

Scientific Realism, Adaptationism and the Problem of the Criterion

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Abstract Scientific Realism (SR) has three crucial aspects: 1) the centrality of the concept of truth, 2) the idea that success is a reliable indicator of truth, and 3) the idea that the Inference to the Best Explanation is a reliable inference rule. It will be outlined how some realists try to overcome the difficulties which arise in justifying such crucial aspects relying on an adaptationist view of evolutionism, and why such attempts are inadequate. Finally, we will briefly sketch some of the main difficulties the realist has to face in defending those crucial aspects, and how such difficulties are deeply related: they derive from the inability of SR to satisfyingly avoid the sceptical challenge of the criterion of truth. Indeed, SR seems not to be able to fill the so-called ‘epistemic gap’ (Sankey 2008). In fact, the epistemic gap cannot be filled in no way other than obtaining a criterion of truth, but such a criterion cannot be obtained if the epistemic gap obtains.

Resumo O Realismo Científico (RC) tem três características nucleares: (1) a centralidade do conceito de verdade; (2) a ideia de que o sucesso é um indicador fiável de verdade; e (3) a ideia de que a inferência para a melhor explicação é uma regra segura de inferência. Neste artigo mostraremos como alguns realistas tentam superar as dificuldades suscitadas pela justificação daquelas três características, à luz de uma concepção adaptacionista da evolução, e por que razão tais tentativas nos parecem ser inadequadas. Finalmente, descreveremos brevemente algumas das principais dificuldades que os realistas enfrentam quando defendem as três características mencionadas, e como tais dificuldades estão intimamente relacionadas: elas derivam da incapacidade do RC em evitar, de um modo satisfatório, o desafio cepticista do critério de verdade. O RC parece-nos ser, de facto, incapaz de superar o chamado ‘hiato epistémico’ (Sankey 2008). Na verdade, o hiato epistémico não pode ser superado sem a assunção de um critério de verdade, mas um tal critério não pode ser obtido se o hiato epistémico se verificar.

1. Scientific Realism

It seems to be fair to say that Scientific Realism (SR) has, at least in its mainstream formulations, three crucial aspects: 1) the centrality of the concept of truth, 2) the idea that success is a reliable indicator of truth, and 3) the idea that the Inference to the Best Explanation is a reliable inference rule. It is impossible to account here for all the realist positions which have been elaborated so far, but it is important to underline that there are several formulations of SR which are cast in different terms, and which are not based on all (or, any of) the aspects outlined above. For example, Devitt denies that SR has to be understood in terms of truth.¹ In what follows we will focus on what can be labeled a ‘standard’ realist position, i.e. a position which is based on all the three aspects described above, and our considerations will be limited to such kind of SR. Thus, throughout this article by ‘SR’ we will mean ‘standard scientific realism’.

1.1. Scientific Realism, Truth, and The No Miracle Argument

SR can be briefly described as the claim that our best scientific theories are true. As Saatsi and Vickers state: “scientific realists seek to establish a link between theoretical truth and predictive success.”²

The concept of truth is central for SR. For example, Giere states that: “virtually every characterization of scientific realism I have ever seen has been framed in terms of truth.”³

The most shared view of truth among the realists⁴ is that of *truth as correspondence*.⁵ For example, Sankey states that: “correspondence

¹ Devitt, 1997.

² Saatsi and Vickers, 2011, 29.

³ Giere, 2005, 154.

⁴ In what follows, for brevity, ‘realist’ will be used in place of ‘scientific realist’.

theories which treat truth as a relation between language and reality are the only theories of truth compatible with realism.”^{6, 7}

The main argument to sustain SR is the No Miracle Argument (NMA).⁸ The central idea of the NMA is that the truth of a scientific theory is the best, or the only scientifically acceptable, explanation of its empirical success.

The problem is that success seems not to be an adequate indicator for truth: it is not easy to support the idea that only truth can lead to success.⁹ In fact, claiming that the success of a theory is due to its being true would imply that such theory should not be radically modified over time or ever considered false. If only truth implies success, then there could not be a theory which is empirically successful and false. But the history of science seems not to allow us to support such a claim.¹⁰ Saatsi summarizes this line of reasoning in the form of a *reductio ad absurdum* as follows:

⁵ On the necessity for the realists to aim at a substantive theory of truth, and on the relation between such a kind of theory of truth and the correspondence view of truth, see Sher, 2004.

⁶ Sankey, 2008, 17.

⁷ Many positions have been elaborated on the issue of truth (see for a survey Burgess and Burgess, 2011). Thus, even if truth as correspondence seems to be the most widespread view among the realists, not any realist adopts such view. Here we will focus on correspondence, but some of the objections we will deal with can be formulated even with respect to other conceptions of truth.

⁸ Putnam, 1975; Psillos, 1999.

⁹ On why success is not a reliable indicator of truth see Wray, 2013. Against the claim that only true theories can account for novel predictive success see Stanford, 2000.

¹⁰ See, e.g., Laudan, 1981. Cf. also Worrall, 2008, 287: “The chief obstacles to this view [SR] are precisely those posed by the facts about theory-change in science. If we accept that earlier theories in the history of science were quite radically false and yet enjoyed striking predictive success, then it can scarcely be claimed that it would be a miracle if present theories enjoyed the success they do and yet were not even approximately true.” For a detailed analysis of a historical case of successful and false theory see Saatsi and Vickers, 2011. On the relation between success and truth see also Held, 2011.

(1) Assume that success of a theory is a reliable test for its truth. (2) So most current successful scientific theories are true. (3) Then most past scientific theories are false, since they differ from current successful theories in significant ways. (4) Many of these past theories were also successful. (5) So successfulness of a theory is not a reliable test for its truth.¹¹

It has been argued that it is unfair to claim that it is necessary to show that *only* the truth implies success, if we want to rely on success in order to claim for the truth of our successful theories. Indeed, success should be understood as a *good* indicator of truth in the same sense in which any indicator is taken to be ‘good’ in scientific practice, i.e. accordingly to its ‘rate of success’. In this perspective, the reliability of an indicator has to be cast in statistical terms.¹² If this approach is right, then it would be pointless to underline that there are some cases in which success has not been a good indicator of truth, because, on average, we nevertheless could claim that success is a good indicator of truth.

The problem with this approach is that in order to show that an indicator is ‘good’ we have to show that the rates of ‘false positives’ and ‘false negatives’ that it produces are both small.¹³ But to do that, we should construct four sets: that of the false positives, that of the false negatives, that of the true positives, and that of the true negatives. Comparing the dimension of each set with the totality of the theories considered, we could derive the different rates we are interested in. In the context we are dealing with, false positives are ‘successful but false theories’, false negatives are ‘true but unsuccessful theories’, true positives are theories that are both ‘true and successful’, and true negatives are theories that are both ‘false and unsuccessful’.

¹¹ Saatsi, 2005, 1089.

¹² Lewis, 2001.

¹³ Lewis 2001, 374-375.

There are two main problems when trying to construct such sets: 1) the very notions of ‘false negative’ and ‘true negative’ are not clear at all in this context. For example, Saatsi states that: “I can make no sense of the idea of delineating a non-arbitrary, well-defined collection of *both false and unsuccessful* theories (...) or true yet unsuccessful”¹⁴; 2) in order to construct the four sets mentioned above, we have to determine in which set each theory has to be put, i.e. we should already know which theory is true. The fact is that in the ordinary clinical practice from which Lewis takes the analogy between empirical success and pregnancy tests, this can easily be done, because there are several ways of assessing the rate of success of the indicator we want to evaluate which are independent from that indicator (we can easily check how many times a pregnancy test has been successful without having to rely on that test). But when dealing with the debate on the truth of our best scientific theory, there is not a way of assessing the correctness of all the theories we are evaluating independent from our *best* theory. But we take our *best* theory to be *true* exactly because it is *the most successful*. As Wray states, in order to infer that our theories are likely true it is not sufficient to state that “*if* the false positive and false negative rates for our test are low, and *if* most of our current theories are successful,” then our best theories will likely be true, we “also need to know that most successful theories are true.”¹⁵ Thus, there is not an independent way of evaluating our indicator, i.e. there is not a way of justifying the claim that success indicates truth without circularly assuming that very claim.

