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

Abstract

For a long time, philosophers of science have expressed 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 the demarcation problem of old leads to a dead-end, the concept of pseudoscience is not going away anytime soon, and deserves a fresh look. 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 failures and shortcomings in science apart from pseudoscience (such as fraudulent or faulty research). Next, I argue that pseudosciences can be fruitfully regarded as *simulacra* of science, doctrines that are not epistemically warranted but whose proponents try to create the impression that they are. In this element of imitation of 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. The indirect, symptomatic approach defended here leads to a general characterization of pseudosciences in all domains of inquiry, and to a useful diagnostic tool.

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

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

# Introduction

## 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 (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 qualms about 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 invariably spark public outcry). Semantics aside, most philosophers would agree that the doctrines mentioned above 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; creationism hampers the educational opportunities of children in religious communities (Scott, 2004); climate denialism obstructs necessary political action to reduce human carbon emissions (Oreskes & Conway, 2011; Jolley & Douglas, 2014); and people in developing countries are stricken with blindness because of myths about genetically modified food (Paarlberg, 2009).

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).

## A philosophy of pseudoscience?

Is it time for philosophers to take a fresh look at the demarcation problem? Is it our professional duty, as some believe, to help society discriminate between genuine science and its harmful pretenders? Recent years have indeed seen a revival of philosophical interest in demarcation (Dawes, 2018; Fasce, 2017, 2020; Fernandez-Beanato, 2020; Hansson, 2009, 2017; Hoyningen-Huene, 2013; Pigliucci, 2008; Schindler, 2018), 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 may even be easier to circumscribe pseudoscience than to define science.

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. In section 2.1 I argue against the definite article “the” in the phrase “the demarcation problem”, distinguishing between two different tasks which have often been conflated: *normative* and *territorial* demarcation. I further distinguish between pseudoscience and various other things that fall short of being good science, such as fraudulent, sloppy, fruitless or unreliable research (2.2). Next, using a simple lexical meta-definition suggested by Hansson, I develop a naturalized approach to pseudoscience (3.1). 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. In section 3.2, I show that this ‘cultural mimicry’ is bound to manifest itself in only a small number of ways, which can be fruitfully seen as indirect symptoms of pseudoscience. Finally, I discuss how the current account differs from other approaches to demarcation, in particular from falsificationism (4.1) and from the currently popular multicriteria approaches (4.2).

# Demarcating the demarcation project

## Normative vs. territorial demarcation

The demarcation problem, as is well known, 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. 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 (XXX). For instance, Hoynighen-Huene’s 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.[[1]](#footnote-1)

## Naturalizing “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, a necessary condition for a theory to be scientific (and in some formulations also a 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). A more recent first-principles criterion of demarcation is the commitment of science to ‘methodological naturalism’. This criterion entails that theories involving supernatural or non-natural explanations are *ipso facto* unscientific (Mahner, 2011; Pennock, 1999; Ruse, 2005).

None of these proposals have garnered broad assent among philosophers of science. In a nutshell, critics have objected that they brand some paradigmatic sciences as pseudoscientific, and fail to rule out some obvious pseudosciences. More generally, first-principle approaches fail to do justice to the open-ended and heterogenous nature of science.[[2]](#footnote-2) Rather than starting out with a definition of science, and then defining “pseudoscience” or “non-science” simply by negation, I propose to naturalize the concept of pseudoscience, looking at real-life specimens. There are many different ways in which something can fail to be proper science, but not all of those should be designated as “pseudoscience” (Ladyman, 2013). Fraud, for instance, is conceptually different from pseudoscience, and involves the deliberately manipulation of research, with data that is being fabricated, embellished or tampered with. 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” (Hansson 2013). 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 define 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.”[[3]](#footnote-3) 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 various pseudosciences, which set them apart from the theories and doctrines that are widely regarded as scientific, and which may help educators, policy makers 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 mimicry

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 the term “pseudoscience” will generally arrive at the same judgements: the first class of theories and practices have hardly any scientific merit, and should not be funded or taught in the classroom, while the second class have and should. This near-unanimity could lead us to believe that perhaps deep down everyone is tacitly relying on the same theoretical virtues (Schindler, 2018), and that 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 the same relevant experts. It is also possible that the defects from which the aforementioned theories suffer are completely different in every case, though 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 miscellaneous doctrines 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 vacuum. They are 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 can only emerge in a cultural environment in which science already exists and is regarded as an epistemic authority worth emulating (XXX; Gordin, 2012; Numbers & Thurs, 2013). As Hecht writes, pseudoscience “has no independent existence, but achieves it meaning only through a comparison (always unfavorable) with the thing that it purports to be” (2018, p. 7). Even though some pseudosciences do not explicitly don the mantle of “science”, and may even oppose (mainstream) science in favor of an “other way of knowing”, they still aspire to an epistemic standing that is similar to the sciences, and will often imitate some of its external trappings (e.g. professional journals, technical jargon, serious conferences). In any event, pseudosciences can be regarded as a form of imitation or mimicry because they falsely claim to offer what science does not in fact offer: a reliable body of knowledge in a certain domain of reality.

