomes will come from what might first appear immoral intent.

Feynman, Heisenberg and Wittgenstein

Hannah Arendt

Bohe-Heisenberg

I understand that you needed to include these sections to provide a contrast to the contributions to science from Hannah

Arendt and the Bohr-Heisenberg debate. Nevertheless, this content is difficult to read, and one cannot help but raise the question of the relevance of a 1920's view of philosophy to current time. That said, I agree with the need to raise concern over the societal consequences of an increasingly scientific illiterate society. Perhaps we are seeing some of the consequences of this today in the extremist (in both directions) political developments in the USA and other democratic countries. When real knowledge is unable to be deciphered from false knowledge, democracy can become unravelled, and freedoms can be lost.

Unfortunately, I think the purpose the manuscript was drowned by the detail of these sections.

Conclusion

Paragraph 3

Yes, the best paragraph in the entire manuscript. This is what you need to more clearly have built the manuscript around. People pursue science, and in doing so, infuse good and bad into the process in both a priori and a posteriori functions. All people, including scientists, need to be more aware of this reality.

Paragraph 7

It is a shame you spoil the impact of your manuscript by stating, "... suggesting that at least some emphasis is required on the conjectural and creative aspects of science," As I have commented, good science has its foundation in *a priori* pursued conjecture and creativity. As such, these features at question are not trivial. Proper a priori procedures that are followed in the pursuit of science can separate ordinary science from extraordinary science. Surely the latter is what we should all strive for and the roles of *a priori* procedures coupled with the infusion of naturalistic principles and behaviours on the *a posteriori* side are essential for this transition to occur.