This is a very debated issue, and cannot fully presented here, but this brief digression is just aimed at underlining that there is not an easy way to coherently develop and defend the intuitive idea that there is no need to defend the claim that only truth leads to success if we

¹⁴ Saatsi, 2005, 1096.

¹⁵ Wray, 2013, 1727.

want to maintain the realist claim that success is a good indicator of truth.

1.2. The NMA and the Inference to the Best Explanation

The importance of the Inference to the Best Explanation (IBE)¹⁶ for the realists is due to the fact that IBE is the kind of inference that, if valid, would allow the realists to derive the truth of the confirmed theory from the empirical success of such theory, i.e. to support the core tenet of the realist position.¹⁷ Whether an author accepts IBE or not has been considered to be roughly equivalent to whether she embraces realism or not.¹⁸ Indeed, the NMA can be described as an IBE.¹⁹

So, if to support SR the realists rely on the NMA, they have to face the problems related to the nature of IBE, i.e. to the nature of abduction, given that Harman states that the “inference to the best

¹⁶ Lipton, 2004. IBE is a kind of inference introduced by Harman, 1965, but already considered by Peirce (Kapitan, 1992, 2; Psillos, 2011, 128), which can be described as: “one infers, from the premise that a given hypothesis would provide a ‘better’ explanation for the evidence than would any other hypothesis, to the conclusion that the given hypothesis is true” (Harman, 1965, 89).

¹⁷ The relevance of IBE for the realists is widely recognised. Cf., e.g., Douven, 2002, 355, who states that: “defenses of scientific realism typically rely on Inference to the Best Explanation.”

¹⁸ Cf. Hitchcock, 1992, 151: “The principal link between the scientific realism debate and competing theories of scientific explanation is provided by a family of inference patterns which march under the slogan ‘inference to the best explanation’.”

¹⁹ Psillos, 1999. Frost-Arnold, 2010, 45, given that the basic form of IBE is:

(1) q is the best explanation of p

(2) p

(3) q

describes the NMA as an IBE in the way that follows:

(1) The (approximate) truth of mature scientific theories is the best explanation of their empirical success.

(2) Mature scientific theories are empirically successful.

(3) Mature scientific theories are (approximately) true.

explanation' corresponds approximately to what others have called 'abduction',²⁰ and that IBE can be seen as a generalization of abduction.^{21, 22}

Another relevant feature of this abductive realist line of reasoning is that it seems able to secure the reliability of the IBE abductively, relying on a sort of benign circularity. For example, Psillos states that: "It is transparent that the NMA has two conclusions," the first is that "we should accept as (approximately) true the theories that are implicated in the (best) explanation," and the second is that "since, typically, these theories have been arrived at by means of IBE, IBE is reliable (truth-conducive)."²³

²⁰ Harman, 1965, 88.

²¹ See Cellucci, 2013, § 18.7. Different positions on the relation between abduction and IBE have been adopted. Mackonis sketches the situation and presents his personal view as follows: "Some researchers do not conceptually discriminate between IBE and abduction or use the term 'abduction' as standing for IBE (Barnes 1995; Carruthers 2006; Douven 2011; Fodor 2000; Josephson and Josephson 2003; Niiniluoto 1999; Psillos 2002), but this stance is wrong: there is more to IBE than mere abduction. Some others argue that IBE and abduction are conceptually distinct (Campos 2009; Minnameier 2004; Hintikka 1998; McKaughan 2008), however, this stance is also an exaggeration: two concepts are indeed related. The most accurate description of the relation between IBE and abduction is to state that they overlap to some degree" (Mackonis, 2013, 976). We will follow Cellucci's view (2013).

²² It may be objected that Peirce stated the conclusion of abduction in the form: "Hence, there is reason to suspect that A is true" (Peirce, CP 5.189) and not "Hence, A is true." But it is important to underline that here we are dealing with abduction in relation to SR and to the realist view of abduction, and realists' aim is to claim for the truth, or the approximate truth, of the scientific theories. If realists consider abduction to be the inference rule normally used by scientists in their work (cf. Psillos, 2002, 605: "abduction, suitably understood as Inference to the Best Explanation, offers the best description of scientific method") and consider the product of scientists' work, i.e. the scientific theories, to be true, we can affirm that realists tend to see abduction and IBE as inferences to the truth. For example, Psillos states that: "It should be taken to be implicit in the realist thesis that the ampliative-abductive methods employed by scientists to arrive at their theoretical beliefs are reliable: they tend to generate approximately true beliefs and theories" (Psillos, 1999, xviii).

²³ Psillos, 2011b, 24.

To sum up, SR is centered on the concept of truth, and in order to support their main argument realists rely on success as an indicator of truth, and on a kind of abductive inference to infer from the success of a theory the truth of such theory.

So, two main goals for the realist are: 1) to secure the link between success and truth, and 2) justify the reliability of such inference.

2. Scientific Realism and Adaptationism

Some realists, let's call them: evolutionary realists, try to overcome the difficulties which arise in attaining the goals just mentioned (and some of such difficulties will be analyzed in section 3), relying on an adaptationist view of evolutionism. In this section it will be outlined why such attempts are inadequate.

2.1. Scientific Realism and Evolutionary Adaptationism

It is important to analyse the centrality of some realist assumptions in the adaptationist view of evolution, in order to underline the circularity of the realist's attempt to rely on such view to naturalize the human ability to produce knowledge. This attempt is in fact intended to secure the realist's confidence in the link between success and truth relying on evolutionary considerations. On the one hand, such an approach is motivated by the idea that a naturalistic stance should commit us with evolutionism,²⁴ and so, given that many

²⁴ Cf. Giere, 2006, 53: "If evolutionary naturalism is understood to be a general naturalism informed by the facts of evolution and by evolutionary theory, then no responsible contemporary naturalist could fail to be an evolutionary naturalist in this modest sense."

realists view themselves as naturalists, that SR should be compatible with evolutionism. On the other hand, such an approach is motivated by the difficulties the realist faces in justifying her claims, and by the idea that evolutionism may provide a solution to such difficulties.²⁵

2.2. Evolutionary Adaptationism

If a realist tries to naturalize knowledge through evolutionism, the position at hand is that of adaptationism.²⁶ Indeed, Evolutionary Adaptationism (EA) can be briefly described as the claim that natural selection is the only relevant cause of the evolution of a trait and that every relevant trait is an adaptation.²⁷ Being an adaptation means for a trait to be able to increase the fitness of the organisms which present such trait.²⁸ A strong correlation between adaptive traits and an increase of fitness is asserted by adaptationists: if a trait is individuated, then an increase of fitness due to such trait has to be measured, and if an increase of fitness is measured, then an adaptive trait has to be the cause of such increase.

2.3. Adaptationism and IBE

Adaptationism is deeply related to SR. First of all, who supports EA supports even the validity of IBE, given that abduction is the inference commonly used by adaptationists, and we have already seen that to accept the IBE almost amounts to embrace SR. For example,

²⁵ Thomson, 1995.

²⁶ De Cruz, 2007.

²⁷ Orzack and Forber, 2010; Lewens, 2009; Godfrey-Smith, 2001. Each of these claims has been contested, but the point here is to make clear why EA is so appealing for the realists.

²⁸ Cf. Resnik, 1989, 195: "An adaptation as a product is roughly anything that is the product of the process of adaptation (natural selection)."

Griffith calls the IBE the “adaptationist abduction.”²⁹ Secondly, IBE is evolutionarily justified by the adaptationists claiming that it is “plausible that the human brain was selected in part because of its capacity for and disposition to such inference [i.e. IBE],” given the “survival value of this disposition.”³⁰ Thus, as the realist in the case of the NMA, the adaptationist uses abduction in her arguments, and justifies the reliability of such inference abductively.

So, combining selectionism and functionalism in order to naturalize SR seems to many realist authors a coherent strategy:

The proper function of some mechanism, trait, or process in evolved organisms is ultimately relative to fitness, and the brain has as proper function the production of beliefs that are fitness-enhancing.³¹

But this is not sufficient to link adaptation and truth. Another step is necessary to achieve such goal:

The evolutionary argument (...) contends that natural selection will form animal brains that tend to produce true beliefs (...). Cognitive faculties that are widely off the mark would seriously compromise a creature’s ability to survive and reproduce.³²

So, in order to naturalize realism, to produce beliefs that are *fitness-enhancing* has to mean to produce *true* beliefs.³³

²⁹ Griffiths, 1996, 521. Resnik states that the adaptationists search for adaptationist explanation, “an explanation that hypothesizes that a given trait is an adaptation (the product of natural selection)” (Resnik, 1989, 196), and that in order to try to confirm such hypothesis they “practice what philosophers of science have dubbed ‘inference to the best explanation’” (Resnik, 1989, 201); Lewens states that “the method” of IBE is the “most favoured by many adaptationists” (Lewens, 2009, 179).

