

A Regimented and Concise Exposition of Karl Popper's Critical Rationalist Epistemology

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Abstract. Criticisms of Karl Popper's critical rationalist epistemology are often confused and misleading. In part that is due to Popper's somewhat lax use of language, in which technical terms are used in more than one sense. I attempt to clarify Popper's views by regimenting his terminology. The result is offered as a clear and concise exposition of the main points of Popper's epistemology.

Keywords. Ad hoc; critical rationalism; epistemology; falsifiability; metaphysics; Karl Popper; rationality; science.

1. INTRODUCTION

Discussions of Karl Popper's epistemology typically exhibit a range of confusions. To some extent that is Popper's fault. He disdained meaning or linguistic analysis as trivial and scholastic. But that reasonable disdain engendered in him a reluctance to be fussy over terminology; and that reluctance led him to speak loosely, often using terms ambiguously, thereby leaving his expositions unclear overall, and wide open to misinterpretations. To exhibit the value and coherence of Popper's epistemology it is therefore necessary to restate it in a clear and concise way that regiments the terminology that Popper uses. This paper is an attempt at that task.

There are alternative and equally good ways in which such a regimentation may be accomplished. However, as no-one else, so far as I am aware, has attempted such a regimentation, I recommend that the following exposition should be accepted as standard. The regimentation differs from the terminology I have used in some other expositions of Popper's ideas (Frederick 2010; 2015; MS). The fact that those expositions differ among themselves in the ways in which Popper's terminology is explained is itself a testament to the need for a standard regimentation. The references to Popper's work given below show some places in which will be found his relevant views but, plainly, not necessarily the same terminology.

It may be helpful, before launching into the regimented exposition, which may be a little dry, to give a less formal

sketch of Popper's epistemology so that its broad outlines can be comprehended. On Popper's view, the growth of knowledge begins with a problem, which is usually an inconsistency discovered either within an inherited theory, or between inherited theories, or between an inherited theory and an accepted observation statement. We attempt to solve the problem by proposing new explanatory theories. We criticise these theories in various ways and we evaluate them as better or worse solutions to our problem. As a result, we usually come to understand the problem better, which leads us to suggest further new theories, which are in turn criticised and evaluated. It may be that we eventually settle on one theory as clearly better than its available rivals (as happened in the case of Newton's theory in the eighteenth century). That dominant theory may then become a main focus for our criticism, identification of new problems and further development of theory. The attempt to resolve the problems that the criticism of the dominant theory generates may lead to new conjectures which are rivals to that theory and which manage to stand up to criticism better than that theory does, thus leading to its revolutionary overthrow.

The growth of knowledge is thus a process of conjecture and criticism. An important kind of criticism is empirical, that is, the discovery of points at which a conjecture clashes with reality as we experience it. Popper proposes that what makes a conjecture scientific is its susceptibility to empirical criticism, that is, its falsifiability. A conjecture incapable of such an empirical clash is deemed metaphysical. How-

ever, falsifiability may be either direct or indirect; and that enables some conjectures, which are metaphysical in that they are not directly falsifiable, to qualify as scientific because they are indirectly falsifiable. The process of conjecture and criticism leads to progress only when criticisms are not evaded in pseudo-scientific ways. What distinguishes science is not just that its theories are, directly or indirectly, falsifiable but also that its procedures are not ad hoc. That requires that an amendment to a theory that removes an inconsistency identified by criticism is acceptable only if it solves some problem in addition to the problem of removing the inconsistency.

In section 2, I deal with Popper's demarcation of different types of statement. The terms 'empirical,' 'falsifiable,' and 'scientific' seem to be used interchangeably by Popper and by those who have been influenced by him; but there are two different types of statement that those terms can appropriately be used to distinguish, and each of those types has an important role to play in Popper's epistemology. Similarly, metaphysical statements are often contrasted with scientific statements, especially in Popper's earlier work; but Popper recognises, especially in his later work, two types of metaphysical statement, one of which is an integral part of science. In section 3, I turn to Popper's demarcation of different types of epistemic procedure into rational or irrational or, less broadly, scientific or pseudo-scientific. Popper sometimes calls statements that are defended by means of pseudo-scientific procedures 'metaphysical' (1959, section 9) or 'non-empirical' (1959, section 20). However, empirical and scientific statements can be defended in pseudo-scientific ways; though, as a consequence, they may suffer amendments which turn them into non-empirical or non-scientific statements. Pseudo-scientific *procedures* should not be confused with metaphysical or non-empirical *statements*. I ignore Popper's theory of verisimilitude because it seems to me to be indefensible. In section 4, I conclude. All citations in parentheses in the following sections are references to works by Popper.

