

## Is Simplicity an Adequate Criterion of Theory Choice?

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### Abstract:

According to Richard Swinburne, the principle of simplicity is of great importance to theory choice scenarios and theoretical changes in the sciences. In particular, he holds that the theory choice criterion of fit with background evidence can be reduced to the criteria of simplicity and of yielding the data. We will, however, rebut this reduction thesis and show that three central aspects of theoretical change (confirming power of empirical data, reliability of experimental methods, and truth of new theoretical proposals) cannot be adequately reconstructed if simplicity is regarded as a key criterion of theory choice.

### Keywords:

Simplicity, fit with background evidence, theory choice, theoretical change

### 1 Introduction

How is it that we can choose between alternative explanations, hypotheses or theories? By means of which criteria do we figure out which one out of a number of rival explanations, hypotheses or theories is the one most probably true? The answer given by Richard Swinburne reads: There are four criteria which direct the choice between competing theories in the sciences.<sup>1</sup> These are, first, the two a posteriori criteria of how well a given theory yields the data it is supposed to explain and how well it fits with the background evidence. On the other hand, there are the two a priori criteria of scope and simplicity (Cf. SET, 11-13 and EJ, 80-83).

All four criteria of theory choice Swinburne holds to be of *epistemic nature*, which is to say, they are decisive factors in judging whether one theory is more probably true than another.

Thus, if

- (1) a theory  $T_1$  yields more data than its rival theory  $T_2$  does, or if it yields data that is attributed a higher degree of probability,
- (2)  $T_1$  fits better with our background evidence than does  $T_2$ ,

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<sup>1</sup> Like Swinburne, we will limit our discussion to theory choice in the sciences: „limiting myself mainly to cases where the hypothesis at stake is a scientific theory consisting of one or more purported laws of nature.“ (SET, 13)

(3) the scope of  $T_1$  is more limited than that of  $T_2$ ,

(4) and if  $T_1$  is simpler than  $T_2$  in the sense suggested by Swinburne,

then  $T_1$  is more probably true than  $T_2$ . If, however,  $T_1$  is not to be preferred to  $T_2$  on grounds of fulfilment of all four criteria, shortcomings in one area may be compensated by good satisfaction of another criterion. Swinburne himself is aware of the fact that the weighing of criteria is a complicated matter, which is why he does not advance any theory on how to measure a theory's degree of fulfilment of the criteria or of how to ponder these degrees against one another. Due to this problem Swinburne restricts his discussion to cases in which theories differ regarding satisfaction of one criterion only (Cf. SET, 14-15).

Moreover, the four criteria are not equally central in determining which theory is to be chosen out of a number of rival theories. In his writings, Swinburne emphasizes the role of the criterion of simplicity, as the title of his lecture *Simplicity as Evidence of Truth* indicates. This is because except for simplicity, Swinburne claims, the importance of the role each of these criteria play in the process of theory choice is widely acknowledged and uncontroversial. To him, the strictly a priori criterion of simplicity is of such importance regarding theory change that without it, "we would be utterly lost." (SET, 15)

The salience of the criterion of simplicity being of such concern to Swinburne, it will also be the main topic of our paper. This being so, we will not dispute Swinburne's definition of simplicity in terms of the six facets he names in *Simplicity as Evidence of Truth*. We will, however, provide an argument against Swinburne's claim that in scientific theoretical progress the criterion of simplicity has to be attributed the very superior function among the four criteria for theory choice.

In doing so, we will first analyse the main part of Swinburne's argument for the superiority of the criterion of simplicity, namely his claim that there is a relation of reduction between the criterion of fit with background evidence on the one side, and the criteria of simplicity and of yielding the data on the other. Second, we will confront Swinburne's theory choice criterion of simplicity with three central aspects of theoretical change in science and show that the concepts of plausibility and acceptability, rather than that of simplicity, give rise to an adequate reconstruction of these aspects. Furthermore, we will argue that Swinburne's concept of simplicity cannot capture the mechanisms on grounds of which scientific progress is said to be truth-conducive.

## 2 Swinburne's reduction thesis

### 2.1 *The prominence of the criterion of simplicity*

Swinburne's argument for the prominence of the criterion of simplicity in theory choice can be reconstructed in the following way:

(1) The criterion of scope needs to be assigned minor importance as its fulfilment seldom influences a theory's degree of truth, for in most cases if a theory fulfils the remaining three criteria, the question of scope hardly affects its degree of truth.<sup>2</sup>

(2) The criterion of fit with background evidence is reducible to the criteria of simplicity and yielding the data (Cf. SET, 15 and EJ, 41, 95-96). This issue will be dealt with in more detail below.