³⁰ Goldman, 1990, 39.

³¹ De Cruz and De Smedt, 2012, 413.

³² De Cruz and De Smedt, 2012, 416–417.

³³ There is a deep relationship between the evolved structure of the human brain and scientific knowledge, in fact “from an evolutionary perspective, science is a recent development in our species. Thus, scientists have to draw on the same cognitive resources as other people, and they are subject to the same cognitive limitations” (De Cruz, 2011, p. 205). So, those cognitive

We have reached the realist core of this view: the crucial premise of such view is that only true beliefs can be useful. Thus, given that only useful beliefs producers will be selected, because useful beliefs increase fitness, selection will retain only true beliefs producers.

2.4. Adaptationism and Truth

Stich has sketched this position as follows: “the argument seems to be that natural selection favors true beliefs, (...). So if an organism is the product of natural selection, we can safely assume that most of its beliefs will be true.”³⁴

This means to connect adaptation to success. And given that for the realist the success is related to the truth, this amounts to connect adaptation to truth.³⁵

The problem is that if we commit ourselves to claim that human cognitive structures are true beliefs producers because they have been selected for, and so that adaptedness implies truth, then we should be able to demonstrate that every cognitive adaptation is able to produce nothing else than (or at least mostly) true beliefs.

But this is not an easy task, because, as Stich, among others, has stressed,

resources have to be able to produce true beliefs in order to give us humans the ability to produce true scientific theories as SR claims.

³⁴ Stich, 2011, 83.

³⁵ The analogy between the concept of adaptedness and that of correspondence has been analyzed in Godfrey-Smith, 1998. Philosophers who have tried to naturalize intentionality have often proposed a theory of meaning based on the idea of a relation of correspondence between organic inner states and states of the world: “Correspondence as a property of thought, and adaptedness as a property of biological structure and behavior, are both apparently used in explanations of success” (Godfrey-Smith, 1998, 174); in such a view, correspondence is seen as “*a general-purpose fuel for success in dealing with the world*” (Godfrey-Smith, 1998, 172).

it is simply not the case that natural selection favors true beliefs over false ones. What natural selection does favor is beliefs which yield selective advantage. And there are many environmental circumstances in which false beliefs will be more useful than true ones.³⁶

The problem of connecting selection and truth is analogous to that viewed above of linking the truth of a theory to its empirical success. As the success cannot guarantee the inference to the truth of its (hypothesized) cause, so the survival is not able to discriminate among its possible causes.³⁷ So both success and survival are not reliable indicators of truth.

The realists face a dilemma: either they reduce their explanation to a vacuous tautology,³⁸ or accept that success is caused not only by true beliefs, but this would amount to dismiss realism,³⁹ at least to the extent that the empirical success of a theory is considered to be reliably related to its being true, so that we can safely infer the truth

³⁶ Stich, 2011, 83. See also McKay and Dennett, 2009. It may be objected that such kind of claims is self-defeating (e.g. De Cruz et al. 2011). This objection is discussed in Sterpetti, forthcoming.

³⁷ Goldman, 1990, 40, summarizes some of the difficulties that such a position has to face as follows: "That some cognitive capacity exists and serves useful functions does not show that it was selected; that it was selected does not show that it produces mostly true beliefs; that it produces true beliefs in one context does not show that it continues to do so in others".

³⁸ Cf. Downes, 2000, 435, who states that the risk is to claim that "successful action is guided by beliefs produced by a mechanism selected for to produce the kind of beliefs that produce successful action." Cf. even Godfrey-Smith, 1998, 188, who states that adaptiveness and fitness, like "correspondence (...)" are relations that appear, *prima facie*, to have a role in explanation of success. However, when people have tried to say more clearly what these properties are, they have often drawn so heavily on the relation between fitness and success that success has become partially constitutive of fitness or adaptiveness (...). So these properties have tended to lose their capacity to causally explain success."

³⁹ In fact, in an evolutionary scenario "the relevant notion of truth, (...), is truth that is instrumental in aiding survival in the short run and contributes to reproductive fitness. But this is no way to reconstruct the notion of truth on the standard [correspondentist] account. For the standard account to work, it requires an independent conception of truth and then an account of how this is related to selection" (Downes, 2000, 435).

from the success, which indeed is considered to be the main realist ‘intuition’.⁴⁰

It may be objected that the realists are not committed to the claim that only the truth leads to success, and that the evolutionary realists may easily account for the cases of selected false and useful beliefs. What they have to show is just that the *majority* of the selected beliefs are true. But, as Plotkin clearly states, the difficulty of linking ‘truth’ and ‘survival’ is not a matter of degree, because even “if it were only very rarely untrue, but the holders of the untruths survived and reproduced, that would be enough to nullify any foolish claim by evolutionary epistemology to overcoming the justification problem,” i.e. to support the claim that success is a good indicator of truth: in fact, only “if survival and reproduction are absolutely correlated with knowledge could they be an infallible guide to true belief,” but “this is not the case.”⁴¹ Thus we cannot safely rely on the success of some organism to assess the truth of such organism’s knowledge.

In order to avoid misunderstandings, it is worth specifying that here we are assessing the epistemological attempts made to naturalize SR through evolutionism, i.e. to justify SR relying on selection. We are not dealing with the cognitive and evolutionary issue of evaluating the truthfulness or the falseness of our evolved beliefs relying on our present scientific knowledge, which we deem to be true because of its success. An ‘evolutionary road’ to SR tries to show that we are able to produce true scientific theories because evolution gives us some sort of truth-tracking ability. Thus, if we take the evolutionary road we have to show that selection leads to the truth without relying on the truth of our scientific knowledge, otherwise our attempt would be plainly circular. From this perspective, it is selection which has to secure our ability in producing true science; it cannot be the truth of our science

⁴⁰ Worrall, 1989b.

⁴¹ Plotkin, 1997, 234.

that justifies our claim that the majority of the beliefs produced by our evolved cognitive systems are true.⁴²

It is important to take those two different approach distinct, because it is easy to confound them. This kind of confusion occurs when the evolutionary realists try to defend their position relying on some account of the ‘false but useful’ beliefs which tries to explain the evolutionary origin of our false beliefs taking for granted the truth of our knowledge, while they (the realists) should provide a justification of the fact that we are inclined to take for granted the truth of our science. For example, McKay and Dennett state that in

many cases (perhaps most), beliefs will be adaptive by virtue of their veridicality. The adaptiveness of such beliefs is not independent of their truth or falsity. On the other hand, the adaptiveness (or otherwise) of *some* beliefs is quite independent of their truth or falsity.⁴³

To give an example of an adaptive misbelief they refer to a supernatural belief, which may be advantageous even if it is *clearly* false. In this case, we can easily tell the true from the false from the point of view of our present science. Thus, we can easily determine which beliefs are useful and true, which beliefs are useful and false, and then try to give an evolutionary explanation of the latter. Moving along this line, McKay and Dennett are not compelled to justify their assumption that true beliefs are more conducive to usefulness and success than false beliefs, they simply take it for granted, and construct their examples from the vantage point of our present science. This is clearly a licit stance in trying to evolutionarily explain

⁴² On a similar point cf. Worrall, 1989a, p. 384: “Those who make the right inductions, those who base their actions on generalizations that have enjoyed predictive success had, and have, a selective advantage. This argument no doubt needs careful handling. But however carefully handled and however persuasive it can be made to seem, it is clearly circular. It is based on our belief in the correctness (or essential correctness) of Darwinian theory. But this in turn (...) is based on our methodological principles.”

⁴³ McKay and Dennett, 2009, 507.

misbeliefs, but has not to be confused with a licit epistemological justification of the evolutionary realist claim that true beliefs are more adaptive than false ones.

