**Diagnosing Pseudoscience – by Getting Rid of The Demarcation Problem**

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Abstract

For a long time, philosophers of science have shown little interest in the so-called demarcation project that occupied the pioneers of their field, and most now concur that terms like “pseudoscience” cannot be defined in any meaningful way. However, recent years have witnessed a revival of philosophical interest in demarcation. In this paper, I argue that, though we should not resuscitate the demarcation problem of old (as philosophers have rightly concluded that such a first-principles approach leads to a dead-end) we should have a second look at the concept of pseudoscience. What is the common denominator of all theories and activities commonly regarded as “pseudosciences”? My approach proposes to naturalize and down-size the concept, anchoring it to real-life doctrines and fields of inquiry. First, I argue against the definite article “the” in “the demarcation problem”, distinguishing between *territorial* and *normative* demarcation, and between different scientific failures and shortcomings apart from pseudoscience (such as fraudulent or faulty research). Next, I develop a naturalistic analysis of pseudosciences as being *simulacra* of science, doctrines that are not epistemically warranted but whose proponents try to create the impression that they are. In this element of cultural mimicry, I argue, lies the clue to their common identity. Despite the huge variety of doctrines gathered under the rubric of “pseudoscience”, and the wide range of defects from which they suffer, pseudosciences all engage in similar strategies to create an *impression* of epistemic warrant, which follow from certain general facts about human psychology. In short, my naturalistic approach is captured by the central idea that, though there are many ways in which things can go wrong, there are comparatively fewer ways to pretend that they haven’t.

Keywords: pseudoscience; demarcation problem; naturalism ; epistemic warrant; immunizing strategies

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# Introduction

*“It is error only, and not truth, that shrinks from inquiry.” – Thomas Paine*

## The demise of demarcationism

How to tell apart science from non-science? Once upon a time, this was regarded as the foundational question of philosophy of science, the *sine qua non* of the whole enterprise. But times have changed. The so-called “demarcation project”, as it came to be known, has fallen out of favor among professional philosophers of science. Many now believe that the demarcation problem is intractable, that the whole question is misguided, and that terms such as “pseudoscience” or “unscientific” should be erased from our vocabulary altogether. In 1978, Imre Lakatos could still write that “[t]he generalized demarcation problem is, it seems to me, the primary problem of philosophy of science” (Lakatos, Worrall, & Currie, 1978, p. 107). But as he was penning these words, the tides were already turning against demarcationism, and few philosophers would echo his judgement today. Probably most decisive in this turn of fate was Larry Laudan’s seminal 1983 paper pronouncing the “demise of the demarcation problem” (Laudan, 1980, 1983). Not only have all previous philosophical attempts to distinguish science from pseudoscience failed, according to Laudan, but there is no hope of ever resolving the matter. Words like “pseudoscientific” are nothing but “hollow phrases which do only emotive work for us” (Laudan, 1983, p. 125).

But while few philosophers have dared to touch the corpse of demarcationism after Laudan declared it dead, moving on to more interesting topics instead, the rest of society somehow failed to take notice. The concept of “pseudoscience” remains as ubiquitous as ever in the public arena. Educational and judicial authorities have regularly used it to justify the expulsion of certain theories (most notably creationism) from school curricula and from the classroom (Jones, 2005; Pennock & Ruse, 2009). Physicians and public health officials warn the public against the dangers of certain “pseudoscientific” remedies and therapies (Rovira & Raffio, 2017). Most wealthy and industrialized nations have at least one (semi-)professional organization dedicated to criticizing and combating pseudoscience, the oldest and most influential being the Committee for the Scientific Investigation of Claims of the Paranormal (CSICOP) founded by the philosopher Paul Kurtz in 1976. Moreover, there seems to be broad agreement about what the term refers to. Prototypical examples of pseudosciences include homeopathy, creationism, phrenology, Freudian psychoanalysis, astrology, Intelligent Design, parapsychology, Scientology, Velikovsky’s theories about world collisions, or the theory that vaccines cause autism. As the sociologist Thoms Gieryn wrote, despite much philosophical hand-wringing, “demarcation is routinely accomplished in practical, everyday setting” (1983, p. 781). Editors of academic journals seem to have no difficulty in desk-rejecting submissions defending these long discredited theories, while government research agencies consistently fund research on astronomy rather than astrology, or evolution rather than creation (the few notable exceptions to this rule immediately invariably spark a public outcry).

In addition, interest in the phenomenon of pseudoscience seems to be alive and well, and even growing, in other academic fields. Both psychologists and sociologists have taken an interest in the correlates and cognitive roots of belief in pseudoscience (Lilienfeld, Ammirati, & David, 2012; Tavris, 2014; Zaboski & Therriault, 2019)(Torres, Barberia, & Rodríguez‐Ferreiro, 2020), and have recently begun to develop properly validated belief scales of pseudoscience (Fasce & Picó, 2019; Lobato, Mendoza, Sims, & Chin, 2014). Historians of science have investigated the emergence of the concept of pseudoscience and related boundary disputes of science in the 19th century (Gieryn, 1983; Gordin, 2012). Recently, MIT Press published an edited volume entitled *Pseudoscience: The Conspiracy Against Science* (Kaufman & Kaufman, 2018), with contributions from sociologists, political scientists, biologists, skeptics and psychologists (but with notably few philosophers).

Is this continued talk about something called “pseudoscience” misguided? Semantics aside, even those philosophers who have abandoned the demarcation project would probably agree that the doctrines mentioned above have little to be said in their favor. Indeed, because of their lack of scientific merit or epistemic warrant, they can wreak significant havoc in society. Parents who refuse to vaccinate their children expose them to dangerous infectious diseases (Jolley & Douglas, 2014); desperate people pay inordinate sums of money to quacks and charlatans who don the mantle of science (Goldacre, 2010); creationism hampers the educational opportunities of children in religious communities (Scott, 2004); denialism of the scientific consensus on climate change obstructs necessary political action to reduce human carbon emissions (Jolley & Douglas, 2014; Oreskes & Conway, 2011) ; and people in developing countries are stricken with blindness because of irrational fears about genetically modified food (Paarlberg, 2009).

