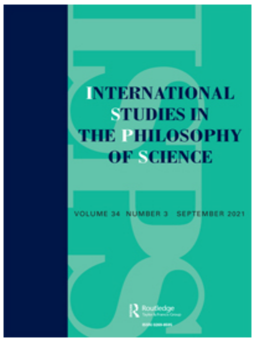

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Pseudoscience as a Negative Outcome of Scientific Dialogue: A Pragmatic-Naturalistic Approach to the Demarcation Problem

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ABSTRACT
The demarcation between science and pseudoscience is a long-standing problem in philosophy of science. Although philosophers have been hesitant to engage in this project since Larry Laudan announced its demise in the 1980s, pseudoscience as a societal phenomenon did not disappear, and many policy makers and scientists continue to use the concept. Therefore, the philosophical challenge of explaining what pseudoscience is and how it differs from genuine science still stands. Even though it might well be impossible to identify all pseudosciences by means of a set of necessary and sufficient conditions, we can nonetheless, in a naturalistic fashion, establish that pseudoscience is a real phenomenon, diagnose recurring features and symptoms, and explain how these emerge. In this paper we argue that science builds on and emerges from interactive reasoning, a process that, under particular conditions, weeds out beliefs and practices that are not (sufficiently) justified. When people nevertheless think of these beliefs and practices as equivalent to or even better than the ones accepted by the scientific community, they are rightfully regarded as pseudoscience. We explain the processes by which beliefs and practices may degenerate into pseudoscience and discuss the implications of our demarcation approach for the understanding of pseudoscience.

KEYWORDS
Pseudoscience; demarcation; dialogue; naturalism; pragmatism; interactionist theory of reasoning

1. Introduction

Humans can fly to the moon, unravel the building blocks of the universe, retrace their natural history all the way back to the first forms of life, and combat and defeat deadly diseases. These are only a few of the major accomplishments that we owe to science and technology. And yet, in spite of the great advances our species has made in recent centuries, many people still adhere to various forms of pseudoscience and science denialism, such as creationism, anti-vaccination and anti-GMO beliefs, a whole suite of 'alternative' medical therapies, and even, most absurdly, flat earthism. Today,

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pseudoscientists and conspiracy theorists undermine scientifically informed measures to stem the spread of Sars-Co2-V by propounding all sorts of unfounded and sometimes downright fantastical theories, for instance the belief that COVID-19 has been invented to cover up the symptoms of 5G radiation. In many cases, these beliefs pose a real threat to the functioning of democratic societies and to the well-being of their citizens, which explains why making the distinction between science and pseudoscience remains a relevant and urgent matter (Pigliucci and Boudry 2013). Nevertheless, especially after Larry Laudan (1983) proclaimed its demise in the early 1980s, philosophers largely abandoned the so-called 'demarcation project' for several decades. Laudan not only argued that earlier attempts at demarcating science from pseudoscience had failed, but also that the project itself was a philosophical dead-end. According to Laudan, the concept of 'pseudoscience' neither denotes a real phenomenon, nor does it reflect an objective evaluation—it only serves rhetorical purposes, i.e. as an expression of disapproval.

Even today, however, the spread and impact of different 'pseudosciences' continues to show that the demarcation problem will not go away by simply neglecting it. Pseudoscience and science denialism remain a formidable societal concern, which we have to properly understand before we can address it in a firm and effective manner. Philosophers can and should contribute to this important project by studying what makes a practice pseudoscientific. Recent years have seen something of a revival of the demarcation project, with many philosophers concluding that the rumours of its demise have been greatly exaggerated (e.g. Bhakthavatsalam and Sun 2021; Blancke, Boudry, and Pigliucci 2017; Boudry 2021; Boudry, Blancke, and Pigliucci 2015; Dawes 2018; Fasce 2019; Hansson 2017, 2020; Hirvonen and Karisto 2022; Holman and Wilholt 2022; Letrud 2019; McIntyre 2019; Tvrdý 2021).

In line with this recent revival, we intend to shed new light on the demarcation problem by taking a pragmatic-naturalistic approach. This means that we look at the cognitive and social processes involved in the production and spread of both scientific and pseudoscientific beliefs, to investigate what they are and how they differ. By relying on the pragmatist approaches of Haack (2003), Laudan (1977), and Longino (2002), in combination with the interactionist theory of reasoning of Mercier and Sperber (2017), we argue that the term 'pseudoscience', though indeed often serving rhetorical purposes, (1) does denote a real phenomenon and, (2) carries normative force—the practices and theories labelled as 'pseudoscience' are rightly dismissed as irrational, and are harmful in a variety of ways. Following Longino (2002) (and more recently: Oreskes 2019; Rauch 2021) we argue that science results from critical dialectical interactions within certain communities that qualify as 'scientific'. Scientific beliefs and practices are those which the relevant community accepts as being justified in light of currently available evidence.