(3) If we neglect the criterion of scope and reduce the criterion of fit with background evidence to the remaining two criteria, any choice between two rival theories that yield the data equally well would have to be considered impossible if it were not for the criterion of simplicity.<sup>3</sup>

Again, this argument is valid only if there is indeed a relation of reduction between the two criteria of simplicity and yielding the data. This relation will be discussed below.

Simplicity plays yet another role in regard to the criterion of fit with background evidence. Swinburne claims that it is through the criterion of simplicity that we judge which theories fit with our background evidence and which do not: In judging whether a theory  $T_1$  or its rival theory  $T_2$  fits better with our background evidence, we really go by simplicity. But just how do we do this? According to Swinburne, in the sciences we do not compare the theories by referring to the degrees of simplicity they incorporate if seen by themselves as isolated theories, but rather we are concerned with the question which of the theories conveys a simpler overall picture if taken together with our background evidence (Cf. EJ, 96 and SET, 41). For example, a theory  $T_1$  which postulates the existence of five chemical elements is certainly simpler than a theory  $T_2$  which suggests that there are a hundred and eighteen chemical elements, but this is true only if both theories are being considered in isolation. However, if within the background evidence we find reason to believe that there probably exists a large number of chemical elements, we would be justified in choosing  $T_2$  over  $T_1$ . Thus,  $T_2$  is the less simple theory if seen by itself, but if considered in the light of background evidence,  $T_2$  plus background evidence provides a simpler overall description of the world.

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<sup>2</sup> „[T]he influence of this criterion is not very great when we are dealing with hypotheses that satisfy the other criteria very well.“ (EJ, 82)

<sup>3</sup> „[W]ithout the criterion of simplicity we can make no step beyond the observable data.“ (SET, 15)

Before we explore whether the relation between the three criteria – scope being neglected – can in fact be considered a reduction, we will have to make some preliminary remarks as to what Swinburne means when referring to ‘background evidence.’

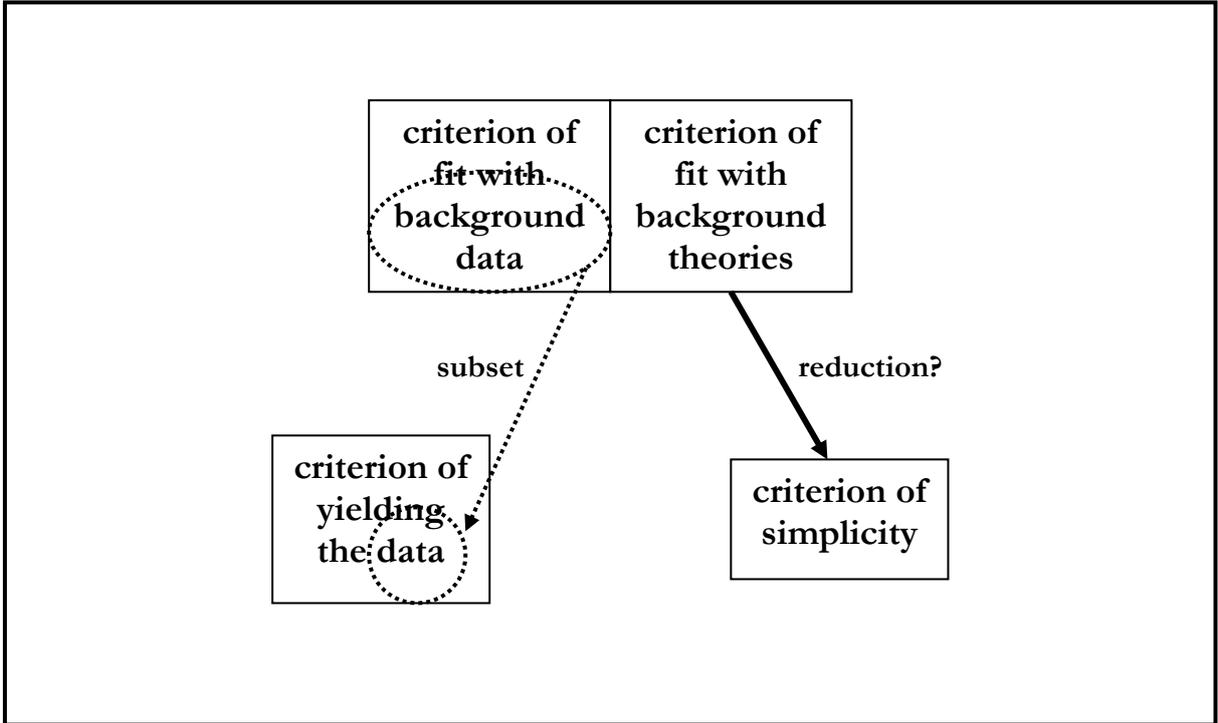
## 2.2 *The need to clarify the concept of ,background evidence‘*

In his writings on the four criteria for theory choice, Swinburne remains very unspecific as to what ‘background evidence’ amounts to, and he seems to do so deliberately. Sometimes, however, background evidence is sketched as “everything else that we believe we know about the world” (EJ, 80), so that it seems that Swinburne uses the terms ‘background evidence’ and ‘background knowledge’ almost interchangeably.

