Clarifying three philosophic myths surrounding objections to demarcation criteria

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Here are three philosophic myths that are often tossed around like a shuttlecock:

1. Popper's demarcation criterion of falsifiability sets out the boundaries of the natural sciences from non-science or pseudo-science.
2. Popper's criterion explicitly demarcates isolated scientific theories from non-scientific or pseudo-scientific theories.

   Consequently,
3. The criterion is either too restrictive and/or permissive a criterion to demarcate the domains of science from non-science or pseudo-science (the *objection from ill-fit*).

All three of these myths are false.

At least one collected book has been recently published on the deficiencies of Popper's demarcation criteria (Boudry and Pigliucci 2013); a number of articles in this book propose new demarcation criteria. It is good that philosophers are interested in this problem, but it is not the problem that Ayer, Carnap or Popper attempted to answer: all three set out a demarcation of what is *empirically significant* and what is not. In fact, Ayer's 1936/46 criteria and Carnap's 1956 criteria are either trivial or reduce to Popper's 1934/5 criteria (See: Popper 1959, pp. 65-66, Ayer 1936, pp. 97-99, Ayer 1946 and Carnap 1956).

In short, the three attempted to introduce a new category in philosophical taxonomy to join the likes of the analytic/synthetic, a priori/a posteriori and necessary/contingent distinctions. They are not

interested in setting out the limits of what is science from non-science. This may be surprising to some philosophers.

Furthermore, none of Ayer, Carnap and Popper's criteria are limited to isolated theories. In fact, all three propose two separate necessary and sufficient conditions for demarcation. It may be surprising to discover that there is not merely one criterion of demarcation. I recall learning as an undergraduate in a class on philosophy of science that Karl Popper proposed that scientific theories were scientific in virtue of being falsifiable. However, I was mistaken, as was my teacher. So were many prominent philosophers of science. These myths are no better than claiming that Carnap and Ayer's criteria of demarcation are self-refuting for they are neither verifiable nor analytic (another myth I was told in that introductory class). In sum, these unfaithful reconstructions of past philosophers of science should be set aside.

That is not to say that there are no good objections to the demarcation criteria from Ayer, Carnap and Popper. There are some, and they require understanding what purpose these demarcation criteria serve and what they actually are. My purpose is only to shed light on these popular misconceptions, and in doing so, facilitate better understanding of the history of the discipline of philosophy of science.

1 Introduction

A number of philosophers dismiss a specific territorial problem of demarcation as unsolvable (Kitcher 1982; Bunge 1983; Thagard 1978; Laudan 1983). Furthermore, the shift in recent years has been towards solving a normative problem of demarcation at the expense of this territorial problem (Boudry and Pigliucci 2013). One objection is routinely advertised as a potential culprit for abandoning territorial demarcation criteria. We can call it the *objection from ill-fit*.

This objection may be valid when directed at some possible territorial criteria addressed in Boudry and Pigliucci 2013, for example; however, I argue it is spurious when presented against its primary intended target: the criterion and problem set out by one main advocate for demarcation, Sir Karl Popper. It is spurious for three reasons: (i) it misidentifies the scope of the boundaries that are drawn, (ii) what is to be demarcated, and (iii) what purpose the demarcation criterion serves. In contrast to popular myth, Popper's criterion of *falsifiability* sets out the limits of empirical inquiry, not the natural sciences; it applies to theoretical systems, not individual theories; it is taxonomic, not normative.

I explain how the objection from ill-fit looks *prima facie* promising upon a surface reading of Popper's 1959 book, *The Logic of Scientific Discovery*, but is is based on a mistake in exegesis of key terminology. The implied meaning of these terms were enough to lead to a gross misunderstanding. Due to a quirk of the German language that does not exist in English (i.e. the respective scopes of 'science' vs '*Wissenschaft*') Popper chose to translate a key technical term in the German edition, '*empirischen wissenschaft*' as 'empirical science', rather than 'knowledge gained by experience' or any other suitable translation. Popper then failed to adequately signpost the meaning of this technical term. This choice has lead to the entrenchment of the philosophical myth that the objection from ill-fit targets Popper's demarcation criterion. I isolate some key passages that lead to the entrenchment of this myth and compare them to the original text of Popper's book, *Logik der Forschung*. Even a limited grasp of German reveals the extent of the problems in the 1959 translation that lead to the perpetuation of this myth.