Pseudoscience, in contrast, refers to the beliefs and practices that are defended by their proponents as trustworthy alternatives to scientific beliefs and practices, even though the relevant scientific community regards them as not, no longer, or unlikely to be sufficiently justified. Pseudoscience, in general, can thus be regarded as an important negative epistemic outcome of the dialogue taking place within a group of inquirers investigating a particular domain. We discuss how critical dialectical interactions result in either science or pseudoscience, why and under what conditions we (i.e. those who are not experts in the relevant fields) can rely upon the outcome of these interactions to demarcate science from pseudoscience, and how our approach builds further and differs from a recent proposal by Dawes (2018). We then engage with potential objections to our approach and show how our understanding of pseudoscience accounts for some of the typical features or symptoms of pseudoscience.

2. The Challenge Ahead

Thinking about what science is also implies thinking about what it is not. The phenomenon of pseudoscience in particular challenges us to explain what distinguishes the fake (*pseudo*) from the real. In contrast to other forms of non-science such as philosophy or religion, pseudoscience pretends to be scientific by adopting the trappings of science. As pseudoscience piggybacks on the epistemic and cultural authority of science (O'Brien, Palmer, and Albarracin 2021), it is crucial to explain why pseudoscience, even though superficially looking like science, does not deserve that epistemic status. Although philosophers of science such as Popper and Lakatos thought the project of demarcating science from pseudoscience was not only philosophically but societally relevant, most philosophers have since lost interest in the problem, and even regard it as misguided.

Laudan and Haack are among the most prominent philosophers sceptical about the demarcation project. They suggest that we should always evaluate theories and practices on a case-by-case basis, not by philosophical fiat. Hence, Laudan argued that 'we ought to drop terms like "pseudo-science" and "unscientific" from our vocabulary; they are just hollow phrases which do only emotive work for us' (Laudan 1983, 125). In a similar spirit, Haack (2003, 116) writes that 'rather than criticising work as "pseudo-scientific", it is always better to specify what, exactly, is wrong with it'. We agree that specifying the mistakes and errors of a particular theory is more informative than simply brushing them aside as pseudoscience, especially for scientific practitioners debating the merits of such theories. However, we believe that the winnowing process in scientific communities results in a phenomenon that we can, after the fact, rightly label as 'pseudoscience', both in its descriptive and normative sense, and that we can study and identify its typical features across a range of different domains.

To clarify what is at stake, let us start from two relatively recent definitions of pseudoscience. First, Hansson (2009, 240) suggested that pseudoscience can be characterised as follows:

> (1) It pertains to an issue within the domains of science (in the wide sense). (2) It is not epistemically warranted. (3) It is part of a doctrine whose major proponents try to create the impression that it is epistemically warranted.

Fasce (2017, 476) suggested the following criterion:

> Pseudoscience

1. Refers to entities and/or processes outside of the domain of science.
2. Makes use of a deficient methodology.
3. Is not supported by evidence.
4. Is presented as scientific knowledge.

Despite the fact that they rely on a list of criteria to define pseudoscience, both these characterisations go a long way towards meeting the pragmatists' concerns. The criteria they provide, as the pragmatist would argue, do not by themselves allow us to distinguish science and pseudoscience. If one wants to distinguish creationism from evolutionary theory or homeopathy from modern medicine, we cannot just note that the former theories are epistemically unwarranted, make use of a deficient methodology, or are not supported by evidence. That still leaves open the question *why* exactly epistemic warrant is lacking, why the methodology is deficient, or why evidence is lacking. In Haack's words, we still have to specify what exactly is wrong with it. From a pragmatic point of view, this task is not so much a philosophical as a scientific one. It is up to scientists themselves to decide what theories are warranted, which methodologies are acceptable and which ones are not, and what theories are best supported by the evidence. In other words, even though philosophers of science can help scientists to outline the general features or criteria which good scientific theories should exhibit (simplicity, explanatory scope, consistency, non-adhocness, etc.), it seems that the specific decisions to apply these criteria in practice, accepting some theories while dismissing others, lies with scientists.