2. THEORIES (STATICS)

One of Popper's concerns is to demarcate empirical statements from those which belong to metaphysics, logic or mathematics (1959, sections 4 and 5). He offers the following criterion:

(E) an *empirical statement* is one that is falsifiable (1959, sections 6, 15 and 21).

The term 'falsifiable' is defined using the term 'basic statement.' The latter is explained as follows:

(B1) a *basic statement* is one such that

- a. it has the form 'There is a ϕ in the spatio-temporal region k ,' where ' k ' represents a term that denotes a delimited spatio-temporal region, perhaps by means of co-ordinates,
- b. it describes something that we could conceivably observe, given our actual powers of observation, so ' ϕ ' represents a term which connotes an observable property (1959, section 28);

(B2) an *accepted basic statement* is one which is agreed by observers to describe an observed situation (1959, section 29).

Where the spatio-temporal region denoted by the term represented by ' k ' is within our current field of observation, a basic statement may be expressed more colloquially by using an indexical, as in 'This is a swan,' 'That is black,' 'Here is a glass of water,' 'Over there is a red swan.'

The notions of falsifiability are explained as follows:

(F1) a statement is *falsifiable* if and only if it is inconsistent with a basic statement (1959, sections 6 and 21);

(F2) a statement is *falsified* if and only if it is inconsistent with an *accepted basic statement* which describes a reproducible situation (1959, sections 6, 21 and 22).

A reproducible situation is one that either occurs regularly in nature or which we can bring about regularly by means of experiments. An example of a falsifiable statement is 'All swans are white.' It is also an example of a falsified state-

ment, given that statements equivalent to ‘This is a black swan’ have been accepted in the light of observations.

Here is the explanation of a metaphysical statement:

- (M) a *metaphysical statement* is one which is not a part of logic or mathematics and which is not falsifiable (1959, section 15).

The notion of a scientific statement is explained thus:

- (S) a *scientific statement* is one which, in conjunction with accepted basic statements, and perhaps also some accepted background knowledge or hypothetical assumptions, entails a *novel* falsifiable prediction which survives attempts to falsify it (1959, sections 18-20).

A prediction is a basic statement. Its derivation from a scientific statement requires at least one accepted basic statement to be conjoined to the scientific statement. Thus, from a scientific statement, perhaps in conjunction with some accepted background knowledge or hypothetical assumptions, we may be able to derive a statement of the form ‘If *p*, then *q*,’ where ‘*p*’ and ‘*q*’ represent basic statements describing reproducible situations. If we accept the basic statement represented by ‘*p*’ we can derive as a *prediction* the basic statement represented by ‘*q*’ (1959, section 12). A prediction is novel if and only if what it predicts is unexpected in the light of our background knowledge (1963a, p. 220). One attempts to falsify a prediction if and only if one seeks a situation in which the corresponding basic statement of the form ‘*p*’ and a basic statement inconsistent with the corresponding basic statement of the form ‘*q*’ are accepted.

So, the statement

- (1) all swans are white

is an empirical statement because it is falsifiable. But it is a scientific statement only if, when it was first uttered, our background knowledge did not imply that all swans are the same colour and, for some time afterward, the search for non-white swans found only swans that were white. A statement once classified as scientific remains scientific even if it is later falsified, as (1) was after the acceptance of some basic statements of the types ‘That is a swan’ and ‘That is not white,’ where the two occurrences of the word ‘that’ denoted, in context, the same thing (a black swan).

If we take Newton’s theory to be the conjunction of the three statements of the laws of motion and the statement of the law of gravity, then Newton’s theory is a scientific statement because, in the eighteenth century, in conjunction with

- some accepted background knowledge concerning the properties of familiar phenomena, including light and the working of telescopes,
- some accepted basic statements about the (reproducible) positions and motions of objects,
- some hypothetical assumptions, including those concerning the refraction of light and a statement to the effect that there are no other forces acting in the situation apart from those we know about,

it entailed *novel* falsifiable predictions, about the positions of the planets and the motions of terrestrial bodies, which survived attempts to falsify them.

From (F1), bold theories like Newton’s are not falsifiable: they must be conjoined with a bulk of background knowledge or hypothetical assumptions before we get a falsifiable statement. Thus, by (E), they are not empirical statements. So, major scientific theories are often not empirical statements. They are also plainly not axioms or theorems of logic or mathematics (although they generally *employ* a good deal of logic and mathematics, that is, they include such statements as implicit parts of themselves). Consequently, from (M), major scientific theories are typically metaphysical statements (1959, section 4; 1982, sections 20 and 27). We can nevertheless distinguish such statements from *purely* metaphysical statements as follows:

- (PM) a *purely metaphysical statement* is one which is not falsifiable and the conjunction of which with accepted background knowledge and accepted basic statements, and with any hypothetical assumptions currently postulated by its defenders, entails no novel falsifiable predictions (1959, section 85).