Subsequently, many of his critics mistakenly took the aim of his stated demarcation criterion to delineate the boundaries between the natural sciences and other forms of empirical inquiry; other philosophers concluded the criterion was normative rather than territorial; other inattentive critics took the aim of the criterion to be limited to individual theories. These three mistakes in exegesis lead to the popularity of this version of the objection from ill-fit. I then locate the key passage that likely lead to this mistake in *The Logic of Scientific Discovery*. I show how Popper aimed to set out a criterion for demarcating empirically significant from empirically non-significant domains of discourse. Consequently, the objection from ill-fit is spurious when directed at Popper's territorial criterion. I conclude that no philosopher should continue to present the objection from ill-fit as targeting this particular territorial criterion of demarcation.

A differing objection from ill-fit may be more fruitful: it targets Popper's 1934/5 criteria, as well as A.J. Ayer's 1936 and Rudolf Carnap's 1956 respective criteria, since all three criteria exclude universalised probabilistic statements. The problem is that, as Carnap notes, universalised probabilistic statements 'are neither falsifiable nor verifiable…neither their negations nor they themselves are completely confirmable…' (Carnap 1937, p. 27; cf. Popper 1959, p. 190). Early in their careers, both Carnap and Popper presented replies to this objection that fold in their normative criteria that are rarely mentioned in the literature (e.g. Popper 1959, ch. VIII). It is as if many philosophers of science have never read past the first few chapters of *The Logic of Scientific Discovery* and, as I did for many years, relied on the testimony of others.

2 A misunderstanding of scope

Though brief, what follows is a fairly accurate depiction of what the philosophical community takes to be the two possible purposes of Popper's proposed demarcation criterion: 'Popper…wanted to distinguish scientific theories or hypotheses from nonscientific and pseudoscientific ones' (Pigliucci 2013, p. 10. See also , p. 320). We can call the two problems a *normative* and a *territorial* problem of demarcation.

Territorial demarcation problems are taxonomic: distinctions are made without judgment over their respective values. One formulation of a territorial problem requires elucidating 'the distinction between science and nonscience in general' (Mahner 2013, p. 31). This formulation is repeatedly attributed to Popper in the philosophical literature (E.g. Boudry 2013, p. 81 and Nickles 2013, p. 101). For one example, the *Stanford Encyclopedia of Philosophy* article on Popper states that falsifiability is a 'criterion for demarcating science from non-science' (Thornton 2016). This understanding of the territorial problem addressed by Popper is fundamentally mistaken.

On the other hand, the normative problem attempts to distinguish 'bona fide science from pseudoscience' (Boudry 2013, p. 79). 'Science' in this sense is intended as an honorific bestowed on certain theories, practices or communities and judgment of their respective values. This formulation of the normative problem is attributed to Popper as well (See also Laudan 1983, p. 118, Boudry 2013, p. 80). As I show, this depiction of Popper's aims in setting out his version of the demarcation problem is also inaccurate.

Contra Boudry 2013, p. 82, Mahner 2013, p. 114, *et al.*, Popper's interests at the time of the publication of *Logik der Forschung* are not set towards demarcating the natural sciences from non-science. In fact, he is explicit about this in the 1959 introduction to the English translation: the natural sciences are 'commonsense knowledge writ large…Its very problems are enlargements of the problems of common-sense knowledge' (Popper 1959, pp. xxvi, xix).