However, zooming out of such domain-specific assessments of what is scientific and non-scientific, we might still be able to make general claims about science, non-science, and pseudoscience, thus shedding more light on Hansson's definition. Ironically, as we will show next, we can even do so based on ideas developed by those who have been quite dismissive of the demarcation project.

3. Science as a Dialogue

3.1. Science as Common Sense, 'Only More So'

A pragmatic-naturalistic approach to science implies that, in order to understand what makes science special, as philosophers such as Francis Bacon, John Locke, and David Hume already realised, we first need to see how it arises out of the normal talents and constraints of the human mind, and how it ultimately overcomes these limitations (Haack 2003; Kitcher 1993). Such an approach to science implies that the scientific pursuit of knowledge is not essentially different from everyday forms of inquiry. Susan Haack (2003, 96) expresses this perspective succinctly with the phrase that science is very much like common sense, 'only more so'. Science builds upon our ordinary sensory, cognitive, and social capacities by using all sorts of mental crutches and scaffolds, ultimately arriving at a complex understanding of the world that is highly counterintuitive. Many of these cognitive scaffolds are material (telescopes, measuring devices, scans, particle accelerators), while others are conceptual: we employ mathematics, logic and statistics, but also metaphors and analogies, to scaffold our inference-making and improve communication (Boudry, Vlerick, and Edis 2020; Haack 2003, chapter 4).

By far the most important of these scaffolds consists of the minds of other scientists. Reliance on peers is an essential dimension of science, which has been overlooked by many early attempts to solve the demarcation problem on purely logical/conceptual grounds (Dawes 2018; Longino 1990; Oreskes 2019). Even the great Isaac Newton, who is often regarded as a paragon of the 'solitary genius', admitted that he could only have discovered his laws of motion by 'standing on the shoulders of giants'. In their research, scientists never start from scratch, but rather build on the realizations of their predecessors and their peers. Furthermore, science has become increasingly specialised, to the point where the study of particular domains requires many different skills and forms of expertise, not all of which can be mastered by a single individual. As a result, in science we find a wide distribution of cognitive labour, with scientists having to place some trust in the research activities and findings of their peers (Kitcher 1993, chapter 8). It is, of course, a form of calibrated trust, not blind, as science also includes institutional arrangements such as peer review and academic meetings that involve criticising one another's work. It is exactly because such checks and balances are in place that the trust of scientists in one another, and in particular the consensus among a group of experts, tends not to be misplaced (Longino 2002; Oreskes 2019).

3.2. From the Social to the Rational: Local Epistemologies

If science depends on collective efforts and collaborations, how do these social processes result in rational scientific beliefs? The key to the answer lies in human reasoning. In contrast to more traditional views, recent advances in cognitive psychology suggest that the evolutionary function of human reasoning is (perhaps surprisingly) not to arrive at accurate beliefs through solitary reasoning. Instead, reasoning is an inherently social activity in which we provide reasons to others under the form of arguments and justifications, and they in return to us. On the production side, reason tends to be 'biased and lazy' (Mercier and Sperber 2017, 9); biased, because we look for reasons in our support; and lazy, because it often takes less effort to find a simple but perhaps weaker reason than a strong but more difficult one. This explains the long-standing finding that human reasoning displays a confirmation or myside bias, a tendency to select and interpret data and arguments in such a way that they support one's case (Mercier and Sperber 2011, 63–66; 2017, chapter 11). As scientists are not superhumans, they too are susceptible to this bias (Mercier and Heintz 2014). In contrast to what Popper once suggested, real scientists do not actively look for falsifying evidence, or at least not usually. Most of the time, they set up experiments and seek evidence to verify or confirm their own hypothesis and theories. In some cases, they would even select evidence or massage their data in order to make them fit pre-conceived theoretical expectations (Ritchie 2020).

This account may not be in accordance with the traditional model of individual rationality, but according to the argumentative theory of reasoning this is not a problem. This is because, on the receiving side, reasoners tend to be more critical and objective. People may be lazy when it comes to their own reasoning, but they display 'epistemic vigilance' when it comes to reasons presented by others (Mercier 2020; Sperber et al. 2010). On the one hand, they want to avoid being misinformed, deceived, or manipulated. On the other, they do not want to miss out on a learning opportunity either. In this framework, the rationality of science resides in the social exchange of reasons, not in the individual production and critical evaluation of reasons. When people are confronted with the reasons provided by others, they tend to evaluate them in a more objective and critical manner. This explains why science contains social norms and institutional structures that facilitate and optimise the critical evaluation of each other's beliefs (Longino 2002; Oreskes 2019; Rauch 2021).