The fact is that also in the context of an evolutionary justification of SR, exactly as in the case of the inference from the empirical success of the theories to the truth we have seen above, we cannot reach an Archimedean point of view and assess whether the hypothesis that ‘only the truth leads to success’ is true or not. We can only rely on success. And we can safely compare some measures of success. But does this make the hypothesis that is the truth which explains the success more confirmed? The answer is in the negative. The point is that it is easy to mistake an increase in the success for an increase in the confirmation of the hypothesis that it is only the truth which can explain the success, exactly because we tend to implicitly assume that it is only the truth that leads to success. But as many other implicit assumptions we make, and notwithstanding how much this assumption about the truth seems evident to us, such assumption may be unreliable.⁴⁴

This point is related to the fact that referring to ‘truth approximation’ instead of referring to ‘truth’ is often considered to be sufficient to secure SR against the objections inspired by the theory change or by the falseness of some of our beliefs. According to this approach, some aspects of a theory may not be strictly true, but we can nevertheless claim that we are approximating the truth. The evidence for the fact that we are approximating the truth should be given by the increase in the success of our theory. But this approach rests on the assumption that an increase in success may be due only to an increase in the quantity of truth present in our theory. But, as

⁴⁴ Think, e.g., to Nozick’s (2001) position, according to which if we accept evolutionism we cannot state neither if what appears to us as self-evident and necessary is instead contingent, nor if it is (or has ever been) even true.

already noted, an increase in success may be due to an increase of truth only if only truth can lead to success. In other words, the more cautious formulation of SR, i.e. the ‘approximation-to-the-truth’ formulation, rests exactly on the same claim that ‘only truth can lead to success’ on which rests the straightforward formulation of SR, i.e. the ‘truth’ formulation. Thus claiming that our theories, or beliefs, are just approximation to the truth, does not solve the problem of justifying SR.⁴⁵

Let’s turn to the fact that many evolutionary realists face the objection that not only truth leads to success claiming that it is not difficult for them to account for some few false beliefs which are also useful, if the majority of the useful beliefs are true. The problem is that in order to construct the set of the false beliefs, that of the true beliefs, and then compare them, the realists have to already know which are the false beliefs and which the true ones. That is, the realists can avoid the objection based on the difficulty of inferring the truth from the success by claiming to be able to show that the set of the useful-and-true beliefs is greater than the set of the false-and-useful beliefs, and so that an inference from the success to the truth is justified at least in the majority of the cases. But to construct those sets they need to use exactly what they instead should ground. But if this would be possible, then we should admit that we already possessed a justified way to tell the true from the false beliefs. A realist approach should justify the tool it uses in discriminating the true from the false beliefs, and it should not use that very tool in doing it.

⁴⁵ We are not denying that our ability in coping with the world and in elaborating theories which are more successful than the previous ones is something that we have to try to explain. The point is assessing if the traditional solution is satisfying.

So, the only way to maintain an *evolutionary* realist perspective, and secure that success is implied *only* by true beliefs, is to *presuppose* such a realist connection.⁴⁶ For example, Millikan states:

Assuming that the capacity to form and to use beliefs has survival value mainly in so far as the beliefs formed are true (...), and *assuming that* humans currently have this capacity in part because, historically, having it had survival value, the mechanisms in us that produce beliefs, (...) all have in common at least one proper function: helping to produce true beliefs.⁴⁷

Thus, realists can succeed in naturalizing knowledge through EA only because EA assumes realism among its premises, and adding to EA another crucial realist premise, i.e. that only true beliefs can increase fitness.

3. Abduction, Truth, and the Problem of the Criterion

In this section, we will be briefly sketch some of the main difficulties the realist has to face in relation to each of the crucial aspects of SR outlined in section 1, and how such difficulties are related. Such difficulties may in fact be re-conducted to the inability of SR to satisfyingly avoid the problems deriving from the sceptical challenge of the criterion of truth.

3.1. Abduction and the Production of True Hypotheses Problem

As stated above, IBE is considered by realists a valid inference and is also commonly seen as an ampliative inference, in some way similar

⁴⁶ On the fact that in such kind of argument the claim that only true beliefs can be useful may only be assumed, cf. Sage, 2004.

⁴⁷ Millikan, 1984, 317, italics mine.

to induction. IBE is also generally considered to be related to abduction.

The problem is that some author has (convincingly) claimed that abduction is neither ampliative, nor truth-preserving.⁴⁸

For example, analyzing the way normally inference rules are classified,⁴⁹ Cellucci states that abduction is: 1) neither ampliative; 2) nor truth-preserving:

$$(ABD) \frac{B \rightarrow A \quad A}{B}$$

In fact, with regard to 1): “conclusion B is a subformula of the major premise $B \rightarrow A$, and so is already contained in it.” With regard to 2): “if A is true and B is false, then $B \rightarrow A$ is true, so both premises of (ABD) are true but the conclusion B is false”⁵⁰; so abduction cannot be considered neither ampliative nor truth-preserving.

Indeed, “what generates new information is not (ABD), but rather the process that yields its major premise, $B \rightarrow A$, thus something prior to (ABD)”.⁵¹ This line of thought goes back at least to Frankfurt, who states:

⁴⁸ We put aside here the other criticisms that have been already moved to IBE and focus on Cellucci’s one for two reasons: 1) there is an enormous and well known literature on the former; 2) Cellucci’s criticism to IBE is different from the others criticisms already moved to IBE because these are, normally, at their turn committed to some concept of truth and to the deductivist view, which considers deductions as justified. Cellucci’s work, instead, not only denies that abduction is ampliative, and denies a pivotal role to the concept of truth, but also shows that the asymmetry between deductive inferences/justified and non-deductive inferences/unjustified is untenable (Cellucci, 2006).

⁴⁹ Cellucci sees abduction as a counterexample to the standard classification of inference rules, given that “(ABD), on the one hand, like deductive rules, is non-ampliative, and, on the other hand, like non-deductive rules, is not truth preserving” (Cellucci, 2013, § 18.2).

⁵⁰ Cellucci, 2011, 124.

⁵¹ Cellucci, 2013, § 18.2.

Clearly, if the new idea, or hypothesis, must appear in one of the premisses of the abduction, it cannot be the case that it originates as the conclusion of such an inference; it must have been invented before the conclusion was drawn.⁵²

So, what really contributes to the ampliation of knowledge occurs *before* abduction and cannot be described as an abduction, because it is beyond our rational control, i.e. it is beyond logic:

Our first premisses, (...), are to be regarded as an extreme case of abductive inferences, from which they differ in being absolutely beyond criticism. The abductive suggestion comes to us like a flash. It is an act of *insight*.⁵³

So, the ampliative process of hypothesis production is distinct from abduction and is not describable by abduction as an inference rule, because “it is sub-conscious and so not amenable to logical criticism”,⁵⁴ while “reasoning is deliberate, voluntary, critical, controlled, all of which it can only be if it is done consciously.”⁵⁵ For example, Kapitan states that in “strict Peircean terms, the emergence of hypotheses is not a matter of inference and, therefore, not a matter of a unique form of inference.”⁵⁶ Many authors try to solve this puzzle by adding *something* to the Peircean scheme of abduction, in order to account for what they call ‘the creative side’ of abduction,⁵⁷ and try to avoid that abduction may be considered nothing more than the fallacy of affirming the consequent.⁵⁸ For example, Schurz analyzes and

⁵² Frankfurt, 1958, 594. Peirce himself writes that “A cannot be abductively inferred, or if you prefer the expression, cannot be abductively conjectured until its entire content is already present in the premiss” (Peirce, CP 5.189) [note that in Peirce’s text ‘A’ corresponds to ‘B’ in the formula given above].

⁵³ Peirce, CP 5.181.

⁵⁴ Peirce, CP 5.181.

⁵⁵ Peirce, CP 2.182.

⁵⁶ Kapitan, 1992, 8. Cf. Hoffmann, 1999, 278: “the logical form for itself leaves the question unanswered how to get the hypothesis.”

⁵⁷ Cf., e.g., Aliseda, 2006; Magnani, 2009; Hoffmann, 1999.