In a series of papers, Hansson has thus proposed the following meta-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).

But, as I will argue, 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. This is the ‘cultural mimicry’ we already discussed: pseudoscientists try to imitate the real thing, in the hope that innocent consumers won’t be able to tell the difference (Blancke et al., 2017). Many have tried to fool people by adopting some of the outward trappings which have come to be associated with science. For instance, a discipline like parapsychology has its own peer-reviewed journals, scientific conferences, and uses mathematical formalizations and technical jargon just like in other fields of psychology. 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

Cioffi wrote that “a successful pseudoscience is a great intellectual achievement. Its study is as instructive and worth undertaking as that of a genuine one” (1998, p. 115). If a belief system is to create a convincing impression of being a genuine science, two things are essential, regardless of the subject matter: (a) steering clear of counterevidence and (b) seeking out some spurious support. Beliefs and theories may be appealing for any number of reasons, but if they fly in the face of reality, they will garner little success. Boudry and Braeckman (2011) have distinguished between ‘immunizing strategies’ and ‘epistemic defense mechanisms’, and documented how they appear in various guises in practically every pseudoscience (the relationship with Popper’s “conventionalist stratagems” will be discussed in 4.1). 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, 2013; 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 (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.[[4]](#footnote-4) Defenders of alternative medicine, when presented with properly randomized clinical trials into the efficacy of their therapies, 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 (XXX, p. 155; Gordin, 2012, p. 50).

### An asymmetry between evidence and counterevidence

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 foreclosed. Ideally, in order to create a decent impression of epistemic warrant, pseudosciences have to evade adverse evidence while simultaneously enjoying (occasional) confirmations. In other words, they create an asymmetry between positive and negative evidence: soliciting positive evidence in a way that does not involve a genuine threat of failure, and evading negative evidence without completely closing off the (apparent) positive evidence. At bottom, this is the rationale behind the practice of cherry-picking (of data, experiments or sources), and of strategic vagueness. 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, when Freud theorizes that libidinous desire lies at the root of *every* neurosis, 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 a vicious explanatory feedback loop. 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 (owing to the placebo effect, spontaneous remission or regression to the mean), 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

### Logical properties vs. behavior

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 (and 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 its defenders. 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, taken in isolation, seem to be perfectly falsifiable and have in fact been roundly refuted. For instance, the claim by Young-Earth Creationism that the Earth is 6.000 years old has countless falsifiers, and is indeed contradicted by virtually every geological finding. More generally, any demonstrably false proposition is “scientific” under Popper’s demarcation criterion, precisely in virtue of it having been refuted. On the other hand, as philosophers of science have known ever since the criticism by 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 empirical observation. 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, 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 ancillary hypotheses in the bundle, but this is what actual scientists have often done, and with good justification.

By contrast, my naturalistic approach departs radically from Popper’s logicism. First, the current account of evasive behavior is *dynamic*: it is not dealing with ‘unfalsifiability’ as a logical property of some theories or propositions, but with persistent *strategies* and *maneuvers* to avoid empirical risks and to create an asymmetry between evidence and counterevidence (see also Derksen, 1993; Kitcher, 1982, 1993). At some point in his *Logic of Scientific Discovery*, Popper also discusses certain “conventionalist stratagems” to evade falsification, such as the introduction of ad hoc hypotheses. But he does not see the persistent use of such stratagems by a community as diagnostic of pseudoscience. For Popper, the scientific of pseudoscientific nature resides in the theories themselves, and the falsificationist should make a methodological *decision* to never resort to such conventionalist moves (Popper, 1959/2002, pp. 57-63).

Popper himself would probably have dismissed the current account as hopelessly mired in “psychologism”, a charge which I would welcome, since this psychologism is exactly what allows us to escape from Popper’s logicist straitjacket. 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. Kitcher (1993, p. 196) even goes as far as stating that pseudoscience is merely a “derivative category” of the psychological category of “pseudoscientists”. Pseudoscience is simply what pseudoscientists do (Kitcher, 2007, p. 115).

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. In reality, what we see is that pseudoscientists evade counterevidence in different ways and at different levels: sometimes by refusing to participate in an experiment, sometimes by exploiting equivocations, sometimes by resorting to ad hoc reasoning.

Now we can see how my account 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 excusesin the creationist community when confronted with every fresh piece of evidence for an old earth. Good scientists can *afford* to take some empirical risks, precisely because they capture some important part of reality, while pseudosciences like creationism, Holocaust denialism, astrology or phrenology can only survive by developing strategies for deflecting the constant onslaught of unwelcome evidence. The question of whether these theories are falsifiable or unfalsifiable as such is rendered moot.