Interactive reasoning plays a central and under-appreciated role in science. Scientists continuously partake in the process of making assertions, critically evaluating the work of their peers, and replying to criticism, supporting and arguing for their position by invoking reasons (Longino 2002; Ziman 1968). They defend their own beliefs against their peers by citing data as reasons to accept their hypothesis and by citing methodologies to accept their data. They point at a particular unsolved problem to explain why their research is relevant and invoke the beauty or elegance of an explanation to prefer it over alternative accounts. Science is a process of pitting reasons against reasons in a continuous social exchange. Even when scientists rely upon certain practices or theories without providing an explicit justification, they do so under the assumption that others have supported these practices and theories with sufficient reasons.

Reasons are central in science because the dynamical collection of reasons accepted by a majority of scientists working on a particular problem or domain (a scientific community) constitutes what Longino (2002, 184–189) calls 'local epistemologies'. By constantly exchanging reasons scientists can extend their agreement and reach a consensus about which beliefs and practices are justifiable and which ones are not. Hence, local epistemologies weed out the beliefs and practices that do not meet the standards imposed by a scientific community based on good reasons. As such, the concept builds on and thus stands in the tradition of Lakatosian research programmes (Lakatos 1976) and Laudan's notion of a research tradition, which he describes as 'a set of ontological and methodological "do's" and "don'ts"' (Laudan 1977, 80).

The process of interactive reasoning by itself, however, does not guarantee that humans will construe truth conducive local epistemologies in any given domain. If that were the case, given the deep evolutionary origins of interactive reasoning, human societies would have universally developed science as soon as they started asking questions about the universe. The proper conditions need to be in place for a group of inquirers to optimally consider and deliberate all the relevant reasons available at a particular time. Those conditions—and their improvements—are in their turn the result of trial and error, and ultimately of scientific inquiry (for a discussion of these conditions, see below). Only when those conditions are in place (as well as a range of socio-economic and political boundary conditions) will a group of inquirers, or a scientific community, begin to develop rational and epistemically superior beliefs about the universe. In a mature science, this means that, at any given time, the relevant scientific community will have reached a consensus about certain theories and practices, because there are no (longer) reasons that would make them reconsider that consensus. Of course, such a consensus always remains defeasible, in the sense that someone may come up with novel reasons (either conceptual or empirical) that challenge the old consensus.

In sum, interactive reasoning enables us to connect the social with the rational dimension of science. A community of scientists constantly provides and evaluates reasons, which under particular conditions results in local epistemologies that determine which beliefs, practices, and behaviour are justifiable and hence rational. As we will show next, this connection between the social and the rational has important implications for our understanding of pseudoscience.

4. Scientific Dialogue and Pseudoscience

Following this interactionist model, it is not up to philosophers to decide what practices and theories fall within and outside the realm of science; scientists make such decisions on the basis of local epistemologies that emerge spontaneously from the dialectical interactions within a scientific community. Nevertheless, this pragmatic-naturalistic approach still allows us to make some general distinctions between science and pseudoscience. If science is the process of a critical dialogue as well as the outcome of that process, pseudoscience can be regarded as comprising doctrines and practices that are completely unsupported by good reasons according to a majority of scientists within a particular field, though the adherents pretend otherwise. Pseudoscience is thus a (particularly) negative outcome of scientific dialogue.

This account is more than just a reiteration of the sociological observation that pseudoscience comprises those practices that are rejected by scientists. It also spells out, at a general level, why scientists reject them: because the exchange of reasons within the relevant scientific community has determined that they are not (or no longer) supported by good reasons. Of course, we could still ask on what basis scientists in different fields make such distinctions. Here, we might indeed find, as the critics of demarcationism have suggested, that the standards for what counts as good reasons differ substantially between different scientific communities. Scientists studying high energy physics might have very different expectations about what counts as a proper theory and what are good ways to obtain it than scientists involved in molecular biology (Knorr Cetina 1999). Scientists in different fields may pay attention to similar theoretical desiderata to evaluate theories—such as simplicity, consistency, elegance and explanatory power —but how those criteria are fleshed outwill be largely determined by domain-specific factors.