⁵⁸ Magnani, 2009, 15.

classifies different kinds of abduction.⁵⁹ When he comes to the more creative rather than selective patterns of abduction, it is easy to see that what he is doing is incorporating some other ampliative inference rule, such as induction or analogy, in the supposed first stage of abduction, i.e. that of the hypothesis production. This is transparent, for example, in § 6.2, where he analyzes what he calls ‘analogical abduction’, i.e. an abduction in which the hypothesis has been produced by analogy. But at this point it is not clear why we should continue to talk of ‘abduction’, and refer to Peirce, if the process of hypothesis production can be described by different rules and it is itself not abductive. The so-called ‘creative’ part of abduction is clearly not an abduction. This confirms that abduction is not ampliative.

So, following Peirce, we should *presuppose* that humans are able to (unconsciously) produce hypotheses which in some way are likely to be true.⁶⁰

How could we account naturalistically for the human ability to (unconsciously) produce true hypotheses? The answer could seem to be, *prima facie*, referring to evolution:

A *naturalistic* basis means that Peirce likens abductive instinct to those instincts that animals possess for getting food and reproducing (...). If animals have innate tendencies that help them to survive in their environments, why not to assume that we as human beings have analogously innate tendencies for finding correct theories? This kind of an instinct would obviously have strong adaptive value for us.⁶¹

⁵⁹ Schurz, 2008.

⁶⁰ Cf. Peirce, CP 7.220: “the existence of a natural instinct for truth is, after all, the sheet-anchor of science.” Cf. also Anderson, 1986, 152: “For Peirce, however, because abduction is not a matter of pure chance, science is understandable. As Rescher says, ‘Peirce insists that trial and error cannot adequately account for the existing facts’.”

⁶¹ Paavola, 2005, 134.

The problem, as already seen above, is exactly that that adaptive beliefs have to be true beliefs can be either postulated or supported by an abductive argument.

So, trying to naturalize abduction and show that abduction is reliable in finding true hypotheses relying on an evolutionary account of abduction which endorses an adaptationist view of evolution, which at its turn assumes the validity of abduction, would be circular.

3.2. Truth and the Problem of the Criterion

As we have already seen, the concept of truth realists usually are committed to is that of truth as correspondence. This is the most widely accepted concept of truth, but nevertheless it is elusive. For example, Bunge states that “everyone uses the correspondence concept of truth, but nobody seems to know exactly what it is.”⁶²

The problem for the realist derives from the divide that exists between the conception of truth she adopts and the epistemic optimism that characterizes SR. In fact, given that: 1) the usual definition of knowledge realists assume is that of ‘justified true belief’;⁶³ and that 2) truth is intended as a mind-independent correspondence to the world, it can be stated that the “realist conception of truth is a non-epistemic conception of truth, which enforces a sharp divide between truth and rational justification.”⁶⁴

⁶² Bunge, 2012, 74.

⁶³ Cf. Sankey, 2008, 14, n. 2: “the traditional justified true belief account of knowledge is a minimal condition for a realist conception of knowledge.” The problem of providing an effective criterion, which emerges in relation to the concept of truth, emerges also in relation to the concept of knowledge, cf. Sankey, 2008, 101: “The justified true belief analysis of knowledge provides a set of conditions, satisfaction of which qualifies a subject as having knowledge. It does not provide criteria which enable a subject to recognize that those conditions obtain, and is thereby in possession of knowledge.”

⁶⁴ Sankey, 2008, 112. Cf. also Sankey, 2008, 16: “It is important to note that there are a number of alternative theories of truth which contrast with the

But this means that the concept of truth normally endorsed by realists is intrinsically unable to provide a *criterion* of truth, i.e. a tool to determine the truth of a given statement: given “the non-epistemic nature of truth, there is no logical relation between method and truth.”⁶⁵ This is obviously a problem for SR, given that SR maintains that our best scientific theories are true, and that it is through the scientific method that scientific theories are developed, evaluated, and selected.

In fact, SR, while denying the relation between method and truth, is at the same time “a position of epistemic optimism, which holds against the sceptic that humans are able to acquire knowledge of the world.”⁶⁶ So, the problem for the realist is to show how the scientific method can lead to the truth and fill the epistemic gap, i.e. to solve what Sankey has called ‘the problem of method and truth’.⁶⁷

The main difficulty is that to solve such problem amounts to solve what has been called since antiquity ‘the problem of the criterion of

correspondence theory of truth. (...). According to such theories of truth, truth is a property which a belief or statement may have in virtue of some epistemic property of the belief or statement. (...). Because such theories of truth identify truth with an epistemic property of belief, they are sometimes called ‘epistemic theories of truth’.”

⁶⁵ Sankey, 2008, 112. Cf. also Sankey, 2008, 112: “On the realist conception of truth, truth is a relation of correspondence that obtains between statements and mind-independent states of affairs that obtain in the world. (...). Thus, truth depends solely on the way the world is, (...). As such, no epistemic condition enters into the realist conception of truth.”

⁶⁶ Sankey, 2008, 112. In fact, those authors, as Laudan and van Fraassen, who support a non-epistemic concept of truth and deny that we can fill the epistemic gap between method and truth, are labeled by realists ‘scientific sceptics’ (Sankey, 2008, 116). On the realists’ epistemic optimism, cf. Sankey, 2008, 34: “it would be perfectly consistent for the scientific realist to refrain from any positive epistemic commitment to the truth or progressiveness of science. (...). But realists typically do not adopt such a sceptical attitude toward science. They typically support a stronger epistemic thesis to the effect that science has made progress toward the truth, and, in so doing, has produced genuine knowledge about the objective world.”

⁶⁷ Sankey, 2008.

truth'.⁶⁸ A simple argument which brings a very hard challenge, at least for the realist.⁶⁹

The main feature of the argument of the criterion is that it is built up in such a way to force the opponent in one of three alternatives,⁷⁰ each of which is considered to be able to show that the opponent's claim is untenable.⁷¹ The idea is that through such argument is possible to show how a claim is not really justified in the way its proponent pretends that it is.

Indeed, the argument of the criterion forces the opponent to assent that its claim is justified: 1) circularly; 2) just assumed and not justified; 3) justified referring to some other claim, and that this leads to an infinite regress.⁷²

⁶⁸ See Cling, 1997, 1994; Floridi, 1994, 1993; Chisholm, 1982; Sankey, 2012, 2011, 2010. The problem of the criterion of truth is the ancient sceptical paradox of the wheel: "in order to know any proposition we must first know a criterion, but in order to know a criterion we must already know some proposition" (Cling, 1997, 109).

⁶⁹ See Cellucci, 2013, § 18.19; Chisholm, 1982. On the relevance of such problem, cf., e.g., Chisholm, 1982, 61: "The problem of the criterion' seems to me to be one of the most important and one of the most difficult of all the problems of philosophy" and Rescher, 2003, 22: "It is difficult to exaggerate the significance of this extremely simple line of reasoning."

⁷⁰ Cf. Floridi, 1993, 207: "It is a combination of Agrippa's second, fourth and fifth tropes, i.e. *regressus*, *hypothesis* and *diallelus*."

⁷¹ This is a debated issue, which cannot be developed here, see, e.g., Cling, 2003, on circularity, Cling, 2004; Alston, 1989; Klein, 1999, on infinite regress, Betz, 2010, on *petitio principii*.

⁷² Cf. Sextus Empiricus, 1976, II.2: "[...] in order to decide the dispute which has arisen about the criterion, we must possess an accepted criterion by which we shall be able to judge the dispute; and in order to possess an accepted criterion, the dispute about the criterion must first be decided. And when the argument thus reduces itself to a form of circular reasoning the discovery of the criterion becomes impracticable, since we do not allow them [the dogmatics] to adopt a criterion by assumption, while if they offer to judge the criterion by a criterion we force them to a regress *ad infinitum*. And furthermore, since demonstration requires a demonstrated criterion, while the criterion requires an approved demonstration, they are forced in circular reasoning."

Here we cannot account for the attempts which have been made to solve the problem of the criterion,⁷³ but it will suffice to underline how SR seems not to be able to offer a justification of its claims about truth and knowledge which can face the challenge of such argument.⁷⁴

The reason lays in the concept of knowledge that SR adopts. If knowledge is related to the truth, then SR cannot avoid or face the problem of the criterion, given that the concept of truth as correspondence does not provide an adequate criterion of truth.