## A philosophy of pseudoscience?

Is it time for philosophers to have a second look at the demarcation problem? Is it our professional duty, as some believe, to help society discriminate between genuine and fake science? Recent years have indeed seen a revival of philosophical interest in demarcation (Boudry, 2011; Dawes, 2018; Fasce, 2017, 2020; Fernandez-Beanato, 2020; Hansson, 2009, 2017; Hoyningen-Huene, 2013; Pigliucci, 2008), and even the emergence of something called ‘philosophy of pseudoscience’ (Pigliucci & Boudry, 2013). In contrast to the original work on the demarcation problem, this recent spate of publications has been a largely collaborative effort, involving contributions from sociologists, psychologists, historians and “field workers” (people in skeptical movement).

I believe that the differences between science and pseudoscience are indeed real and substantial, but I also believe that the original demarcation project was misguided. In this paper, I will defend a naturalized approach to pseudoscience, which tries to disentangle the concept from the first-principles approach that became known as “the” demarcation problem. Rather than demarcating science and non-science on first principles, we should start from the common usage of the term “pseudoscience”, in particular the real-life doctrines and activities that are most often designated as such. In defending the usefulness of a concept like pseudoscience, I shall also argue against a negative approach. Instead of tackling pseudoscience by first giving a comprehensive definition of science – a pretty tall order – we should define pseudoscience in its own right, drawing from real-life instances. “Pseudoscience” should not be seen as a catch-all term equivalent to “whatever is not scientific”, but as carving out a more specific phenomenon in modern societies. Paradoxically, as we will see, it is easier to circumscribe pseudoscience than to define science, for two reasons: (1) though there are many ways for something to fail to be “scientific”, only some of those ways deserve to be labeled “pseudoscience”; (2) though pseudosciences are heterogeneous and multifarious, the ways in which they cover up their defects are largely similar.

The structure of this paper is as follows. First we need to make our way through the conceptual thicket of what became known as the demarcation problem. I distinguish between two different tasks which have often been conflated: *normative* and *territorial* demarcation. Next, I argue against the definite article “the” in the phrase “the demarcation problem”, which has inspired ambitious first-principles approaches (e.g. falsificationism) that were doomed to failure and that have been rightly criticized by the likes of Laudan. Demarcationists have tried to solved too many different problems at once, and in doing so have bitten off more than they could chew. Next, I distinguish between pseudoscience and various other things that fall short of being good science, such as fraudulent, sloppy, fruitless or unreliable scientific research. “Pseudoscience” is not a catch-all term for whatever falls outside the category of science, but refers to certain positive *doctrines* that masquerade as science. Next, using a simple lexical meta-definition suggested by Hansson, I develop a naturalized approach to pseudoscience. What unifies pseudosciences in different domains, I shall argue, is that they engage in a form of pretense or deception, and have achieved a measure of success in doing so. Because of the way the human mind works, this ‘cultural mimicry’ is bound to manifest itself in only a small number of ways. These, I argue, constitute the symptoms that allow us to diagnose pseudosciences, and to tell them apart from real science. Finally, I discuss how the current account differs from other approaches to demarcation, in particular from falsificationism and from the currently popular multicriteria approaches. At the end of the paper, it should be clear that “pseudoscience” carves out a genuine phenomenon in our societies and, because it causes significant damage, deserves closer philosophical scrutiny. Philosophers of science can provide a valuable service to the public interest by helping lay people and policy makers to identify the false contenders of science. We should not resuscitate the dream of a grand solution to what Lakatos called “the generalized demarcation problem”, but neither should we pretend that pseudoscience doesn’t exist.

# Demarcating the demarcation project

## Normative vs. territorial demarcation

In the early days of the field, philosophers of science were occupied with something called “the demarcation problem”. As is well known, this problem grew out of the attempt by logical positivists to establish a criterion of sense or meaning (Friedman, 1999). What became generally known as *the* demarcation problem, however, was due to the classic formulation by Karl Popper. Though Popper was wrestling with some of the same issues as the logical positivists, his was not a criterion of meaning, but of ‘scientificness’. As Popper put it himself, he was not interested in the difference between meaningful and senseless statements, but “between the empirical sciences on the one hand, and mathematics and logic as well as ‘metaphysical systems’ on the other” (Popper, 1959/2002, p. 11). In his later writings, Popper gave the demarcation project more normative bite: instead of distinguishing between science and other (possibly legitimate) fields of inquiry like logic or history or metaphysics, the goal was to weed out *pseudoscience*, the false pretenders of science.

Though both Popper’s projects have often been lumped together under the rubric of “the” demarcation problem, I believe they are logically separate, and I refer to them as *territorial demarcation* and *normative demarcation*, respectively (Boudry, 2013a). Territorial demarcation deals with classifications *within* the human web of knowledge, whereas normative demarcation distinguishes between real and false knowledge, between theories and practices that are valuable and those that aren’t. For instance, Hoynighen-Huene’s recent account of “systematicity” as a defining characteristic of science is an exercise in territorial demarcation, since its main ambition is to separate science from everyday knowledge and other forms of valid knowledge, not from pseudoscience (Hoyningen-Huene, 2013). Pseudoscience, as the etymology of the term makes quite clear, is an inherently normative and defamatory concept. It refers to something that masquerades as science, or is falsely presented as scientific by its adherents. Nobody would proudly proclaim to be a pseudoscientist, though of course some people self-identify as ‘metaphysicians’ or ‘logicians’. In the rest of this paper I shall ignore the problem of the territorial demarcation of science. For what it’s worth, I believe that the latter problem is indeed intractable, not only because science has fuzzy territorial boundaries with everyday knowledge and with philosophy or other neighboring disciplines, but because, following Quine (1951) and others, I believe all of our human epistemic endeavors are enmeshed in one big web with many interconnected strands. By contrast, I believe that the problem of normative demarcation between good science and pseudoscience is both vital and tractable. In contrast to territorial demarcation, the categories of science and pseudoscience are largely distinct, do not overlap, and are certainly not mutually dependent. Science is not entwined with pseudoscience in the way it is entwined with logic, mathematics and everyday reasoning.