As for the expression ‘background evidence’, two things should be noted. First, according to Swinburne there seems to be evidence in the narrow sense, which differs from what he holds to be background evidence. Evidence in the narrow sense is evidence immediately relevant for the hypothesis in question. Background evidence, on the other hand, is all the evidence not directly relevant for the treatment of the respective hypothesis (Cf. EJ, 80, 151). Concerning theory choice in the sciences, the background evidence a given theory must fit with is constituted by theories of neighbouring fields or areas of wider scope. No answer is given, however, to the pressing questions of which criteria determine neighbourhood of fields or why theories have to fit with theories of neighbouring fields and not with theories of the same field. Also, for reasons unspecified, Swinburne neglects the subject of whether we can actually distinguish between evidence in the narrow sense and background evidence, as is evident in the following passage: „There are various ways of doing this [that is, making a distinction], and not a great deal turns on whether or how it is done.“ (EJ, 151)

Also, like his explanation of the expression ‘background’, Swinburne’s remarks concerning evidence remain rather vague, which he himself concedes in characterizing his accounts as “very loose holding-accounts“ (EJ, 80). This, however, is problematic, as it obscures a certain ambiguity in Swinburne’s use of the term: On the one hand, Swinburne seems to refer to empirical data (or phenomena or observations) when using the expression ‘evidence’. For instance, he provides an example consisting of the hypothesis that John stole the money from the safe and evidence regarding John’s character gathered beforehand (Cf. EJ, 81). Other passages suggest that what is meant by ‘background evidence’ is not empirical data, but scientific theories. This is the case whenever Swinburne makes observations on the special context of theory choice in the sciences (Cf. SET, 41-43 and EJ, 95-96).

Considering this, it appears to us that Swinburne’s ambiguous use of the expression ‘background evidence’ should not be dismissed by calling it a mere conceptual discrepancy without consequences. It is only through acknowledging that background evidence subdivides into two components, namely background *data* and background *theories*, that it becomes clear that the relation of reduction – insofar as it is legitimate to talk about a reduction at all – holds not between three, but two criteria of theory choice: fit with background *theories* and simplicity.



The remaining half of the criterion, that is, fit with background *data*, proves to be a subtype to the criterion of yielding the data, since for a theory to yield the data is for it to yield all the *relevant* data. According to Swinburne’s own explications of the term ‘background’, background data are data which are not *directly* relevant for the theory in question but *immediately* relevant. Hence, the set of background data of a given theory is a subset of the set of data this theory has to yield.

2.3 *The relation between the criterion of fit with background theories and the criterion of simplicity*

This said, we will now direct our attention towards the question if, and if so, in how far, the relation that exists between the criterion of fit with background theories and the criterion of simplicity can be considered a reduction.

As shown in section 2.1, Swinburne's claim is that in judging whether theory  $T_1$  fits in better with the available background theories than does its rival theory  $T_2$ , both theories have to be considered not in isolation, but as complexes consisting of the respective theory in conjunction with the body of background theories. These complex belief systems will then be compared to each other in terms of the six facets of simplicity and the simpler will be chosen. Evidently, Swinburne claims that considerations of fit are really considerations of simplicity, which is to say that „[f]itting better‘ is ‚fitting more simply‘, and thus making for a simple overall view of the world.“ (SET, 40) But just how are we to understand these claims? On the one hand, Swinburne seems to say that, as considerations of fit are the same as considerations of simplicity, the criteria of fit with background theories and simplicity are identical at the end of the day, despite the different labels. On the other hand, he seems to hold the weaker hypothesis that these criteria are not identical, but that the criterion of fit with background theories is in some way reducible to the criterion of simplicity (Cf. SET, 15 and EJ 41, 95-96). We believe that Swinburne can assume *neither* the first *nor* the second option. There is one point, however, to which we agree: applying the criteria independently of each other results in preference of exactly the same range of theories. If ‘F‘ stands for the three-place predicate ‘p fits better with q than does r’  $[F(p, q, r)]$  and ‘S‘ stands for the two-place predicate ‘p is simpler than q’  $[S(p, q)]$ , and the relevant universe of discourse is the set of all (systems of) sentences, then the following equivalence holds:  $F(p, q, r) \equiv S(p \wedge q, r \wedge q)$ . This means, for example, that in theory choice scenarios, if a theoretical proposal p fits better with background theory q than an alternative theoretical proposal r does, the conjunction of p and q is simpler than the conjunction of r and q. However, the extensions of the two predicates so introduced are radically distinct, since they contain different kinds of elements, namely tuples and triples, respectively. What is more, the intensions of the predicates clearly differ. Even if applying the predicates independently of each other leads to preference of the same theories, they still have different meanings.