Indeed, the 'standard' realist approach to the problem is making reference to Tarski's work. For example, Ruttkamp states that truth "is a semantical relation between language and reality. Its meaning is given by a modern (Tarskian) version of the correspondence theory."⁷⁵ But the inadequacy for SR of a merely semantic treatment of the issue of the concept of truth is clearly stated by Sankey, when he analyzes the relation between the tarskian T-scheme and the most widely adopted theories of truth.⁷⁶ For Sankey, the correspondence theory of truth is obviously compatible with the T-scheme, but the latter is not sufficient to clarify the concept of truth that SR needs.⁷⁷ Something

⁷³ The issue has been set in its actual form by Chisholm, 1982. Cf. Cling, 1994, 232: "Chisholm says that there are only three possible responses to this problem: (i) adopt skepticism, (ii) claim to have an answer to 'how are we to decide whether we know?' and use it to answer 'what do we know?' (methodism), or (iii) claim to have an answer to 'what do we know?' and use it to answer 'how are we to decide whether we know?' (particularism)."

⁷⁴ This does not mean that we have to embrace scepticism, but that SR is probably not the right way of accounting for scientific knowledge. In fact, until SR is maintained, and so it is the traditional account of truth and knowledge, knowledge is unattainable by humans, and so the sceptical arguments are unavoidable. On this, cf. Cellucci, 2013.

⁷⁵ Ruttkamp, 2002, 177.

⁷⁶ Cf. Sankey, 2008, 49: "the T-scheme is common ground to all the standard theories of truth. The disquotational, pragmatic, coherence, internalist, verificationist and correspondence theories of truth all agree that truth, *whatever it is*, must conform to the T-scheme."

⁷⁷ Cf. Sankey, 2008, 111: "Since a statement is true just in case the state of affairs to which it corresponds obtains, the correspondence conception satisfies the equivalence condition specified by Tarski's T-scheme:

more than a mere *definition* of truth is needed to provide a criterion of truth. In fact, Tarski's scheme does not give us a criterion to tell the true from the false,⁷⁸ nor it is able to connect "language and reality", because, as Bunge states,

It does not contrast language, or rather its epistemic designatum, with extralinguistic reality – which is what 'correspondence' is supposed to mean. Indeed, Tarski's formula just bridge a bit of language (...) to a bit of metalanguage.⁷⁹

Moreover, Cellucci has convincingly shown that not only the concept of truth as correspondence cannot provide a realist criterion of truth, but that the most important conceptions of truth that have been proposed until now are inadequate as a criterion of truth,⁸⁰ and that to provide a criterion of truth is indeed necessary in order to support a realist conception of science:

If the goal of science is truth and, on the other hand, a concept of truth does not provide a criterion of truth, we will generally be unable to determine whether a given sentence is true or false. Then, (...) the goal of science cannot be generally achieved because it transcends human capacities.⁸¹

(T) 'P' is true if and only if P.

While the T-scheme is not a definition of truth, it provides a minimal condition of adequacy that must be satisfied by any account of truth."

⁷⁸ It is worth noting that Tarski states that a "criterion" of truth "will never be found" (Tarski, 1944, 363–364), and that there is no point in complaining that the concept of truth as correspondence does not provide a criterion of truth, since the concept of truth as correspondence "is not designed at all for this purpose" (Tarski, 1969, 69). On this point see Cellucci, 2014.

⁷⁹ Bunge, 2012, 66.

⁸⁰ Cellucci, 2014, 2013. More precisely, Cellucci, 2014, analyses the following concepts of truth: 1) truth as correspondence, 2) truth as intuition of the essence, 3) truth as consistency, 4) truth as systematic coherence, 5) truth as possession of a model, 6) truth as provability, and shows that they are all inadequate as a criterion of truth.

⁸¹ Cellucci, 2013, 152–153.

But if “truth is humanly transcendent, we will generally be unable to recognize a truth when we reach it, therefore we will be unable to say that we have acquired knowledge of the world through it.”⁸²

But this would obviously be at odds with realist’s epistemic optimism. In fact, SR needs not only a definition of truth as correspondence, but a way of showing that the correspondence such defined between the theory and the world actually occurs, it needs a tool to tell the true from the false,⁸³ i.e. a criterion of truth.⁸⁴

It may be argued that we have not to be realist about a whole theory, and that we could *select* the parts of a theory we intend to be committed to. The problem is how to ‘carve’ the theory we are interested in and determine which are its ontologically relevant parts. We should be able to discriminating which elements were indispensable in order for the theory to give accurate predictions and

⁸² Cellucci, 2014, 4.

⁸³ For example, Rescher states that in “characterizing a claim as true, we indicate that what it states corresponds to the facts, so that its assertion is in order. But while this factually (‘stating which is the case’, ‘corresponding to the facts’) is what truth is all about, we cannot apply or implement it as such: it does not provide a basis on which the truth of claims can be determined” (Rescher, 2003, 146–147. Cf. also Munz, 1993, 177: “it is comparatively easy to arrive at a concept of truth. But as soon as one seeks to define the precise criteria by which one can determine whether any particular statement is true or not, one is confronted with an array of possibilities, none of which are satisfactory.”

⁸⁴ On the features such a criterion should have, cf., e.g., Cling, 1997, 110–111: “An ideal criterion would express a reliable and complete touchstone of truth: a mark or sign by which we could distinguish true from false propositions on any topic. Having such a criterion is not the same as grasping the meaning of ‘true’, for we might understand what it would be for a proposition to be true without being able to tell the true from the false. To have a criterion of truth is to grasp that some detectable property other than the property of being true would correctly distinguish true from false propositions. Thus we may think of an ideal criterion of truth as a principle according to which a specified property *C* is such that *C* is not part of the meaning of ‘true’, but a proposition *P* would have *C* (in the appropriate circumstances) if, and only if, *P* were true. Ideally, then, a criterion of truth would provide us with a perfectly reliable indicator of truth and of falsehood.”

take only those indispensable elements as existing. The problem is that we can do this kind of evaluation only in relation to our *past* theories and from the point of view of our *present* best theory.⁸⁵ The risk is that our explanation of the success of the past theories make explicit the positive contribution to the empirical success of the past theories only of those elements which have been retained and passed in the new theory. There could be other parts of the theory which were 'indispensable' to reach the predictions but that now we judge as irrelevant, and there is the possibility that some of the elements which we now judge as indispensable and relevant will be discarded in the future. Thus, our judgement on what exists could be based only on the similarity between certain parts of the past theory and certain parts of the new theory. In order to claim that this similarity tells us what exists we should be able to defend the claim that our present theory *is* true. But we can do that only relying on success. The problem, again, is how to justify the claim that success is due to the truth.

It may also be objected that we should intend a criterion not as a tool able to tell the true from the false, but just as an *epistemic norm* aimed at justifying a belief, whose satisfaction does not entail the truth of the justified belief. Thus, a criterion may be satisfied and the belief which satisfies such a criterion may nevertheless be false. Our criterion would be fallible, and we could account for the distinction between truth and justification.

The problem is that in any case SR aims at the truth. But if we do not have a tool to state with certainty whether something is true or not, we will never be able to know whether we have reached the truth or not. Moreover, normally the realists maintain that science arrives at truth thanks to its *method*. Scientific method is what makes a belief *justified*. Thus, if method is related to the justification, and the realists

⁸⁵ Stanford, 2000.

take the method to be truth-conducive, this means that, in a realist perspective, justification cannot be taken to be *really* so distinct from the truth. For example, Sankey states that the questions “about the relation between method and truth divide scientific realism from anti-realism in the philosophy of science,” since they are “questions about the truth-conduciveness of method. While they relate directly to the epistemic status of method, they bear indirectly on the nature of rational justification. For if use of method conduces to truth, then, given the relation between method and justification, the warrant provided by method is warrant with respect to truth.”⁸⁶ In this perspective, an epistemic norm is equivalent to a criterion of truth:

Sextus Empiricus (...) speaks of a ‘criterion of truth’ that is used to ‘judge of reality and non-reality’ (...). Since an epistemic norm is used to justify belief, and since belief involves belief in the truth of the content of the belief, an epistemic norm plays the same role as a ‘criterion of truth’.⁸⁷

But if a criterion of truth does not entail the truth of the belief which satisfies it, then in what sense should it be defined as a *criterion* of truth? If something can satisfy a criterion of truth and at the same time not to be true, then such a criterion is simply not a real criterion of truth. Thus, it is not easy for the realists to avoid to face the problem of the criterion.