Popper's stated purpose of his proposed falsifiability criterion is to 'provide a suitable distinguishing mark of the *empirical, non-metaphysical, character of a theoretical system*' (Popper 1959, 11, cf. 14, emphasis added); the problem of demarcation is to find 'a criterion…[that] would enable us to distinguish between the empirical sciences on the one hand, and …"metaphysical" systems on the other' Popper 1959, p. 11. Any proposed solution to this territorial problem elucidates a theory of the absolute limits of empirical inquiry, not the limits of the natural sciences.

One may interject: *What is meant by the 'empirical sciences', then? Surely Popper is speaking about the limits of the sciences, not the limits of empirical inquiry!* Here is, I think, one major problem with Popper's translation that has lead to the perpetuation of this myth. Popper explicitly defines 'empirical science' ('*empirischen Wis-*

senschaft' in the 1934/5 German edition) as follows: 'The system called "empirical science"...must satisfy the criterion of demarcation, ...i.e. it must not be metaphysical, but must represent a world of possible experience' (Popper 1959, pp. 16-17; see also Popper 1934/5, pp. 11-12. Popper's use in *Logik* of the phrase '*empirischen Wissenschaft*' tracks the German use of this technical term. For one example, I quote from Weibl and Herdina's English-German technical philosophical dictionary:

> 'empirical science' is defined as '*empirische Wissenschaft* ...empirical knowledge, knowledge by experience, empirical generalisation' (Weibl and Herdina 1997, p. 120).

In contrast to his technical term 'empirical science' when referring to 'empirical knowledge', Popper uses the technical term, 'natural science' ('naturwissenschaft'), when referring to the sciences (Popper 1959, pp. 18, 48, 58). Thus 'empirical science' extends to cover knowledge gained from experience *in toto*, not the natural sciences.

Note also that Popper introduces a definition of this technical term several pages after he sets out his formulation of the demarcation problem. This failure to signpost this technical term has, I believe, helped this myth spread. The translators of the English edition–Popper, Julius and Lan Freed–set out to be faithful to the text. From the introduction to the 1959 translation, we have the following: 'The original text of 1934 has been left unchanged for the purpose of the translation' (Popper 1959, p. xiv).

This aim in translation is impossible: a change to a text is necessary in translation. Examining the original edition and translation, there is a strict adherence to sentence-by-sentence translation in the first chapter. What has not changed, however, is the order of sentences. Furthermore, whenever possible a 'literal' one-to-one English equivalent of a German term is given.

This choice in translation sets the reader up for confusion: in the first sentence of the opening chapter, Popper introduces a technical term ('empirical science') that implies through the use of the term 'science' some important relationship with the natural sciences. Rather than define his technical term on the first page in an added footnote, the definiens is introduced after he had used the term eighteen times (Popper 1959, pp. 3-4, 9, 11-12, 14-16).

Furthermore, this problem is compounded: in these sixteen pages before the definiens, Popper frequently uses the terms 'scientific' and 'natural sciences' in ways that repeatedly invite equivocation if the reader is not aware that they are each themselves technical terms in German philosophical discourse, and reflected as such in the German edition. Popper's use tracks the use of their corresponding German technical terms, in which the closest analogue in English to the word

Wissenschaft is the catchall term 'science'. The only differentiation made to each term is the choice to translate these key terms by amending 'empirical' ('empirischen') or 'natural' ('natur') to 'science' ('Wissenschaft'); their technical meaning is not signposted by Popper.

This produces exegetical confusion in the very passage first setting out the demarcation criterion: the German edition says, 'Ein empirisch-wissenschaftliches System muß an der Erahrung scheitern können' (Popper 1934/5, p. 13). Popper translates 'empirisch-wissenschaftliches System' as 'an empirical scientific system' (Popper 1959, p. 18). This can be understood as either 'an *empirical*-scientific system', i.e. as a system of empirical knowledge, or 'an empirical *scientific*-system', i.e. as a system of theories in the natural sciences.