## Getting rid of “the” demarcation problem

In trying to solve *the* demarcation problem, early demarcationists proceeded in a negative fashion: first you define what science is, preferably by means of a small set of necessary and sufficient conditions, and that will automatically tell you what is not-science. In many cases, this has led to solutions to the demarcation problem based on first principles. For Popper, the necessary condition for a theory to be scientific (and in some formulations also the sufficient condition) is its falsifiability, the fact that it forbids certain observable states of affairs. Moreover, falsifiability is defined as a strictly logical relationship between a theory and observation statements (see 4.1). Other such first-principles solutions to the demarcation problem include the criterion that science is “guided by natural law” and “has to be explanatory by reference to natural law” (Ruse, 1996), which was used in the McLean v. Arkansas trial on the teaching of “scientific creationism” in biology classrooms. More recently, philosophers have argued that a defining feature of science is its commitment to naturalism (in either methodological or metaphysical guise). This means that supernatural or non-natural explanations and theories are *ipso facto* unscientific (Mahner, 2011; Pennock, 1999; Ruse, 2005).

However, such general definitions run afoul of the heterogeneity of science, and also conflate territorial and normative forms of demarcation. For instance, the demarcation criterion based on ‘natural laws’ would arbitrarily rule out all or most of the historical sciences (which is a form of territorial demarcation unless you are prepared to reject all historical research as worthless). The principle of methodological naturalism, on the other hand, elevates what is at most a useful rule of thumb (‘ignore supernatural causes’), recommended in view of the consistent failure of supernatural hypotheses, into an essential *definition* of science (Boudry, Blancke, & Braeckman, 2010; Fishman, 2009; Fishman & Boudry, 2013). Moreover, it also conflates territorial and normative demarcation. While some proponents of methodological naturalism have argued that science rejects supernatural hypotheses because they are epistemically *bad* (Forrest, 2000), others have merely argued that they belong to a different ‘territory’ or ‘magisterium’, and that science should remain agnostic on the matter (Gould, 1999; Pennock, 1999; Ruse, 2005). As several critics have argued, however, supernatural hypotheses are in fact often perfectly testable by regular scientific methods, and it is a contingent fact of history that such hypotheses have failed time and again (Edis, 1998, 2002; Fishman, 2009; Fishman & Boudry, 2013).[[1]](#footnote-1) In any event, many paradigmatic pseudosciences do not violate naturalism, so the principle is ill-fitted to serve as a general demarcation criterion.

In short, I agree with Laudan and others that such misguided first-principles approaches fail to do justice to the heterogeneous and open-ended nature of science. Indeed, the instrumental use of such criteria in the courtroom, with the express goal of keeping Intelligent Design and assorted forms of creationism out of the classroom, has also backfired strategically, since it has exposed scientists to the charge of anti-religious prejudice and dogmatism. After all, why would scientists arbitrarily rule certain theories and hypotheses out of court because they involve supernatural causes (Boudry et al., 2010; Boudry, Blancke, & Braeckman, 2012; Shanks, 2004)?

## Different forms of badness

Rather than trying to define science on first principles, and then defining “pseudoscience” or “non-science” simply by negation, I propose that we naturalize the concept of pseudoscience, starting from real-life phenomena. There are many different ways in which something can fail to be scientific, depending on your unit of analysis and the epistemic standards operative in a certain discipline, and not all of those should be designated as “pseudoscience”. Put differently, there are many different ways for things to go wrong, and we have different names for different categories of failings (Ladyman, 2013). Fraud, for instance, is conceptually different from pseudoscience, and refers to scientific research that is deliberately manipulated, with data that has been either wholly fabricated or significantly tampered with. Fraud can be committed in the name of some pseudoscience, but not necessarily so. A scientific study can also simply be faulty or erroneous, because of some honest mistakes in methodology or some malfunctioning equipment. Another failing is lack of fruitfulness. A scientist may collect reliable data but fail to develop fruitful theoretical insights. This is a shortcoming, but not the sort for which we should use the term “pseudoscience”. Likewise, we value scientific work that leads to practical technological applications, but that does not mean that research falling short of this benchmark should be condemned as pseudoscience (for a review, see Fasce, 2017).

What, then, is “pseudoscience”? Oxford English Dictionaries defines it as “a spurious or pretended science; a branch of knowledge or a system of beliefs mistakenly regarded as based on scientific method or having the status of scientific truth.”[[2]](#footnote-2) It should be clear that this is quite different from fraudulent research, which does not necessarily takes place within an alternative doctrine of knowledge. Indeed, many fraudsters operate within the safe confines of an established scientific theory, so as not to raise any suspicions that might expose them. It is also quite different from research that is simply faulty or unreliable, since such research will usually stop short of blossoming into a full-fledged doctrine. For philosophers of science, I believe the task at hand is significantly more simple, and significantly more modest, than trying to crack “the” demarcation problem: is it possible to flesh out this common usage of the term pseudoscience? Is it possible to identify certain common features or symptoms among pseudosciences, which set them apart from the theories and doctrines that are widely regarded as scientific, and which may help educators, policy makes and lay people to tell the difference? Or, alternatively, is the term just a “hollow phrase” (Laudan, 1983, p. 125) or “inflammatory buzzword” (McNally, 2003) containing no substance whatsoever?

# Naturalizing pseudoscience

## Cultural success

Several philosophers have noted the paradox that, even though there is substantial disagreement about the criteria for distinguishing science and pseudoscience, both scientists and philosophers are in large agreement (and sometimes unanimity) when it comes to the particulars. Virtually everyone agrees that homeopathy, creationism, phrenology, graphology, Freudian psychoanalysis and astrology are not good sciences, while general relativity, evolutionary biology and the germ theory of disease most certainly are. Even those philosophers who would refrain from using terms such as “pseudoscience” will generally arrive at the same judgements: the first class of theories and practices have hardly any scientific merit, and should not be taught in the classroom, while the second class have and should. This near-unanimity could lead us to believe that deep down everyone is tacitly relying on the same demarcation criteria, and then we just haven’t explicated them yet. But this is not necessarily true. It may also be the case that different criteria happen to converge on the same classifications, or that everyone just follows the judgement of a few scientific experts. It is also possible that the defects from which the aforementioned theories suffer are completely different in every case, but that they are all serious enough to merit the label ‘pseudoscience’. In that case, as Laudan would have it, “pseudoscience” would be nothing more than a catchall category for a miscellaneous and woefully bad theories which have nothing in common except for the fact that they all fall quite short of being scientific. If that were the case, the term could be useful in everyday parlance, but would be of little philosophical interest.