In any event, when we make abstraction of those particularities, the fruits of scientific inquiry deserve our trust to the extent that inquirers within a particular field have interactively considered and evaluated all the relevant reasons in support of different theories and practices, including the ones in support of pseudoscience. When a community of scientists then rejects a particular practice as pseudoscientific or non-scientific, we can be confident that they did so for good reasons (whatever their reasons are). As such, though our demarcation criterion relies heavily on the judgements of scientists within each particular field, this does not mean that pseudoscience is just a 'hollow phrase' that does 'only emotive work for us', as Laudan (1983, 125) wrote, or just a way of dismissing certain practices out of hand as Haack implies. Instead, if our analysis is correct, the concept cuts a cultural phenomenon at its joints and accurately expresses its epistemic unreliability—it is not the real thing but only mimics science (Blancke, Boudry, and Pigliucci 2017).

One might argue that our analysis does not really address the criticisms by Laudan and Haack, but simply takes them on board. Both claim that to dismiss a theory or practice, we have to look in detail at what went wrong, using the criteria set by the relevant research community. That is the reason why they argue that we cannot make the distinction between science and pseudoscience on general and domain-neutral grounds (Hirvonen and Karisto 2022). By accepting that scientists indeed do all the heavy-lifting, we seem to be entirely on their side and to concur that no general solution to the demarcation problem is possible. However, in contrast to what Haack and Laudan seem to think, such an approach does enable us to make some general claims about what counts as proper science and what does not, namely on a social level. One very important condition, as we suggest, is that practices can only be scientific when the relevant research community has accepted them, after having considered and critically discussed all relevant practices and their supportive reasons. This goes for all sciences. Those practices that are still promoted as scientific by its adherents, on the basis of widely dismissed reasons, are what we call pseudoscience.

Our proposal is in line with the social process criterion recently suggested by Dawes (2018). Dawes' criterion says that

> One feature to be taken into account when deciding if a theory is scientific is whether it *forms part of a research tradition that is being actively pursued by a scientific community*. Conversely, a reason to regard a theory as pseudoscientific is that it *purports to be scientific but has been refused admission to, or excluded from*, a research tradition of this kind. (Dawes 2018, 290, italics in the original)

He presents this social criterion as a *pro tanto* reason to consider a theory pseudoscientific, next to evidential and structural reasons.

As he admits, this proposal creates a new demarcation problem, namely how to distinguish scientific from non-scientific communities, but he adds that several solutions are already available (Dawes 2018, 290–292). Merton, for instance, suggested that the scientific community is characterised by its allegiance to the norms of science: universalism, communism, organised scepticism, and disinterestedness. Longino's 'idealised scientific community' must satisfy four criteria (Longino 2002, 129–134): venues ('recognised forums for the criticism of evidence, of methods, of assumptions and reasoning'), uptake ('beliefs and theories must change over time in response to the critical discourse'), public standards ('publicly recognised standards by reference to which theories, hypotheses, and observational standards are evaluated and by appeal to which criticism is made relevant to the goals of the inquiring community'), and tempered equality ('the persuasive effects of reasoning and argument be secured by unforced assent to the substantive and logical principles used in them, rather than by properties, such as social or economic power, of those who are propounding them; and that every member of the community be regarded as capable of contributing to its constructive and critical dialogue').

Other proposals have been articulated since. Speaking more generally of knowledge-producing communities, Rauch (2021, 115), has argued that all such communities should abide by two rules, the fallibilist rule ('no one gets the final say') and the empirical rule ('no one has personal authority') which inspires various commitments ('common cores') such as fallibilism, objectivity, and pluralism (Rauch 2021, 132–138). In a somewhat similar vein, McIntyre (2019, 47) holds that the community of scientists is marked by an ethos that can be described as 'the scientific attitude [that] can be summed up in a commitment to two principles: (1) We care about empirical evidence. (2) We are willing to change our theories in light of new evidence'. And Pennock (2019) suggests that the scientific community is characterised by virtues such as curiosity and honesty.

We build on Dawes' social approach in the sense that we specify the processes upon which scientists rely to exclude certain theories from their research tradition and explain why these processes are reliable. As such, we do not merely intend to deliver a more naturalistic description of the ways in which the distinction between science and pseudoscience emerges. Rather, our approach explains why the characteristics and norms of scientific communities enable scientists to develop and confront various perspectives, formulate criticism, adjust their beliefs and practices to criticism by others, and arrive at a consensus that can always be adjusted or replaced in light of new perspectives, evidence, and methods. This procedural approach further explains why non-experts can rely on scientists' judgement in making the distinction between science and pseudoscience. We can trust that they will have good reasons for doing so because they operate in a social environment in which only the beliefs and practices that have been able to withstand critical questioning survive. As Dawes (2018, 295) rightly notes, we do not have to know the scientists' exact reasons to determine what is a pseudoscience, which makes the criterion 'a quick and easy one'.