Due to this choice in translation and how early the criterion is set out in *Logic* this is the likely source of this confusion over Popper's demarcation criterion. Over time, I conjecture, little attention to the source material lead to the perpetuation of the myth that Popper's criterion is directed towards setting out the limits of the natural sciences.

Naturally, these problems are nonexistent in the German edition (Popper 1934/5). In fact, I could only place variations of this formulation of the objection from ill-fit after 1959, the publication of the first English translation of *Logik*, and could find no instances of this objection from ill-fit in any German texts from 1934/5 to the present) So much for Popper's acumen at translation: he picked the closest term available to the German term 'Wissenschaft' in English, then failed to revise the translation to reflect the implicature of the term 'science' in English.

3 A misunderstanding of the subject to be demarcated

Furthermore, Popper's falsifiability criterion is routinely falsely purported to be the following: a singular theory is scientific if and only if it is falsifiable (Thornton 2016 and Nickles 2013, p. 101). That is, a universal statement counts as belonging to the natural sciences if and only if it is prohibitive: it rules out the possibility of some state of affairs. If the statement is not prohibitive, it is either pseudoscientific, nonscientific or both. This is Popper's (supposed) famous falsifiability criterion. This formulation is the one I was told, and have heard in casual conversation at conferences, and read in articles and books. We have already seen that one part of this common restatement of Popper's falsifiability criterion is mistaken: falsifiability is not restricted to demarcating the natural sciences from other empirical concerns. However, an examination of *The Logic of Scientific Discovery* reveals that Popper's criterion of falsifiability bears little resemblance to this one. Popper first sets it out as follows:

> it must be possible for an *empirical scientific system* to be refuted by

experience (Popper 1959, p. 18).

That is to say, a theoretical system–a large set of sentences–must rule out the possibility of some systems of statements 'of a lesser level of universality' Popper 1959, 25, emphasis added. This formulation is not about universal statements, but of *systems of statements*. Further textual evidence demonstrates Popper's repeated insistence that his criterion of falsifiability is directed towards demarcating *systems of statements*, rather than demarcating singular theories. Popper repeatedly says variations of the following:

> ...we can indeed falsify only systems of theories (Popper 1983, p. 187[1].)

Later in his career, Popper once more attempted to make this point as clear as he could:

> ...it is important to remember that [the criterion of demarcation] applies to theoretical systems rather than to statements picked out from the context of a theoretical system' (Popper 1983, p. 178. See also Popper 1963, pp. 186, 256).

It is as if Popper had to repeatedly clarify an elementary point that had been continually misunderstood. The prevalence of the mistaken formulation as falsifiability applying to a singular theory is concerning. How could this happen?

I believe one answer to this misunderstanding is as follows: once Popper first introduced his falsifiability criterion, his later writing–sometimes in the same section–often does not make it clear that he is referring to *theoretical systems*, and instead uses the phrase 'theory' in its stead. This is noticeable in his collected volume, *Conjectures and Refutations*, which contains numerous references to 'theory', followed by a citation of *The Logic of Scientific Discovery*. Were a philosopher to read *Conjectures and Refutations* without checking *The Logic of Scientific Discovery*, they would conclude Popper's falsifiability criterion applied only to singular theories, not theoretical systems.

4 The erroneous objection from ill-fit

With these two common misconceptions laid out, I now address the popular but erroneous version of the objection from ill-fit. Carl Hempel notes territorial criteria are bound to be both too restrictive and too permissive (Hempel 1950; Hempel

[1] See also Popper 1934/5, pp. 12-13, Popper 1959, p. 18 and Popper 1963, pp. 56, 66 for other examples.

1951). While Hempel's focus is directed at Ayer and Carnap's criteria, this general method has been appropriated to apply to Popper's criterion of falsifiability.