But I believe we *can* go a step further. Despite the significant differences between the theories that are widely regarded as pseudoscience, there are certain patterns and commonalities which may help us to diagnose future examples of pseudoscience, and also to adjudicate between less obvious cases. In order to see what unifies different pseudosciences, we have to continue our naturalistic approach. Pseudosciences do not exist in a theoretical vacuum. They are complexes of culturally shared beliefs and representations that have been developed by particular people in a particular social and historical context. First, pseudoscience is a relational concept (Hecht, 2018). It is a form of mimicry of science, which means that it can only emerge in a cultural environment in which science already exists, and is regarded as an epistemic authority worth emulating (Blancke, Boudry, & Pigliucci, 2017; Gordin, 2012). As Hecht (2018, p. 7) writes, pseudoscience “has no independent existence, but achieves it meaning only through a comparison (always unfavorable) with the thing that it purports to be.” From this point of view, pseudosciences therefore only began to exist sometime in the 19th century, when the technological success of the sciences became widely known and hard to deny, and thus scientific status became something coveted by many (Numbers & Thurs, 2013). The theory and practice of astrology has been around for millennia, but properly speaking, it did not coalesce into a ‘pseudoscience’ before the advent of science itself, and before astrologers began to arrogate to itself the status of a science. Secondly, the prototypical examples of pseudosciences have achieved some measure of cultural success. Theories like creationism, astrology and homeopathy have been in circulation for decades and even centuries, and have attracted a significant number of adherents. This is not a mean feat: of all the possible weird beliefs people may have about the world, only very few will ever be held by anyone, and an smaller minority will spread to many others, forming cultural lineages and traditions (Mori(Boyer, 2018)n, 2015). An even tinier minority will manage to survive in our modern scientific era, a hostile environment in which many once popular beliefs have been weeded out through ruthlessly empirical testing and critical scrutiny (McCauley, 2011)(Boudry, Blancke, & Pigliucci, 2015). But this is precisely what pseudosciences have achieved, in the sense in which the term is most commonly used: they are successful and relatively stable belief systems that have successfully convinced a certain number of people of their epistemic value and scientific status (Hines, 2003). As Cioffi wrote: “A successful pseudoscience is a great intellectual achievement. Its study is as instructive and worth undertaking as that of a genuine one.” (Cioffi, 1998, p. 115).

## A lexical meta-definition

In a series of papers, Hansson has proposed the following definition of pseudoscience:

(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. (Hansson, 2009, p. 240)

Naturally, as Hansson himself admits, this definition leaves open the question of what constitutes ‘epistemic warrant’ in the first place. The main obstacle for the (normative) demarcationist, as Laudan correctly recognized, is the heterogeneity of the sciences. Epistemic and methodological standards vary widely across scientific disciplines. How can we ever hope to come up with a general definition of ‘epistemic warrant’ that captures all this diversity (Hoyningen-Huene, 2013)? As Laudan wrote: “The evident epistemic heterogeneity of the activities and beliefs customarily regarded as scientific should alert us to the probable futility of seeking an epistemic version of a demarcation criterion” (Laudan, 1983, p. 124). This problem of heterogeneity is probably even starker for the designate contrast class of “pseudoscience”. As Hecht wrote: “it seems doubtful that there is a narrative thread that goes from medieval alchemy through phrenology and quack medicine to ESP, AIDS denial, and intelligent design.” (2018, p. 8) More generally, according to Hansson, it is impossible to come up with an account of epistemic warrant that is both general enough to apply to all scientific fields and specific enough to allow for diagnoses of individual theories: “one and the same demarcation criterion cannot both be general and timeless and also be sufficiently precise to tell us how to evaluate the scientific status of specific investigations” (Hansson, 2013, p. 75).

In the rest of this paper, I will try to argue that this problem can be circumvented. It is possible to develop general criteria for diagnosing pseudoscience without first developing a general account of scientificness or epistemic warrant. Paradoxically, we can tell the difference between science and pseudoscience without having to come up with a precise definition of science. Rather than focusing on Hansson’s second criterion, I believe the crux lies in the third one: the proponents ofpseudoscience “try to create an impression” of epistemic warrant. Despite some popular psychological misconceptions, humans are not irredeemably irrational and gullible, and tend not to accept beliefs that are demonstrably wrong, or blatantly contradictory (Mercier, 2013, 2020). Human cognition is generally oriented towards truth, and we have evolved cognitive mechanisms for “epistemic vigilance” (Sperber et al., 2010). People critically evaluate beliefs, both on the basis of content (internal consistency and evidence), credibility of the source, and consistency with prior beliefs. As I already pointed out, pseudoscience is essentially a form of cultural mimicry: its proponents try to imitate the real thing, in the hope that innocent consumers won’t be able to tell the difference (Blancke et al., 2017). Pseudoscientific beliefs, like any other cultural representations, are therefore subjected to a process of cultural selection. If the goal is the create an impression of epistemic warrant, some attempts will be more successful than others. Poor imitations will not attract any adherents and will be discarded, while convincing *simulacra* of the real thing will garner cultural success. Many pseudoscientists have tried to fool people by adopting some of the outward trappings which have come to be associated with science: peer-reviewed journals, scientific conferences, mathematical formalizations, technical jargon. However, since most of these superficial trappings are relatively easy to imitate, they are not very useful for the purpose of demarcation (but see Dawes, 2018 for an interesting sociological criterion). However, some things are harder to fake than others, and “epistemic warrant” is the hardest of all. Reality, as the science fiction writer Philip K. Dick once wrote, is that which, when you stop believing in it, doesn't go away.