In order to solve such a puzzle,⁸⁸ Sankey adopts what he calls ‘abductive realism’, i.e., while “the success argument is usually employed to argue for the approximate truth of theories,” he would “extend the argument to the truth-conduciveness of rules of method.” But the difficulty of providing a criterion of truth cannot be avoided or

⁸⁶ Sankey, 2008, 109.

⁸⁷ Sankey, 2012, 5, fn. 1.

⁸⁸ Cf. Sankey, 2008, 118: “the attempt to combine a naturalistic account of epistemic warrant with the realist view of truth as the aim of science must face the problem that no empirical evidence may show directly or conclusively that use of a methodological rule yields theoretical truth.”

solved by such abductive approach: “The point is not that satisfaction of methodological rules constitutes truth. The point, rather, is that satisfaction of methodological rules is best explained by truth.”⁸⁹

Again, what at its most SR can offer to support its strong claims about truth and reality is a sort of NMA. The truth cannot reliably be inferred from the success of a theory, but the truth of such theory can be proposed as the best explanation for its success. But this move does not really explain anything at all, given that such an explanation is based on the *assumption* that ‘only truth can explain success’, but no ground is given for such assumption.

This line of reasoning seems to be symptomatic of the fact that SR cannot ground its claims on other than success. And cannot do this if not abductively. There is no way of justifying the belief in the truth of the theoretical statements other than relying on success. And there is no way of inferring the truth of theoretical statements from success other than relying on abduction. And there is no way of justifying abduction other than abductively.

But: 1) success is not an adequate criterion to discriminate *only* the true theories; 2) abduction is neither an ampliative, nor a truth-preserving inference, thus it cannot be said to be a *reliable* inference; 3) a circular justification of abduction is not sufficient to make abduction a reliable inference, because rule circularity is not a benign sort of circularity.^{90, 91}

⁸⁹ Sankey, 2008, 107.

⁹⁰ Many realists (e.g., Psillos, Sankey, Ellis) claim that some circularity is not dangerous and can be accepted. Contrary to such position, at least in the context of the justification of the inference rules, cf. Cellucci, 2006, 210–211: “That there is something basically wrong with rule-circularity appears also from the fact that, if to prove the validity of a rule of inference of deductive logic one is entitled to use that very same rule, then some invalid rule can be proved to be valid. For example, consider the *abduction rule*, that is, the rule:

$$(\text{Abd}) \frac{B \quad A \rightarrow B}{A} .$$

So it seems that there are just two ways to try to warrant the realist's epistemic optimism.⁹² The first is to justify our epistemic abilities referring to evolution, but this leads to a sort of circularity. The second is to take for granted a metaphysical framework which allows to warrant the realist's claims, but this amounts to presuppose what should instead be derived.

The first way is that proposed, e.g., by Sankey. Indeed, Sankey is aware that even "if it is granted that realism is the best explanation of the success of science, it does not follow that it is to be accepted as true." So, he tries to provide a naturalized account of our epistemic

Using Abd one can give the following formal proof of the validity of Abd:

$$\begin{array}{c}
 \text{TT } (\rightarrow) \frac{T(A \rightarrow B) \quad T(B)}{T(A \rightarrow B) \rightarrow T(B)} \quad \frac{\text{TT } (\rightarrow)}{T(A) \rightarrow (T(A \rightarrow B) \rightarrow T(B))} \\
 \text{(Abd)} \frac{\quad}{T(A)}
 \end{array}$$

It is no use to object that this proof does not provide a justification of Abd since, while the proof of the validity of MP uses MP, which is valid, this proof uses Abd, which is invalid. For to justify the validity of MP is just what is at issue."

⁹¹ The problem of the criterion of truth and that of justifying and classifying inference rules are related: there is no way to justify an inference rule avoiding circularity (Cellucci, 2006, *contra* Howson, 2000, shows that neither in the case of *Modus Ponens* an inference rule can be demonstrated to be non circularly justified), and there is no way to state an adequate criterion of truth: "If we interpret 'criterion of truth' as 'inference rule', Sextus Empiricus' argument becomes: Those who profess to validate an inference rule are bound to have some inference rule to validate it. Now this inference rule either is not validated or has been validated. If it is not validated, then it cannot be trusted, for no matter of dispute is to be trusted without being validated. If it has been validated, the inference rule used to validate it, in its turn, either has been validated or has not been validated, and so on *ad infinitum*" (Cellucci, 2013, 310).

⁹² Another way may be to follow the 'particularist' approach to the problem of the criterion sustained by Chisholm, 1982, and claim that the optimistic assumption needs not to be justified, and that it is sufficient to provide some case of knowledge we know to be true to support the realist optimism. But such attempt has been already analysed and criticized, and seems not so promising. On this see Cling, 1994.

abilities.⁹³ In fact, he states that “the naturalistic realist may treat the problem of knowledge as the broadly empirical problem of explaining how cognitive agents embedded in the natural world are able to use their epistemic capacities to promote their survival.”⁹⁴

The problem is that Sankey *assumes* the idea that only true beliefs may promote the survival, and so that if our epistemic abilities have been selected, they cannot but produce true beliefs, otherwise we would have become extinct.⁹⁵

Thus, for him the empirical problem of explaining how our epistemic capacities may promote the survival is solved relying on the concept of truth.

The problem is that we started from the difficulty of giving a criterion of truth and justify the adoption of a correspondence theory of truth. So, it is the concept of truth that should be secured empirically, and not an empirical problem that should be explained referring to the truth.

Moreover, in supporting his claim that only true beliefs may promote the survival, Sankey explicitly refers to the proposals of Rescher (1977) and Kornblith (1993). Details of such proposals are not relevant here, but what is worth noting is that both these authors connect our human epistemic abilities to evolution, and that in their proposals it is implicitly assumed the key assumption of

⁹³ Sankey, 2010, explicitly refers to the problem of the criterion and tries to combine the two traditional responses to the problem, i.e. the ‘particularist’ and the ‘methodist’ (see above note n. 59). In fact, he maintains a particularist stance following Chisholm, 1982. But, given that he acknowledges that Particularism begs the question against the sceptic and that it may be not extended to face the relativist’s challenge, he tries to solve this problem giving “a naturalistic account of epistemic warrant,” which is very similar to the methodist proposal given by Rescher, 1977.

⁹⁴ Sankey, 2008, 8.

⁹⁵ Cf. Sankey, 2010, 14: “epistemic norms which lead us systematically astray in our beliefs about the surrounding environment will inevitably give rise to frustration, harm or even death.”

adaptationism we have already seen above, i.e. the connection between adaptive success and truth, which allows them to derive from the selective process the justification of the truth-conduciveness of the products of our evolved abilities. In other words, such attempts, as that of Sankey, implicitly assume exactly what they are supposed to be able to naturalize. So, Sankey's attempt is circular.

The second way is that proposed, e.g., by Ellis (2009). If the relation of correspondence cannot be secured epistemically, it can be metaphysically postulated. Ellis adopts a correspondence theory of truth, and tries to connect it to a truth-makers theory. He, as Sankey, strongly underlines the importance of the mind independence of truth for SR. Ellis doesn't think that the epistemic gap can be filled by the scientific practice. For him, to support metaphysical claims such as realist's, what is needed is a metaphysical framework. Such a metaphysical framework should define what exists in the world in order to decide if a statement is made true by the world or not. This obviously amounts to presuppose what a scientific realist should instead derive.⁹⁶

Indeed, there is no problem in defining the truth as a correspondence to the world, and in stating that a statement is made true by the world. The problem is *how* to provide a criterion which is able to ascertain *if* the world actually makes true a given statement, especially in the context debated here, i.e. SR, whose characterizing

⁹⁶ On the circularity of his approach, cf. Ellis, 2009, 19: "Metaphysical necessitation is the relation that holds between things in the world and the things they make true. That is, it is what is usually called a 'semantic relation'. (...). The concept of plausibility that we require to define semantic relations all depend our general metaphysics, that is, our theory of the ultimate nature of reality. And, for such a theory to be adequate, it must be consistent with our best understanding of the world, and able to accommodate all of the things we truly believe in. This is a logical circle, of course. But it is inescapable. A postulated existent is ontologically plausible if and only if it fits into an adequate metaphysical theory. And a metaphysical theory is adequate if and only if it accommodates all of the things that we truly believe in."

claim is the belief in the truth of the theoretical, i.e. unobservables, parts of scientific theories. How could we identify the truth-maker of a theoretical statement, in order to state that it makes true such theoretical statement, if what we rely on to believe in the existence of what such theoretical statement refers to is just the success of the theory such theoretical statement belongs to?