However, whereas Dawes thinks that his criterion provides a *pro tanto* reason to label a theory or practice as pseudoscientific, next to evidential and structural reasons, we submit that these reasons might be situated at different levels. The two levels result from a division of cognitive labour in which, on the one hand, scientists rely upon evidential and structural reasons to decide which practices are acceptable (or not) and, on the other, people who are not experts in the relevant domain, including lay people but also fellow scientists who work on other domains, place their trust in the outcome of that process (Keren 2018). Non-scientists are in their epistemic rights to demarcate science and pseudoscience based on that trust alone. Finally, we will explain below how our approach accounts for some recurrent patterns in pseudoscience, a question which Dawes leaves unaddressed.

5. Clarifications and Possible Objections

There are several scenarios in which scientific communities reject certain theories and practices, becoming potential candidates for pseudoscience. Sometimes theories and practices that were once widely endorsed are now largely rejected because it has become abundantly clear that they suffer from serious flaws or have since been conclusively refuted. If these theories are still being promoted and defended by some people in spite of this rejection by the scientific community, they can rightfully be regarded as pseudoscience. Psychoanalysis, for instance, was acceptable to many psychologists half a century ago, and still has some hold-outs in the academic world, but is now mostly abandoned and widely regarded as a pseudoscience (Boudry and Buekens 2011; Ferreira 2021; Cioffi 1998). At other times scientists assess newly introduced hypotheses and practices but find them seriously wanting. For instance, at the beginning of the Covid-19 pandemic, it was suggested that the anti-malaria medication hydroxychloroquine was effective both as a prophylactic and therapeutic intervention against COVID-19. Since early results looked promising, scientists took the suggestion seriously but then quickly and conclusively refuted the hypothesis (Andersen et al. 2020; Kashour et al. 2021). Nevertheless, some people continued to tout the therapeutic benefits of hydroxychloroquine even after extensive meta-analyses, rendering the hypothesis pseudoscientific. In yet a third scenario, a theory or practice might appear promising at first but then consistently fail to deliver, which makes scientists wary of its scientific merits and increasingly treat the 'fringe' theory or practice as non-scientific. For instance, because of its experimental approach (e.g. Ganzfeld experiments), parapsychology has been tolerated for a long time, even though extra-sensory perception is now regarded as unsubstantiated and very unlikely. However, because some researchers continue to promote parapsychology and tout certain anomalous findings, despite consistent failures to replicate them, this research has increasingly been pushed towards the border of pseudoscience.

In the previous scenarios scientists reject a theory or practice as pseudoscientific only after having taken the supportive reasons seriously at least for some period. At other times, however, scientists dismiss theories or practices out of hand because they are similar in relevant aspects to older and already discredited theories and practices, or because they are in direct contradiction with very well-established scientific principles (e.g. conservation of energy), something which may or may not be known to contemporary researchers. An example is Intelligent Design Creationism, whose adherents purport to have found scientific evidence for the existence and activities of a supposedly supernatural intelligent designer. Nevertheless, scientists no longer take appeals to the supernatural seriously because such explanations have consistently failed (Boudry, Blancke, and Braeckman 2010).[1]

One might object that it is not always clear when scientists stray from a scientific consensus in their field. For instance, when a majority of scientists has abandoned a particular theory or practice, some scientists still try to garner evidence for it, it in the hope of restoring it to its former status (e.g. Lamarckian inheritance in biology). Things become even more complicated when we realise that scientists sometimes engage in discussions with purveyors of pseudoscience, not because of the intellectual merits of these theories but simply because of their societal impact, or because they are being challenged to a debate by pseudoscientists. Also, pseudoscientists sometimes manage to intrude into scientific debates, for example publishing in a respectable peer-review journal, thereby giving the impression that the scientific community still considers their views as legitimate contenders (Blancke, Boudry, and Pigliucci 2017). Moreover, it goes without saying that purveyors of pseudoscience will continue to discuss their theories and practices among themselves, even if the relevant scientific community has deemed them unacceptable (Blancke, Boudry, and Braeckman 2019).