## Faking epistemic warrant

If a belief system is to create a convincing impression of epistemic warrant, thus overcoming our natural epistemic vigilance, it should therefore do two things: (a) evade counterevidence and (b) seek spurious support. Beliefs may be appealing for any number of reasons, but if they fly in the face of reality, they will garner little success. In earlier publications, we have distinguished between ‘immunizing strategies’ and ‘epistemic defense mechanisms’, and documented how they appear in various guises in practically every pseudoscience (Boudry, 2011, 2013b; Boudry, Blancke, & Pigliucci, 2015; Boudry & Braeckman, 2011, 2012). Immunizing strategies are defined as generic arguments or tactics that function to protect a belief system from critical scrutiny and adverse evidence, while defense mechanisms refer to the special cases in which the immunizing tactics form an integral part of the belief system itself. As I will explain, my approach partly collapses the distinctions between the theory itself and the attitudes and behavior of its adherents. A short survey of such evasive tactics will show that, in some guise or another, they show up in every pseudoscience.

### Evasion and immunization

In 1826, Francis Jeffrey, an early critic of phrenology, complained that the theory “abounds in those equivocations and means of retreat, by which it may often escape from direct refutation” (cited in Cantor, 1975, p. 213). Ever since, strategic vagueness and equivocations have been hallmarks of every pseudoscience, whatever the domain and subject matter. In many pseudoscience, core concepts are either ambiguous and amenable to a range of interpretations, or they are retrospectively redefined whenever threatened with refutation. Such strategic vagueness is characteristic of creationism and Intelligent Design theory, astrology, Freudian psychoanalysis, graphology, homeopathy, and various forms of alternative medicine. In some sophisticated pseudosciences, central concepts or hypotheses lead what may be described as a “double life” (Cioffi, 1985, 1998, p. 116): they have a specific, narrow and exciting interpretation as long as observations seem to conform with the theory, but they deflate into a vaguer, metaphorical and more insipid interpretation whenever threatened with adverse evidence or critically probed. A related strategy of evasion is the systematic use of ad hoc excuses to explain away unwelcome evidence, without yielding any independent prediction or other explanatory offset (Boudry, 2013b; Leplin, 1975). For instance, parapsychologists believe that the presence of inquisitive minds often disturbs psychic phenomena, a phenomenon they call “negative psi vibration” or “catapsi” (Bonewitz, 1989). One of the founding fathers of parapsychology, J.B. Rhine, already remarked that “precautionary measures” against deception and information leaks may hamper psychic performance (Gardner, 1957, p. 307).

Many pseudoscientists also resort to conspiratorial explanations to explain away adverse evidence: creationists argue that evolutionary biologists are deliberately suppressing evidence for Biblical creation to further their materialist agenda, or even that the devil himself may have planted false evidence to lure us into disbelief (e.g. Morris, 1963). Defenders of homeopathy and other alternative therapies maintain that pharmaceutical companies are covering up the evidence for their medicine because it would hurt the business model of Big Pharma (Oliver & Wood, 2014), and climate denialists claim that the scientific establishment is beholden to a radical environmentalist agenda and is actively suppressing dissent (Uscinski, Douglas, & Lewandowsky, 2017). In addition, many pseudosciences center around invisible intentional agents (ghosts, fairies, extraterrestrial visitors), which opens up a wide range of ad hoc excuses. After all, intelligent agents may actively evade detection, cover up the traces of their existence, or refuse to cooperate with experimenters.[[3]](#footnote-3) Defenders of alternative medicine, when presented with properly randomized clinical trials into the efficacy of their therapies, also often argue that every patient is radically unique and that it is therefore impossible to generalize across cases (e.g. Gordon, 1996). This holistic approach, conveniently, protects them from disappointing clinical trials, which are dismissed as ‘crude’ and ‘reductionist’.

Some pseudosciences have even developed a theory-internal explanation for the opposition against them. Famously, Sigmund Freud suggested that the “resistance” against psychoanalysis of his critics bears out one of its main predictions: that we are all under the spell of the hypothesized “unconscious”, which is trying to repress the shocking truths brought to light by psychoanalysis. Those who attack psychoanalysis, according to Freud, display “the same resistance […] as in our patients”, and this resistance “finds it easy to disguise itself as an intellectual rejection and to bring up arguments like those which we ward off in our patients” (Freud, 1957, p. 39). Remarkably, this immunizing gambit shows up in several other pseudosciences. Both Immanuel Velikovsky and L. Ron Hubbard (the founder of Scientology) and their followers, as well as some Marxists, have wielded their own version of the resistance argument, based on the concepts of (respectively) “collective amnesia”, “false consciousness” and the “reactive mind”, all of which are derived from the very doctrine being defended (Boudry & Braeckman, 2011, p. 155; Gordin, 2012, p. 50).

### An asymmetry between confirmation and refutation

At a more fundamental level, evasive behavior is way to create an *asymmetry between refutations and confirmations*. In itself, it is never terribly difficult to insulate a theory from every possible refutation, but this will be of little use if the possibility of positive evidence is thereby forestalled. Ideally, in order to create a decent impression of epistemic warrant, pseudosciences should be able to evade refutations while simultaneously enjoying (occasional) confirmations. The trick is therefore to solicit positive evidence in a way that does not involve a genuine threat of failure, and to evade counterevidence in a way that does not completely forestall the possibility of (apparent) confirmation. At bottom, this is the rationale behind the practice of cherry-picking, reliance on anecdotal evidence, and strategic vagueness. If you engage in cherry-picking (of data, experiments, studies), you create an asymmetry between positive evidence and adverse evidence. Many pseudoscientists carefully select favorable evidence while ignoring, downplaying or distorting negative evidence. To use Bunge’s prosaic analogy, “the pseudoscientist, like the fisherman, exaggerates his catch and neglects his failures or excuses them” (Bunge, 2017, p. 42). The phenomenon of conceptual “double lives” which I discussed above can be seen as a bait-and-switch strategy to simultaneously evade falsifications and still profit from apparent confirmations (Kukla, 2000). Predictions are made in such a way that they are amenable to a range of different interpretations, but whenever some observation confirms a specific interpretation, this is the one the theorist (retroactively) latches on to. For instance, in Freud’s theory about libido as the root of *all* neuroses, the concept of ‘libido’ switches between an explicitly carnal version (whenever the evidence allows a sexual interpretation) and a vaguer and more encompassing version which comes down to ‘love’ (whenever the evidence is less susceptible to sexual interpretation) (Cioffi, 1998, p. 16). In some pseudosciences, notably alternative medicine, the asymmetry between positive and negative evidence is created by means of subtle but vicious explanatory feedback loops. For instance, the theorist will try out different interventions on the patient, following different (sub-)hypotheses about the underlying condition. When, at long last, a certain effect is observed by accident (because of regression to the mean or the placebo effect), this is presented as confirming the latest hypothesis being tested, and thus as yet another confirmation of the belief system as a whole (Boudry & Braeckman, 2011, pp. 151-153).