### Making up excuses

In its original and strictly logicist form, Popper’s falsificationism is an unrealistic and unworkable account of scientific methodology. As Popper’s critics have pointed out, scientists will almost never abandon a successful theory upon the first failed experiment, even if they embrace the heroic rhetoric of falsificationism (as some of them do). Indeed, if past scientists *had* hewn to falsificationist dogma, ruthlessly discarding conjectures the moment they encounter their first refutation, that would have ruined the progress of science (Feyerabend, 1975; Hansson, 2006). An often-cited example of a possible “falsification” of evolution is a that of rabbit fossil in pre-Cambrian layers (Futuyma, 2006, p. 532). Since mammals are believed to have evolved only hundreds of millions of years later, the discovery of such a fossil would completely destroy the theory of evolution. In reality, however, no sensible biologist would give up an extremely successful theory like evolution upon the discovery of a single anomalous fossil. If something like that were to happen, biologists would try to 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 before discarding evolutionary biology wholesale.

Popper wrestled with any such resorts to “conventionalist stratagems” to rescue a theory from falsification, since it threatened to undermine the falsificationist ethos: if a theory is contradicted by experience, even by a single observation, we *have* to abandon it. Lakatos tried to salvage the problem by arguing that such a rescue move is admissible only if it increases the empirical content of the new theory with respect to its predecessor. If it did, then it is “progressive” and thus permissible (Lakatos, 1970). But we do not need to settle this matter for every particular move. In our account, it is more natural to give research communities certain ‘leeway’ in dealing with recalcitrant observations. Biologists should not give up evolution upon the discovery of a single anomalous fossil, but they cannot keep up making excuses indefinitely. If anomalies and apparent refutations keep accumulating, while theorists stubbornly persist in making up excuses, then a field of inquiry degenerates into pseudoscience. It is the cumulative weight of such moves which is damning, not any move in particular. 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 a 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 (XXX).

## Multi-criteria approaches

Among those philosophers who have not given up on the demarcation project, most nowadays favor a multi-criteria approach (Dawes, 2018; Fernandez-Beanato, 2020; Mahner, 2007; Pigliucci & Boudry, 2013; but see Fasce, 2020). 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 situates theories along a number of different dimensions (Dawes, 2018). Other have proposed 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 (but see Schindler, 2018).

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 is indeed common among young-earth creationists and astrologers, but it won’t apply to latecomers like Intelligent Design creationism, 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; XXX; 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 (XXX; 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 gamut of criteria, and to separate essential from secondary features. It is true that pseudosciences 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 agreed-upon account of “epistemic warrant” in the sciences, and it is unlikely that we will ever reach consensus on the matter. Though there are general accounts of epistemic warrant such as Bayesianism, what it means for a theory to be epistemically (un)warranted in one domain will differ substantially from what that means in another domain, depending on the methodological standards and explanatory norms pertaining 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. This, as Hansson pointed out, makes the criterion of ‘epistemic warrant’ useless for practical diagnostic purposes. It is true that all pseudosciences suffer from a lack of epistemic warrant in one way or another, 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.

In cracking the demarcation problem, however, the symptomatic approach developed in this paper allows us to sidestep the question of epistemic warrant. 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. The epistemic flaws of a doctrine like creationism will be quite different from those of Holocaust denialism or astrology, but the strategies engaged in by its advocates to explain away counterevidence will be largely similar. The “social process” criterion recently 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.[[5]](#footnote-5)

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). The current proposal, however, 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. Indeed, if the argument developed in this paper is correct, the symptomatic demarcation criterion is general and can be applied across the board: whatever the subject matter, pseudosciences in all fields of inquiry will exhibit the immunizing tactics described above. Any pseudoscience that does *not* in some way engage in evasive tactics will be too vulnerable to criticism and will fail to achieve any cultural success.

Finally, though I believe my approach differs substantially from Popper’s falsificationism, it may also help to explain the enduring popularity – some would say tenacity – of Popper’s philosophy 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 into a more reasonable and sensible version. This is because, as I have argued, there is indeed an important kernel of insight lurking in Popper’s conception of science, which was evidenced in his astute remarks on psychoanalysis and Marxism, but which unfortunately ended up buried beneath a narrow-minded logicism and deductivism. 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, because their theories lack epistemic warrant. Science makes progress by taking bold risks and learning from mistakes, while pseudoscience forever dig in their heels and stick to their guns.

This paper does not pretend to have offered the final solution on the question of pseudoscience, but I hope to have helped to revive interest in a problem that has long been neglected by philosophers of science. 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.

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1. 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. This is not the case for the normative demarcation project: the categories of science and pseudoscience are largely distinct and nonoverlapping, and are certainly not mutually dependent. [↑](#footnote-ref-1)
2. For a critique of the notion that ‘methodological naturalism’ is an essential attribute of science, see (XXX; Fishman & Boudry, 2013). [↑](#footnote-ref-2)
3. Oxford English Dictionary: [www.oed.com/view/Entry/153794](about:blank). [↑](#footnote-ref-3)
4. 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-4)
5. 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-5)