What then makes their discussions different from the discussions among scientists? Because these research communities are not characterised by the social standards and norms that we listed above. For instance, many communities of pseudoscientists do not abide by the Mertonian norms of organised skepticism, in the sense that they collectively adhere to certain dogmas that are already accepted at the outset and are not to be questioned. Creationists dogmatically assert the truth of the creation story in Genesis, astrologists and homeopaths uncritically accept the received wisdom of certain ancient traditions and authorities. Other pseudosciences violate the norm of disinterestedness, for example climate denialists defending the interests of the fossil fuel industry. More generally, communities of pseudoscientists fail to abide by the principle of fallibility and tempered equality, because they are unwilling to give up their beliefs in light of novel evidence and reasons offered by the scientific community. There will always be some borderline cases, of course, such as the community of physicists investigating cold fusion, or biologists looking into Lamarckian forms of inheritance. Are these researchers still disinterestedly pursuing certain hypothesis and abiding by the norm of organised skepticism, or have their research programmes devolved into pseudoscience?

While we agree that it may be difficult to neatly demarcate science from pseudoscience in some borderline cases, we contend that the messiness is not a defect of our approach, but shows that the distinction between science and pseudoscience is fuzzy rather than black-and-white. In the case of the attempt of a group of scientists to reanimate a discarded theory, they may be regarded as scientific to the extent that their peers consider their effort legitimate (i.e. to the extent that their peers think it is possible that there might be good reasons in support of that view after all). This judgement might depend upon several factors such as how long ago the theory has been abandoned (the longer ago, the more likely that any good reasons in its support would have been found and taken into account already) and the size of the dissenting group (the smaller, the less likely the theory is supported by good reasons since these reasons apparently failed to convince more people).

When scientists discuss pseudoscientific theories, either in interaction with its adherents or not, they remind their audience of the reasons why pseudoscientific theories have been rejected. For instance, medical doctors may write popular pieces in the newspaper explaining why there is no link between vaccines and autism or engage in direct debates with anti-vaccination propagandists. In those cases, scientists must explain the reasons why they reject a particular theory. But such a discussion of a pseudoscience is quite different from what takes place among a group of inquirers. When a purveyor of pseudoscience does manage to create the impression that one partakes in a genuine scientific discussion, for instance by getting a paper published in a scientific journal, then scientists will point out the reasons why they have discarded that position before and why it should be considered pseudoscientific. When this happens, the publications are often quickly retracted. When a group of purveyors of pseudoscience continue to discuss their discarded theories and practices among themselves, such discussion will be disconnected from the scientific community, and thus their beliefs will again fail to qualify as scientific (Blancke, Boudry, and Braeckman 2019). To repeat, it is not interactive reasoning itself that guarantees the production of reliable beliefs about the world, but the fact that the structure of scientific communities enable the recruitment of this process to consider every available alternative and the reasons for them. The fact that adherents of pseudoscience continue to have internal debates does not pose a problem for our proposal.

One final and important objection might be that our argument looks circular in the sense that we argue that scientists are the ones that reject pseudoscience, and pseudoscience is that which is rejected by scientists. However, the independent social conditions and norms of scientific communities we described above allows us to escape circularity. The individuals who participate in such communities, which have certain objective features such as the free exchange of information and the consideration and evaluation of all relevant perspectives, are labelled as scientists, regardless of which theories and practices they accept or reject. Hence, ‘scientists’ are not defined in terms of their rejection of pseudoscience. The rejection is merely the result of their participation in the critical discussion. Pseudoscience comprises those beliefs and practices that have been found wanting by those critical communities—but are nevertheless portrayed and defended as genuine science by its adherents. Since science is thus not defined in terms of its rejection of pseudoscience, we avoid circularity.

6. Implications for Our Understanding of Pseudoscience

A dialectical demarcation between science and pseudoscience such as we proposed in this paper cannot and does not fill out in detail what scientists agree and disagree about. For the most part, therefore, the normative dimension of the demarcation work remains in the hands of scientists, who develop local epistemologies depending on the field of investigation. In this sense, Laudan and Haack are right that we should evaluate the scientific merits of theories and practices on a case-by-case basis, and this work is mostly performed by the relevant experts in the field, depending on the standards and norms within their local epistemology. Nevertheless, our proposal differs from theirs in that it enables us to generalise across domains and identify and explain typical features of pseudoscience *after* they have been branded as such by scientists. These features can be seen as indirect 'symptoms' of the underlying errors and mistakes as diagnosed by the relevant scientific community (Boudry 2021). Note that these symptoms do not constitute the necessary and/or sufficient criteria which all pseudoscience must exhibit. Rather, they are characteristics which theories and practices labelled as pseudoscience, based on the processes outlined above, tend to display.