# Differences with other approaches

## Falsificationism

As the reader has undoubtedly figured out by now, this account of evasive behavior and *ad hoc* reasoning is reminiscent of Popper’s falsificationism. It is therefore crucial to spell out how our approach differs from falsificationism, and why it escapes the traditional (valid) objections leveled against it.

In its classical formulation, and despite some tension in Popper’s own writing, the demarcation criterion of falsifiability describes a strictly logical relation between theory and observation statements: a theory is scientific if and only if it rules out some possible observations. This means that Popper’s criterion is static (theories can be evaluated in snapshots and taken in isolation) and that it abstracts away from the behavior of theorists and belief communities. But there are two glaring problem with Popper’s account, which have been pointed out by many critics: it is both too lenient and too strict. On the one hand, there are many theories and hypotheses which we would not hesitate in calling pseudoscientific but which, if taken in isolation, seem to be perfectly falsifiable and have in fact been roundly refuted. For instance, the creationist claim that the Earth is 6.000 years old has countless falsifiers, and is indeed contradicted by virtually every geological finding. More generally, any blatantly false proposition is “scientific” under Popper’s demarcation criterion, precisely in virtue of that fact that it could be and has been refuted. On the other hand, as philosophers of science have known ever since Quine (1951), Kuhn (1962), Lakatos (1970), Putnam (1991) and others, even our best scientific theories are never falsifiable in isolation. Barring toy examples about the colors of swans and ravens, any complex scientific theory is always several steps removed from observations. Only when conjoined with auxiliary assumptions, boundary conditions and background knowledge do our scientific theories make contact with reality. In other words, theories are always tested in bundles, or in Lakatos’s memorable phrase: “It is not that we propose a theory and Nature may shout NO; rather, we propose a maze of theories, and Nature may shout INCONSISTENT.” (Lakatos & Musgrave, 1970, p. 130). As a result, not only is it always logically possible to rescue a theory from any apparent falsification, by blaming any of the other ancillary hypotheses in the bundle, but this is what actual scientists have often done, and with good justification. Not only does actual scientific practice hardly if ever conforms to Popper’s ideal (Hansson, 2006), but if past scientists *had* hewn to falsificationist dogma, ruthlessly discarding conjectures the moment they encounter their first refutation, they would have ruined science completely (Feyerabend, 1975).

By contrast, my naturalistic approach departs drastically from Popper’s logicism. First, my account evasive behavior is *dynamic*: we are not dealing with ‘unfalsifiability’ as a fixed logical property of some theories or propositions, but with persistent *strategies* and *maneuvers* to avoid empirical risks (see also Derksen, 1993; Kitcher, 1982, 1993). Inevitably, therefore, my naturalistic account also includes the behavior of pseudoscientists and their belief communities. In the current view, falsification-evasion is a psychological and sociological phenomenon as much as a logical one. For that reason, Popper himself would probably have dismissed my account as hopelessly guilty of “psychologism”, a charge which I would welcome, as I believe it shows that our account manages to escape from Popper’s logicist straitjacket. Having said that, I do not believe it is not necessary to swing to the opposite extreme and argue, as Kitcher has done, that pseudoscience is merely a “derivative category” of the psychological category of “pseudoscientists” (Kitcher, 1993). In some cases, we will find that the theory-as-such is in fact perfectly testable, but certain proponents just refuse to accept the verdict and start engaging in evasive behavior. But in many other cases, the evasive behavior has crystallized into systematic patterns of reasoning and explanation, and has become indistinguishable from the theory itself. As Cioffi (1985, 1998) has argued, in a sophisticated pseudoscience it is often impossible to disentangle logical and psychological elements, and to tell where the theory-as-such ends end where the evasions and immunizations of its adherents begin. In some cases, notably Freudian psychoanalysis, the “defense mechanisms” have such a cozy relationship with the theory that they can be regarded as an integral an inextricable part of it (Boudry & Braeckman, 2011). Ironically, some critics of falsificationism, including Laudan himself, seem to have unwittingly inherited Popper’s narrow logicism, in their insistence on an unrealistic separation between the theory-in-itself (as a logically ordered series of propositions) and the stone-walling of those who defend it (see e.g. Grünbaum, 1979, 2008; Laudan, 1982). But in the murky hinterlands of science, such a strict separation is untenable: pseudoscience is indeed, as Kitcher argues, mostly what pseudoscientists do (Kitcher, 2007, p. 115). In any event, a strict separation is unnecessary, since all of these evasions should be regarded as manifestations of the same underlying principle (the need to steer clear of unwelcome evidence), albeit on different levels.

Now we can see how my accounts escapes the classical problems of falsificationism: what is pseudoscientific about creationism is not the naked claim about the age of the earth and how it logically relates to certain observation statements, but the *persistent pattern of evasions and excuses* in the creationist community when confronted with every fresh piece of evidence for an old earth. Whether or not the creation ‘theory’ about the age of the earth ‘as such’ is falsifiable or unfalsifiable, becomes an unanswerable and in any event irrelevant question. Similarly, what makes Newtonian mechanics scientific is not that the principal laws are falsifiable in isolation (they aren’t) but the responsible behavior of the community of physicists in developing the theory and dealing with apparently contradictory data. And this, in turn, follows from the epistemic warrant of the theory. If a theory captures an important aspect of the real world, this will lead to some empirical successes, and make it possible for advocates to defend it without a litany of excuses and evasions. Good scientists can *afford* to take some empirical risks, while pseudoscientists will forever have to run away from the verdict of nature. For instance, evolutionary biology can afford to make bold and specific predictions about the general order of fossils in the geological strata, precisely because the theory captures some important truths about the evolution of life on this planet. For a theory like creationism, the situation is markedly different. In the absence of any correspondence with the world, creationism as a belief system can only survive by evolving strategies for deflecting the constant onslaught of unwelcome evidence. And the same is true for wrongheaded theories in widely different domains, such as Holocaust denialism, astrology or phrenology