An example of a purely metaphysical statement is the theory of atomism in the time of the ancients (1959, section 4; 1982, section 20; 1983, pp. 191-92). That theory stated that the world consisted of atoms and the void and that all changes were to be explained in those terms. It maintained that the atoms were too small to be detected and that the void was unobservable, so from (B1) it was not a basic statement. It was also not falsifiable, since no basic statements

were inconsistent with it, so from (E) it was not an empirical statement. Further, in conjunction with accepted background knowledge and accepted basic statements it entailed no novel falsifiable predictions; and its defenders offered no additional hypothesis which could be conjoined with it and accepted background knowledge and accepted basic statements to yield novel falsifiable predictions. Therefore, from (S), it was not a scientific statement.

However, with the progress of our knowledge and the development of the atomic theory to include many hypothetical assumptions about the nature of atoms, the theory generated novel falsifiable predictions which survived attempts to falsify them (as with the kinetic theory of heat), so the theory became scientific (1959, section 85). Further, with the development of microscopes which made atoms observable, some statements of the theory became falsifiable, and thus empirical, because they were then inconsistent with some basic statements (1983, p. 191). Thus, what is a purely metaphysical theory at one time may become an empirical or scientific theory at a later time, depending on the progress of our hypotheses and their testing (1958, pp. 186-88; 1959, section 4; 1982, section 20; 1983, pp. 191-92). What is not a basic statement at one time may become a basic statement at a later time if the invention of new devices, such as telescopes and microscopes, enhance our powers of observation.

The statement

- (2) nothing travels faster than the speed of light and God exists

contains as its first conjunct a falsifiable statement that has survived attempts to falsify it (such as the experiment at CERN in September 2011), and as its second conjunct a purely metaphysical statement. Thus (2) is falsifiable, and thus empirical, and is as yet unfalsified. However, it is not a scientific statement because it yields no *novel* prediction either by itself, or when conjoined with some background knowledge, some currently proposed hypothetical assumptions or some accepted basic statements describing reproducible situations (1957, pp. 132-34).

Basic statements are theoretical statements in that the observable terms employed in them have implications that transcend the particular situation of observation. For example, 'This is a tree' is a basic statement to which observers may agree in a particular situation of observation. But if the thing thus described suddenly shed its leaves and retracted its branches, or if it waddled off, or if it screamed when

carvings were made on its bark, the previously accepted basic statement, 'This is a tree,' would be falsified by the acceptance of the basic statements describing the unexpected behaviour. Thus, accepted basic statements are falsifiable, they may be false and they may later be rejected on the basis of observations (1959, section 29, appendix *x, (1) - (5)).

We have no way of establishing whether a basic statement is true or false. Even if all accepted basic statements were true, a falsifiable but severely tested and unfalsified general statement may still be false, since the next accepted basic statement describing a reproducible situation might falsify it. Similarly, the failure to falsify any of the novel falsifiable predictions entailed by the conjunction of a scientific statement with accepted basic statements, background knowledge and hypothetical assumptions, cannot preclude that the next accepted basic statement describing a reproducible situation will falsify one of those predictions (1959, sections 1, 3 and 82). A severely tested but unfalsified theory may be false. Further, since basic statements may be false, a falsified theory may be true. Thus, we have no way of establishing whether a self-consistent empirical or scientific theory is true or false. By (PM), there is no way of falsifying a purely metaphysical theory. Provided it is consistent it may be true; but it might also be false. We have no way of establishing whether a self-consistent purely metaphysical theory is true or false. With the possible exception of logical and pure mathematical statements, then, we have no way of establishing, for any statement, whether it is true or false.

3. Practice (Dynamics)

Another of Popper's concerns is to demarcate rational from irrational epistemic procedures and, as part of this, to demarcate scientific from pseudo-scientific procedures. We just noted that, with the possible exception of logical and mathematical truths, and self-contradictions, we cannot establish whether a statement is true or false. Popper thus proposes that the aim of our search for knowledge is to obtain better explanations (1957, pp. 132-34). He then proposes a number of procedures that should help us to succeed in our aim if anything can (1959, sections 11 and 20). Thus, the procedures are proposed as being instrumentally rational. In contrast, epistemic procedures which prevent or undermine our success in achieving our epistemic aim are instrumentally irrational.