As for Swinburne's weaker hypothesis, that is, that the two criteria are not identical, but that the criterion of fit with background theories can in some way be reduced to the criterion of simplicity, there is no reason to accept it in the light of our analysis given above. The aforementioned equivalence relation of the predicates of fit and simplicity does not provide any reason for assuming a relation of reduction between the two criteria, neither with respect to their extensions nor to their intensions. As we do not suppose that Swinburne uses the expressions ‘can be reduced to‘ and ‘boils down to‘ as purely rhetorical phrases, we can only express our hope that Swinburne will fill in this blank in his line of argument.

### 3 Neglected Aspects of Theory Change

In the preceding section we have stressed that the criteria of simplicity and fit with background theories result in preference of the same theories, although they obviously have a different meaning. We have also tried to show that Swinburne's thesis that the criterion of fit with background evidence can be reduced to the criteria of simplicity and yielding the data is ill-founded. It will now be our aim to investigate the adequacy of both criteria to *central aspects of theoretical change*. As will become clear from the following considerations, criteria of theory choice should not only be assessed as to whether they correctly yield the theoretical decisions scientists actually make, but whether they are suitable for an adequate reconstruction of the pivotal factors of theoretical progress. Particularly, in scientific practice theory choice scenarios do not occur methodologically unconditioned and without complex empirical as well as theoretical reasoning preceding the very situation of theoretical choice. Typically, scientists reflect on several aspects of theory confirmation by drawing on empirical data and of theoretical plausibility in view of background theories, *before* they are in a position to choose between two or more rivaling theories. In consequence of this, one has to adopt an historical or dynamical standpoint in order to fully understand the mechanisms by which scientific developments are driven.

In what follows we will have a closer look at three methodological aspects of theoretical change we regard as central to scientific progress, namely *relevance of empirical data*, *experimental methods* and *novel data*. In doing so, we will draw on two criteria of adequacy of the reconstruction of scientific practice. On the one hand, the most prevalent elements of scientific methodology necessary for understanding the development, namely evaluation and choice of theories should be included in any comprehensive account of science. On the other hand, a reconstruction of scientific practice and theoretical progress can be expected to shed light on the various methodological factors responsible for the truth-conduciveness of scientific methods and theories. Whereas the first criterion of adequacy seems to be unproblematic from any philosophical perspective, the second one clearly begs the question against antirealists of the empiricist brand. Swinburne, however, is in full accordance with the realist claim that science is in the truth business and that scientific progress is closely linked to the notion of truth-conduciveness. It therefore seems to be fair to pit the Swinburnian criterion of simplicity against the criterion of fit with background theories in regard of the question of how truth enters the scientific stage.

### 3.1 Central Aspects of Theoretical Change

#### 3.1.1 *Relevance of Empirical Data*

It can be shown by many examples from the history of science, and argued for on philosophical grounds, that a theory's confirmed empirical consequences do not speak in favour of the theory in question with equal force. Rather, pieces of empirical evidence considerably differ with respect to their confirming or disconfirming power, and scientists are well aware of the fact that most of the confirmed empirical consequences of theories do not have any importance for theoretical choices at all. The special relevance of some empirical data is typically measured in the light of accepted background theories. Take, for instance, the famous examples of light deflection by the sun and the precession of mercury's perihelion in the context of evaluating the trustworthiness of Einstein's theory of general relativity. The confirming data resulting from these phenomena have undoubtedly much more relevance to general relativity than many of this theory's other consequences, and they certainly do allow favouring Einstein over Newton precisely because they do not accord with the accepted theoretical background provided by classical physics.

Simplicity in Swinburne's sense, however, does not tell us anything of methodological interest about this feature of data and theory evaluation. It is rather fit with background theories in terms of plausibility or acceptability which elucidates the decisive role of what we already claim to know for how to deal with what we possibly should believe instead.