Of course, as the history of science shows, there should always be some leeway for *ad hoc* maneuvers when a theory is threatened with refutation. It is quite true, as the critics of Popper have pointed out, that scientists will almost never abandon a successful theory after the first failed experiment, pace the heroic rhetoric of falsificationism. In its original and strictly logicist form, Popper’s falsificationism is a completely unrealistic and unworkable portrayal of scientific methodology. To use an often-cited example, no biologist would give up evolutionary theory upon the discovery of a single mammalian fossil in pre-Cambrian rocks (Futuyma, 2006, p. 532). Biologists would much rather rescue evolutionary theory by invoking some sort of ad hoc hypothesis (fraud, misidentification, an unlikely upturning of geological strata), and if that fails, they would try out some local rearrangements in the ancestral tree of the class of mammalia rather than a wholesale rejection of evolutionary biology. Famously, when the observations of Uranus’s orbit failed to confirm the predictions of Newtonian mechanics, physicists did not jettison the whole of Newtonian mechanics (as Popper would have required them to do), since the theory enjoyed outstanding predictive and explanatory successes in other domains. Rather than ‘blaming’ Newton’s laws for the predictive failure, they tried to modify some of the auxiliary assumptions and boundary conditions that went into the prediction, in an attempt to protect the theory itself (or the ‘hard core’ of the research programme). But you cannot keep up making excuses indefinitely. If anomalies and apparent refutations keep mounting, while theorists stubbornly persist in making up excuses, then a field of inquiry degenerates into pseudoscience (Lakatos, 1970).

Importantly, it is not necessary to pinpoint exactly how much leeway theorists can afford, and reasonable people may disagree about the prospects or ‘rescue-worthiness’ of a theory at a particular point in time. But in order to diagnose theories such as astrology, creationism or homeopathy as ‘pseudoscientific’, we do not need to agree on such an clear-cut dividing line (Pigliucci, 2013). In all these disciplines, the pattern of evasive behavior is so systematic and pervasive as to leave no room for reasonable dispute. To insist that the term ‘pseudoscience’ cannot be used in good conscience unless we can draw a precise line in the sand and decide all intermediate cases is an instance of the fallacy known as Loki’s wager (Boudry, 2013a).

But then, a critic might go on to argue, why not just stick to Hansson’s criterion of ‘lack of epistemic warrant’, rather than the roundabout criterion of creating an illusory *impression* of scientific warrant? Because pseudosciences come in all sorts of different flavors and colors, and the reasons for their lack of epistemic warrant will be different in each case. This, as Hansson pointed out, makes the criterion of ‘epistemic warrant’ useless for practical diagnostic purposes. It is true that *all* pseudosciences somehow suffer from a lack of epistemic warrant, but until we have fleshed out what (lack of) epistemic warrant amounts to in each domain, we will have made little progress in separating the wheat from the chaff. For instance, what makes a theory epistemically warranted in the historical sciences will be very different from the standards of evidence used in biology. Consequently, the epistemic flaws of a doctrines like creationism will be quite different from those of Holocaust denialism. But the *strategies* engaged in by both creationists and Holocaust revisionists to explain away counterevidence will be much more similar, and therefore more convenient for purposes of demarcation. Laudan’s principal objection to the demarcation project was that there is simply no silver bullet or shortcut to separate good from bad theories. Whether we like it or not, we have to put in the hard work of actually evaluating the merits of each theory in a piecemeal fashion (Laudan, 1982). However, the current proposal, while nothing like a silver bullet, does allow us to save some time and effort in diagnosing each new pseudoscience. If we see proponents of a belief system systematically engage in evasive behavior and spurious moves, we may suspect that there is something rotten about that theory, *even if* we have not investigated all the relevant evidence.

## Multi-criteria approaches

Among those philosophers who have not given up on the demarcation project, most nowadays favor a multi-criteria approach (Dawes, 2018; but see Fasce, 2020; Fernandez-Beanato, 2020; Mahner, 2007; Pigliucci & Boudry, 2013). Rather than looking for a single silver bullet, they attempt to solve the demarcation problem by means of a combination of different criteria. Some philosophers favor a multifactorial account, which places theories along a continuum on a number of dimensions (Dawes, 2018), while others present a checklist of telltale signs of pseudoscience. The more features a theory exhibits, the more likely it is to be a pseudoscience. (Bunge, 1982, 1984; Derksen, 1993; Kitcher, 1982; Langmuir, 1989; Mahner, 2007). Neither of these criteria, taken in isolation, is necessary nor sufficient for a theory to qualify as a pseudoscience, but together they can be regarded as defining pseudosciences through Wittgensteinian family resemblance.

Multi-criteria approaches have obvious advantages over more ambitious mono-criterial approaches. Since there are many ways in which a theory can deviate from good scientific practice, we should not expect a single criterion to cover all cases. For instance, one recent checklist mentions the “appeal to antiquity” (*ad antequitam fallacy*), the argument that since a theory has been around for so long, it must be true (Lilienfeld et al., 2012). This fallacy may indeed be found among young-earth creationists or astrologers, but it won’t apply to latecomers like the theory of Intelligent Design, which only took shape in the last decades of the 20th century and which deliberately expunged all references to religious tradition. Or take the criterion of “unrepeatable experiments” (Hansson, 2017). Naturally, this will only apply to pseudosciences which involve experimental work in the first place, such as parapsychology and homeopathy, not to historical pseudosciences like Holocaust denialism or creationism. Some pseudosciences use “hyper-technical language” (Lilienfeld et al., 2012, pp. 27-28), but not all of them do. Psychologists have also found that pseudoscientific doctrines often resonate with deeply engrained intuitions – such as essentialism, teleological thinking and sympathetic magic – whereas genuine science flies in the face of our intuitive view of the world (Blancke & De Smedt, 2013; Bloom & Weisberg, 2007; Boudry et al., 2015; Lilienfeld et al., 2012). But of course, different pseudosciences will tap into different intuitions, and there may well be instances of counterintuitive pseudoscience. Resonance with intuitions is at most a warning sign, not a universal feature of all pseudosciences.