One example arguing that falsifiability is a criterion that is too permissive comes from Larry Laudan: it—so Laudan thinks—'has the untoward consequence of countenancing as "scientific" every crank claim which makes ascertainably false assertions' (Laudan 1983, p. 121. Other examples can be found in Lakatos 1981, p. 117, Mahner 2013, p. 30 and Boudry 2013, p. 87).

Philip Kitcher, on the other hand, asserts the falsifiability criterion is too restrictive: 'one can appeal to naive falsificationism to show that any science is not a science' (1982, 44): a scientific theory requires auxiliary hypotheses in order to make any predictions, thus no theory qualifies as 'scientific' on its own. (See also Thornton 2016 and Putnam 1974 for other examples in the literature.)

If no proposed criteria can set out the boundaries between the natural sciences and non-science, philosophers then abandon this territorial problem and redouble efforts to solve normative problems of demarcation Boudry and Pigliucci 2013.

4.1 Why this formation of the objection from ill-fit is mistaken

Note that Laudan confuses normative and territorial criteria: since the territorial criterion set out by Popper delineates the absolute limits to empirical inquiry; it is not normative (Popper 1959, pp. 14, 16). It does not matter if there exists ascertainably false or other epistemically objectionable empirically significant systems of statements that are falsifiable. This is to be expected for any solution to a territorial criterion proposing the limits to the domain of some form of discourse. In this case, empirical systems of statements that are known to be false are empirical because that they are *known to be false through empirical inquiry*. Naturally, *many* pseudo-scientific claims will be falsifiable: these claims are false, are known to be false by many scientists, and yet pseudo-scientists disregard any potential defeating evidence.

An analogy illustrates the absurdity of Laudan's reasoning: it would be as fruitful to object to falsifiability as a territorial criteria on these stated ground as it would to object to criteria for synthetic statements on the grounds that under some stated criterion of synthetic statements, a synthetic statement can be ascertainably false and still be synthetic; that is, the objection from ill-fit as framed previously is not a cogent objection. Of course, since Laudan has confused territorial and normative demarcation criteria, and the two are often simply referred to as 'the problem of demarcation', his objection has been accepted without further investigation. It is, however, more of a thought-terminating cliché than an appropriate rejoinder to the criterion of falsifiability.

Furthermore, note the objection from Kitcher that scientific theories on their own lack any predictive capacity is predicated on two of the previously mentioned mistakes in exegesis: first, the purpose the falsifiability criterion is not about whether a theory is *scientific* or *non-scientific*; it is a criterion for *empirical significance*. Second, isolated theories are not what is demarcated by the falsifiability criterion, but rather *theoretical systems* (Popper 1959, p. 25).

5 A plausible explanation for the origin of the objection from ill-fit

The explanation for the prevalence of the objection from ill-fit as presently framed is, I think, due to a problem in translation.

6 Conclusion

Dismissing Popper's territorial problem based on the previously formulated objection from ill-fit and characterising Popper's stated territorial problem and criterion as such are both predicated on a mistake in exegesis. The objection from ill-fit confuses the problem as normative when it is territorial; as concerned with a scientific theory and not empirical theoretical systems; as setting out the differences between science and non-science when it is about setting out the absolute limits to empirical inquiry. This confusion is most likely due to Popper's refusal to immediately flag the technical definition 'empirical science' in the 1959 English translation.

In summation, philosophers should stop perpetuating the objection from ill-fit presented previously as if it targets Popper's territorial demarcation criterion. It may be effective against proposed territorial criteria that demarcate science from non-science; however, this objection is used repeatedly to target Popper's criterion, and I can find no independent criteria that are not attributed to Popper. There may be other reasons to reject any territorial demarcation criteria between empirical and non-empirical theoretical systems; this objection from ill-fit is not one of them: it is much ado about nothing, a shot aimed at an intellectual ghost.

Other objections from ill-fit directed against Popper's criterion may succeed: while Church's objection does not target Popper's criterion, there remains the third version of the objection from ill-fit: Popper, Ayer and Carnap's criteria exclude universal probabilistic theories.