A major problem faced by every purveyor of pseudoscience is that she has to explain why her beliefs and practices are rejected by the relevant scientific community. Several strategies are available here. One option is to create the impression that the theory in question has not been subjected to any genuine scientific dialogue yet for the simple reason that the scientific community is unwilling to do so because of theoretical or even ideological blinders. Scientists are thereby often pictured as narrow-minded dogmatists who cling to their former beliefs even though the alternative is better supported by reasons. Climate change deniers, for instance, refer to climate change science as 'climate dogma', 'a prescribed doctrine thought to be beyond question' (Ward 2019).

Another strategy, however, is simply to deny that the dialogue has ended and to maintain that their alternative theory still stands on an equal par with other views. Which of the theories will prevail, they argue, has not been decided yet. Here, purveyors of pseudoscience exploit the undeniable fact that science is littered with real controversies, for instance about the status of *Homo floresiensis* (De Cruz and Smedt 2013) or the nature of cultural evolution (Scott-Phillips, Blancke, and Heintz 2018). In the same sense, they argue, there is a controversy about the memory of water (homeopathy) or the mathematical proofs for intelligent design (creationism). In many cases, pseudoscientists try to reinforce this perception of legitimate controversy by arranging public debates between opposing viewpoints, or publishing books in which both alternatives are set on an equal par. Notably, creationists have used this 'balanced treatment' strategy in education, which would allow teachers to teach the controversy. At the same time, they also resort to the first strategy of proclaiming to represent frontier science that the scientific establishment is dogmatically opposed to.

A third strategy is to move the debate to a different playing field altogether, namely from science to society at large, where different norms apply. Following this scenario, purveyors of pseudoscience argue that they are being treated unfairly and are not allowed to openly say what they believe, which violates the norms of democratic society. By enforcing 'orthodoxy', the scientific community violates their freedom of expression and, in some cases, their academic freedom. Comparisons are drawn between fascists or communists who have gone to great lengths to suppress any thought that is at odds with the official ideology. This is the central theme of, for instance, the anti-evolutionist documentary *Expelled. No Intelligence allowed*, which starts with footage showing Eastern German soldiers building the Berlin wall.

These strategies can only work when purveyors of pseudoscience manage to create the impression that their practices and beliefs are as scientific as the real stuff (or even more so). This explains why they tend to adopt the trappings of science (Blancke, Boudry, and Pigliucci 2017). They boast their academic titles, introduce meaningless mathematical formulas, employ difficult-sounding concepts, and publish works with extensive footnotes and an impressive list of references. Furthermore, purveyors of pseudoscience have to create the impression that their position is supported by a wealth of evidence and not threatened by counterevidence, which is not easy when this happens not to be the case. Hence, we observe that pseudoscientific theories tend to adopt a range of immunising strategies that make them resistant to criticism and adverse evidence (Boudry 2021; Boudry and Braeckman 2012).

7. Conclusion

Making the distinction between science and pseudoscience is not an easy task, to say the least. Philosophers have made numerous proposals, but none of them has been entirely convincing and universally applicable. This failure has led to the conclusion that the demarcation problem cannot be solved and should be of no concern to philosophers of science. Yet, ignoring the problem does not make it go away. Science and pseudoscience still exist out there and most philosophers and scientists are largely in agreement when it comes to classifying individual theories and practices. In this paper, we suggested that scientists in their respective field of expertise take care of establishing what counts as scientific through their discursive interactions, which are in turn the result of local epistemologies. Such a pragmatic approach, although not offering a universally applicable demarcation criterion in the traditional sense (Hirvonen and Karisto 2022), still allows us to make the general claim that 'pseudoscience' refers to those theories and practices that are regarded by the scientific community as completely lacking in justification, despite what their proponents claim. This conclusion is not merely a sociological description of a process of exclusion, but also explains why some theories and practices *deserve* to be disbelieved or regarded with suspicion by lay people. Though necessarily fuzzy at the borders, this naturalistic type of demarcation does account for how we distinguish between science and pseudoscience and why these distinctions are justified. It also sheds new light on the typical features of pseudoscience, which arise out of the social dynamics of exclusion by scientific communities.

Note

1. See Dawes and Smith 2018 for the alternative view that science from its very inception has understood its task to be the study of the natural world, as distinct from the world of the gods.

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