Since our epistemic aim is to achieve better explanations, we need to agree on ways in which an explanation may be better than a rival explanation. Here are some ways:

- the explanation offers solutions to genuine problems rather than spurious ones (1958, pp. 190-92, 199-200);
 - the explanation is consistent rather than self-contradictory (1959, sections 23-24);
 - the solutions offered by the explanation actually solve the problems rather than leaving them unsolved, and they better withstand criticism than the solutions provided by rival explanations (1982, sections 27 and 30; 1983, p. 20);
 - the explanation solves not only the problems it was proposed to solve, but also other problems besides (1957, pp. 132-34; 1959, section 20; 1982, section 27);
 - the explanation generates more novel falsifiable predictions than its rivals and those predictions survive testing (1957, pp. 132-34; 1959, section 20; 1963a, pp. 217, 219-20, 241-42);
 - the explanation generates new and interesting problems to solve (1963a, p. 222);
 - the explanation is simpler than its rivals (1957, p. 139; 1963a, p. 241; 1982, section 27);
 - the explanation corrects its previously successful rivals (1957 pp. 139-45);
 - the explanation is either falsifiable or scientific, rather than purely metaphysical, and has survived attempts to falsify it (1959, sections 5 and 20; 1982, section 27).
- vi. where a criticism is telling, we may defend a proposed explanation by modifying it or by combining it with additional hypotheses so that the criticism is rebutted, but only if these manoeuvres allow the explanation to solve additional problems (Popper 1959, sections 6, 19 and 20);
 - vii. in the case of a falsifiable or a scientific explanation, we may seek to overturn a falsification of it by modifying the explanation or by combining it with additional hypotheses so that the falsification is explained away, but only if these manoeuvres give us a revised explanation which has novel falsifiable predictions that survive attempts to falsify them (1959, sections 6, 19 and 20);
 - viii. we should abandon a proposed explanation if the problems it is intended to solve are shown to be not genuine problems (1958, pp. 190-92, 199-200);
 - ix. we should never attempt to justify a proposed explanation but should rather be keen to improve it or to replace it with something better (Popper 1959, sections 1, 8, 11, 85; 1994, section xvi).

Popper proposes the following procedures to help us to achieve our aim:

- i. we should study, and try to criticise, existing explanations, subjecting them to experimental tests if they are falsifiable or scientific, and we should attempt to propose explanations which offer better solutions to the problems for which the existing explanations provide solutions (1959, section 27, including footnote *1; 1982, section 27; 1994, pp. 40-43);
- ii. we should try to identify new problems posed by our study and criticism of existing explanations and try to propose explanations which solve them (1958, pp. 184, 190);
- iii. we should state our problems and proposed explanations as clearly and simply as we can (1983, p. 8);
- iv. we should subject our proposed explanations to critical scrutiny and seek out and invite criticisms of them, including experimental tests with regard to falsifiable and scientific explanations (1959, section 9);
- v. we should accept (at least until it is falsified) an any basic statement that is agreed by observers to describe an observed situation;

Any proposed epistemic procedures which conflict with (i) – (ix) are irrational, given our epistemic aim; and they are pseudo-scientific in connection with falsifiable or scientific statements (1959, section 11). Violations of (i) and (ii) are incompatible with the search for knowledge, since they eschew the attempt to find better explanations. Any violation of (iii) is obscurantist. That damns most ‘Continental philosophy.’ Violation of (iv) or (ix) is incompatible with the search for better explanations. Thus, contemporary epistemology is irrational. Violation of (v) ignores our empirical contact with the world and is thus irrational and pseudo-scientific, given our epistemic aim. Violations of (vi) or (vii) are ad hoc. They are thus irrational in a way similar to violations of (iv) and (ix) because they are attempts to buttress a defective existing explanation rather than to seek a better one. Violations of (viii) are scholastic, producing statements which are irrelevant, obscure, confused or trivial. A good deal of contemporary ‘analytic philosophy’ seems to be of that kind.

4. CONCLUSION

Popper's critical rationalist epistemology is a great advance over traditional and contemporary epistemology. It emphasises criticism rather than dogmatism, imaginative problem-solving rather than pedestrian fact-collecting or scholastic nitpicking, continual progress rather than stagnation, and insight into the development of scientific and metaphysical theories and the progress of our understanding of the world.

However, Popper's lax use of language obscures his message and generates misinterpretations of his views and much misplaced criticism of them. In an attempt to remedy that I have proposed that Popper's technical terms be subject to regimentation; and I have used that regimentation to essay a clear and concise exposition of the main points of Popper's epistemology. I propose that this regimentation should become standard until it is improved upon.

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