By contrast, if the argument developed in this paper is correct, then immunizing strategies and other evasive behavior will be characteristic of *every* pseudoscience, regardless of the domain in question, because all of them face the same challenge. Indeed, many of the features found in multi-criterial approaches are variations on that theme, and can be subsumed under the same heading. For instance, in his list of “ten warning signs of pseudoscience”, Lilienfeld (2012) makes special mention of “evasion of peer review”, next to the more familiar criterion of “lack of falsifiability and overuse of ad hoc hypotheses”. In our approach, which collapses the distinction between theories-as-such and the behavior of its adherents, both criteria can be subsumed under the rubric of immunizing tactics (see also Talmont-Kaminski, 2013). Refusing to submit your theory to peer review is one straightforward and not-so-subtle way to protect it from criticism, and can be seen as the methodological counterpart of the use of immunizing tactics *after*  empirical testing. A similar analysis can be applied to the tendency to “obscurantist language”, which is sometimes included in demarcation lists. Hiding behind a cloak of ambiguity is yet another way of protecting your theory from critical scrutiny. Indeed, this analysis can even be extended to non-empirical domains such as abstract philosophy. It has often been noted that deliberately obscure writing in philosophy is a convenient way to disguise a lack of substance, since it makes theories less amenable to critical scrutiny (Frankish, 2015). This would suggest the existence of “pseudo-philosophies” analogous to pseudosciences (Buekens & Boudry, 2015; Shackel, 2005)

In sum, though we find much of value in multi-criterial approaches, our approach can be seen as an attempt to restore some order in their list of criteria, and to separate essential from secondary features. Pseudosciences may exhibit a range of common defects, all of which can be used for diagnostic purposes, but what unifies all of them is the systematic attempt to create a spurious impression of epistemic warrant, by evading counterevidence and critical scrutiny in general.

# Conclusion

Philosophers of science have no general account of “epistemic warrant” in the sciences, and it is unlikely that we will ever possess one. What it means for a theory to be epistemically (un)warranted will depend on the methodological and empirical standards relevant to that field of inquiry. A fortiori, we have no general account of *lack* of epistemic warrant. Even within a single field, it is difficult to list all the possible ways in which a theory may *fail* to be epistemically warranted, for the simple reason that in a complex world there will always be more ways to do things wrong than to do them right. However, the symptomatic approach to demarcation developed in this paper allows us to sidestep the direct question of epistemic warrant.[[4]](#footnote-4) While there are myriad ways in which a theory can fail to be epistemically warranted, there are comparatively fewer ways to create a false *impression* of epistemic warrant, and these ways are largely the same across different scientific fields. Different pseudosciences have different epistemic defects, but they all try to overcome them in similar ways. Every theory will be confronted with the threat of potentially destabilizing counterevidence. If a theory enjoys genuine epistemic warrant, it can afford to expose itself to critical scrutiny and to empirical testing, but if it fails to have such warrant, proponents will need to systematically resort to immunizing strategies and hoc maneuvers, and to spurious ways for creating an asymmetry between confirmations and refutations. This approach yields a demarcation criterion that is both general and indirect. It is indirect in the sense that it does not focus on the specific epistemic defects of a pseudoscience, but on the ways of overcoming them. But it is also general because, if my argument is correct, pseudosciences will *always* exhibit the immunizing tactics described above, whatever their other foibles. It is not logically impossible to encounter a pseudoscience whose proponents do not engage in immunizing tactics, but given the make-up of the human mind and what it takes to achieve cultural success in our modern scientific age, this is unlikely. Any pseudoscience that does *not* in some way engage in evasive tactics will be too vulnerable to criticism and will fail to win any converts.

Finally, though my approach differs substantially from Popper’s falsificationism, it may also help to explain the enduring popularity – some would say tenacity – of Popper’s falsificationism among working scientists. Philosophers of science have poked numerous holes in falsificationism again and again, but scientists somehow have failed to take notice, and Popper’s stature in the scientific community remains largely undiminished (Godfrey-Smith, 2009). Indeed, many scientists do not realize that their own scientific conduct contradicts the dictates of strict falsificationism, and that Popper’s account does not even allow for the notion that theories can be confirmed or supported by evidence. Not only do Popper’s admirers seem to systematically distort his views of science, but more importantly, they distort them in a more reasonable and realistic direction. This is because, as I have argued, there is indeed an important kernel of insight lurking in Popper’s conception of science, which was unfortunately buried beneath his strict and narrow-minded logicism and his obsession with deduction as the only valid mode of scientific inference. This kernel is: good scientists stick out their necks because they can afford to do so, while pseudoscientists forever have to run away from the verdict of nature. Science makes progress by taking bold risks and learning from mistakes, while pseudoscience forever dig in their heels and stick to their guns.

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1. A similar point applies to the demarcation criterion which rejects a theory as pseudoscientific because it lacks physical foundations or violates some well-established physical law (see Thagard, 1978 on astrology). [↑](#footnote-ref-1)
2. Oxford English Dictionary: www.oed.com/view/Entry/153794. [↑](#footnote-ref-2)
3. In so-called conspiracy theories – defined as alternative accounts of history in terms of the nefarious actions of a small groups of agents working together – these intelligent attempts to evade detection are the conceptual core of the theory (Coady, 2006). Whether or not one wants to classify conspiracy theories as “pseudosciences”, they share many features with traditional pseudosciences, and are impervious to criticism and refutation for similar reasons. [↑](#footnote-ref-3)
4. The “social process” criterion proposed by Dawes (2018) is also “symptomatic” in this sense: it does not directly confront the epistemic defects of a theory, but uses the rejection or exclusion of said theory by the scientific community as an indirect, *pro tanto* reason to regard it as pseudoscientific. Though Dawes’ criterion has important practical value for lay people as a “quick and easy” way to diagnose pseudoscience, I believe it is less satisfactory for philosophical purposes, since it postpones the answer to the underlying epistemic question: *why* is it that scientific communities give some theories their stamp of approval, while rejecting others as false contenders? I believe that the current proposal captures those epistemic reasons better (or at least the common denominator of all those epistemic reasons). [↑](#footnote-ref-4)