References

In:
Ayer, A.J. (1936). *Language, Truth and Logic*. 1st ed. London: Victor Gollanz.
— (1946). *Language, Truth and Logic*. 2nd ed. London: Victor Gollanz.
Boudry, M. (2013). 'Loki's Wager and Laudan's Error'. In: *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*. Ed. by M. Boudry and M. Pigliucci. Chicago: Chicago University Press.
Boudry, M. and M. Pigliucci, eds. (2013). *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*. Chicago: Chicago University Press.
Bunge, M. (1983). 'Demarcating Science from Pseudoscience'. In: *Fundamentia Scientiae* 3.
Carnap, R. (1937). 'Testability and Meaning–Continued'. In: *Philosophy of Science* 4.1.
— (1956). 'The Methodological Character of Theoretical Concepts'. In: *The Foundations of Science and the Concepts of Psychology and Psychoanalysis*. Ed. by Feigl and Schriven. Minneapolis: University of Minneapolis Press.
Hempel, C. (1950). 'Problems and Changes in the Empiricist Criterion of Meaning'. In: *Revue Internationale de Philosophie* 41.11.
— (1951). 'The Concept of Cognitive Significance: A Reconsideration'. In: *Proceedings of the American Academy of Arts and Sciences* 80.1.
Kitcher, P. (1982). *Abusing Science: The Case Against Creationism*. Cambridge: MIT Press.
Lakatos, I. (1981). *The Methodology of Scientific Research Programmes*. Ed. by J. Worroll and Gregory Currie. Vol. 1. Cambridge: Cambridge University Press.
Laudan, L. (1983). 'The Demise of the Demarcation Problem'. In: *Physics, Philosophy and Psychoanalysis*. Dordrecht: Reidel.
Mahner, M. (2013). 'How to Demarcate after the (Alleged) Demise of the Demarcation Problem'. In: *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*. Ed. by M. Boudry and M. Pigliucci. Chicago: Chicago University Press.
Nickles, T. (2013). 'The Problem of Demarcation: History and Future'. In: *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*. Ed. by M. Boudry and M. Pigliucci. Chicago: Chicago University Press.
Pigliucci, M. (2013). 'The Demarcation Problem. A (Belated) Response to Laudan'. In: *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*. Ed. by M. Boudry and M. Pigliucci. Chicago: Chicago University Press.
Popper, K.R. (1934/5). *Logik der Forschung: Zur Erkenntnistheorie der modernen Naturwissenschaft*. Vol. 9. Schriften zur wissenschaftlichen Weltauffassung. Vienna: Verlag von Julius Springer.
— (1959). *The Logic of Scientific Discovery*. Trans. by K. Popper, Julius Freed and Lan Freed. References are to Popper 2000. London: Hutchinson & Co.

Popper, K.R. (1963). 'The demarcation between science and metaphysics'. In: *The Philosophy of Rudolf Carnap*. Ed. by P.A. Schilpp. Vol. XI. Library of Living Philosophers. La Salle: Open Court Press.
— (1983). *Postscript to the Logic of Scientific Discovery: Realism and the Aim of Science*. Ed. by W.W. Bartley. Vol. iii. Originally circulated as private galley proofs in 1956/1957. London: Routledge.
— (2000). *The Logic of Scientific Discovery*. London: Routledge.
Putnam, H. (1974). 'The Corroboration of Theories'. In: *The Philosophy of Karl Popper*. Vol. xiv. The Library of Living Philosophers. La Salle: Open Court Press.
Thagard, P. (1978). 'Why Astrology is a Pseudoscience'. In: *PSA* 1978.1.
Thornton, S. (2016). *Karl Popper*. Ed. by Edward N. Zalta. URL: https://plato.stanford.edu/archives/win2016/entries/popper/.
Weibl, E. and P. Herdina, eds. (1997). *German Dictionary of Philosophical Terms*. Vol. 2: English-German. London: Routledge.