#### 3.1.2 *Experimental Methods*

In many sciences scenarios of theory choice are typically intertwined with the development and results of highly theory-laden experimental methods. In elementary particle physics, for instance, enormous theoretical as well as technical efforts are made for the production of particle detectors of various sorts in order to get reliable experimental results as to the confirmation or disconfirmation of the existence of postulated micro-entities. Moreover, it is of great importance for designing significant experiments to know about counter-effects which might distort the empirical data provided by the experimental apparatuses. With respect to these features of experimental method background theories play the decisive role. The design and control of experiments is to a very large extent dependent on what we already believe, especially about theoretical entities involved in the experimental setups. It is only by experiments thus theoretically guided, however, that reliable data are gained for the confirmation or disconfirmation of novel theoretical proposals. What is even more, theory choice scenarios characteristic for significant episodes of scientific progress usually do not

occur, unless novel data have been provided by means of experimental methods informed by background theories.

Again, it seems to be impossible or, at least, to lead to implausible contrivances, to reconstruct this salient aspect of theory change under the aegis of Swinburne's theory choice criterion of simplicity. None of the six facets of his concept of simplicity gives rise to the theoretically guided methods of experimental design mentioned above. Scientists willing to develop new instruments so as to explore a hitherto unknown part or region of reality would be at a loss, if they relied on the concept of simplicity instead of trying to understand the functioning of probably reliable experimental means on the basis of their theoretical knowledge.

### *3.1.3 Novel Data*

Finally, we do not see how Swinburne is able to capture the importance of so-called novel data as, for example, Galileo's observation of the phases of Venus in favour of Copernicus' heliocentric model of our planetary system. It is, however, relevant to recognize the decisive function novel data fulfil for theory choice scenarios. When it comes to the question of how such scenarios arise at all, and by what kind of reasoning they are motivated, one has to refer to novel data and their methodological role in experimental crucis. And novel data, in turn, lead our attention to the experimental methods stressed in the preceding paragraph, since it is only by means of such methods that novel data relevant for making decisions in theory choice scenarios can be provided.

Apparently, all three elements of theory change are entangled with each other in complex and intricate ways, and they all hinge on background theories already accepted in the scientific community. Background theories guide the development of experimental methods which, in turn, deliver novel data needed to choose between theory rivals. Novel data, again, very often induce theory choice scenarios in the first place. And theoretical proposals confirmed by novel data bring the dynamics of theory change to a full historical circle by providing themselves a new theoretical background in the light of which new experimental methods are developed and against which even newer theoretical proposals are evaluated.

## 3.2 Truth-conduciveness

Another aspect of theoretical change which is of major concern to any realist approach to progress in science and which we have not yet come to discuss, is the notion of truth-conduciveness. Again, it seems as if Swinburne's account of simplicity and its role for theory

choice does not give us any clue towards a deeper understanding of the aspect in question, i.e. provide us with insight in the mechanisms by which truth comes into the theoretical play and is approached ever closer through the historical development of science.

If, contrary to Swinburne's aprioristic likings, one is inclined to assume that by contingent historical reasons background theories are already approximately true, a model of how truth enters into experimental methods and of how new theoretical proposals get closer to the truth within modern science appears to be at hand. To be sure, bringing truth into play via the approximate truth of background theories is a thoroughly empirical manoeuvre, since it is by no means apriorily guaranteed, or made probable, that we have available true or truthlike theories. But as long as Swinburne fails to demonstrate that simplicity can be construed as a truth-conducive *a priori* criterion of theory choice, it seems by far more promising to investigate the historical factors of truth-conduciveness in science than to draw upon the notion of simplicity. At least Swinburne still owes us an *a priori argument* for the truth-orientedness of the theory choice criterion of simplicity.

#### 4 Conclusion

First, contrary to Swinburne's claims, there is little reason to believe that the theory choice criterion of fit with background theories can be reduced to the criteria of simplicity and yielding the data. If Swinburne's notion of background evidence is disambiguated by splitting it up into the notions of background theories and background data, it can be shown that the criteria of fit with background theories and of simplicity are equivalent with respect to actual theory choice processes although they clearly differ in meaning. At any rate, there seems to be no substantive relation of reduction between the two.

Second, the undertaking of adequately reconstructing theoretical changes in science seems to fail dramatically if simplicity is regarded as a key criterion of theory choice. If the criterion of fit with background theories is spelled out in terms of how plausible or acceptable are (1) empirical data with respect to their confirming power, (2) experimental methods with regard to their reliability, and (3) new theoretical proposals with regard to their truth, it is no longer reasonable to suppose that it can be reduced to, or even partly explained by, simplicity. On the contrary, it seems much more adequate to reconstruct theory choice scenarios along the lines of methodologically oriented plausibility or acceptability considerations.