The scientific realist can try to avoid the ambiguities related to the linguistic formulation of the theories of truth, and support a truth-makers conception of the relation between theories and the world. The problem, again, is that the relation of correspondence cannot be shown to actually occur between the theory and the world, but just between the theory and a 'plausible' metaphysical framework which tries to describe the world. Moreover, the way in which this framework is developed is abductive, as clearly emerges from Ellis' own words: "A necessitation relation is metaphysical if the proposition p whose truth is to be explained is made true by some objectively existing thing or state of affairs X ." But how to identify or determine such X ? We have to "specify an X such that (a) X could plausibly exist, and (b), if X were to exist, then p would have to be true." Obviously, in order to specify such X , "*we must have some prior views about the nature of reality.*"⁹⁷

So, there is no way to avoid to support realist's claims other than circularly or postulating exactly what she is wanting to demonstrate, and both these ways are unsatisfactory. In other words, the realists seem not be able to avoid the problem of the criterion of truth, given that they rely on truth, nor their attempts seem to be able to satisfyingly face such challenge, given that they lead to circularity or to a *petitio principii*.

⁹⁷ Ellis, 2009, 19-20, italics mine.

4. Conclusions

We have pointed out that three crucial aspects of SR are: 1) the centrality given to the concept of truth, 2) the idea that success is a reliable indicator of truth, and 3) the idea that IBE is a reliable inference rule.

We have then outlined how some realist tries to naturalize such crucial aspects relying on an adaptationist view of evolutionism, and why such attempts are inadequate.

Finally, we have briefly sketched the main difficulties the realist has to face in relation to any of such crucial aspects, and how such difficulties are deeply related. Such difficulties may in fact be re-conducted to the inability of SR to satisfyingly avoid the problems deriving from the sceptical challenge of the criterion of truth.

This is due to the tension between what the realist maintains about truth and what she maintains about knowledge. In other words, SR seems not to be able to fill the epistemic gap. In fact, the epistemic gap cannot be filled in no way other than obtaining a criterion of truth, but such a criterion cannot be obtained if the epistemic gap obtains.

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References

- Aliseda, A., 2006, *Abductive Reasoning*, Dordrecht, Springer.
- Alston, W., 1989, Epistemic Circularity. *Philosophy and Phenomenological Research*, 47, 1–32.
- Anderson, D.R., 1986, The Evolution of Peirce's Concept of Abduction. *Transactions of the Charles S. Peirce Society*, 22, 145–164.
- Betz, G., 2010, Petitio principii and circular argumentation as seen from a theory of dialectical structures. *Synthese*, 175, 327–349.
- Bunge, M., 2012, The correspondence theory of truth. *Semiotica*, 188, 65–75.
- Burgess, A.G. and Burgess, J.P., 2011, *Truth*, Princeton, Princeton University Press.
- Cellucci, C., 2006, The Question Hume Didn't Ask: Why Should We Accept Deductive Inferences? In: *Demonstrative and Non-Demonstrative Reasoning*, Cassino, Edizioni dell'Università degli Studi di Cassino, 207–235.
- 2011, Classifying and Justifying Inference Rules. In: *Logic and Knowledge*, Newcastle Upon Tyne, Cambridge Scholars Publishing, 123–142.
- 2013, *Rethinking Logic. Logic in Relation to Mathematics, Evolution, and Method*, Dordrecht, Springer.
- 2014, Knowledge, Truth and Plausibility. *Axiomathes*, 24, 517–532.
- Chisholm, R.M., 1982, *The Foundations of Knowing*, Minneapolis, University of Minnesota Press.
- Cling, A.D., 1994, Posing the Problem of the Criterion. *Philosophical Studies*, 75, 261–292.
- 1997, Epistemic Levels and the Problem of the Criterion. *Philosophical Studies*, 88, 109–140.
- 2003, Self-supporting Arguments. *Philosophy and Phenomenological Research*, 66, 279–303.
- 2004, The trouble with infinitism. *Synthese*, 138, 101–123.
- De Cruz, H., 2007, Innate Ideas as a Naturalistic Source of Mathematical Knowledge. Dissertation, Vrije Universiteit, Brussel.
- De Cruz, H. et al., 2011, Evolutionary Approaches to Epistemic Justification. *Dialectica*, 65, 517–535.
- De Cruz, H. and De Smedt, J., 2012: Evolved cognitive biases and the epistemic status of scientific beliefs. *Philosophical Studies*, 157, 411–429.
- Devitt, M., 1997, *Realism and Truth*, Princeton, Princeton University Press.

- Douven, I., 2002, Testing Inference to the Best Explanation. *Synthese*, 130, 355-377.
- Downes, S.M., 2000, Truth, Selection and Scientific Inquiry. *Biology and Philosophy*, 15, 425-442.
- Ellis, B., 2009, *The Metaphysics of Scientific Realism*, Durham, Acumen.
- Floridi, L., 1993 The Problem of the Justification of a Theory of Knowledge. Part I: Some Historical Metamorphoses. *Journal for General Philosophy of Science*, 24, 205-233.
-- 1994: The Problem of the Justification of a Theory of Knowledge. Part II: Morphology and Diagnosis. *Journal for General Philosophy of Science*, 25, 17-49.
- Frankfurt, H.G., 1958, Peirce's Notion of Abduction. *The Journal of Philosophy*, 55, 593-597.
- Frost-Arnold, G., 2010, The No-Miracles Argument for Realism: Inference to an Unacceptable Explanation. *Philosophy of Science*, 77, 35-58.
- Giere, R.N., 2005, Scientific Realism: Old and New Problems. *Erkenntnis*, 63, 149-165.
-- 2006, Modest Evolutionary Naturalism. *Biological Theory*, 1, 52-60.
- Godfrey-Smith, P., 1998, *Complexity and the Function of Mind in Nature*, Cambridge, Cambridge University Press.
-- 2001, Three Kinds of Adaptationism. In: *Adaptationism and Optimality*, Cambridge, Cambridge University Press, 335-357.
- Goldman, A., 1990, Natural Selection, Justification, and Inference to the Best Explanation. In: *Evolution, Cognition and Realism*, Lanham, University Press of America, 39-46.
- Griffiths, P.E., 1996, The Historical Turn in the Study of Adaptation. *The British Journal for the Philosophy of Science*, 47, 511-532.
- Klein, P.D., 1999, Human Knowledge and the Infinite Regress of Reasons. *Noûs*, 33, 297-325.
- Harman, G.H., 1965, The Inference to the Best Explanation. *The Philosophical Review*, 74, 88-95.
- Held, C., 2011, Truth does not explain predictive success. *Analysis*, 71, 232-234.
- Hitchcock, C.R., 1992, Causal Explanation and Scientific Realism. *Erkenntnis*, 37, 151-178.
- Hoffmann, M., 1999, Problems with Peirce's Concept of Abduction. *Foundations of Science*, 4, 271-305.

- Howson, C., 2000, *Hume's Problem*, Oxford, Oxford University Press.
- Kapitan, T., 1992, Peirce and the Autonomy of Abductive Reasoning. *Erkenntnis*, 37, 1-26.
- Kornblith, H., 1993, *Inductive Inference and its Natural Ground*, Cambridge (MA), MIT Press.
- Laudan, L., 1981, A Confutation of Convergent Realism. *Philosophy of Science*, 48, 19-49.
- Lewens, T., 2009, Seven types of adaptationism. *Biology and Philosophy*, 24, 161-182.
- Lewis, P., 2001, Why the Pessimistic Induction Is a Fallacy. *Synthese*, 129, 371-380.
- Lipton, P., 2004, *Inference to the Best Explanation*, London, Routledge.
- Mackonis, A., 2013, Inference to the best explanation, coherence and other explanatory virtues. *Synthese*, 190, 975-995.
- Magnani, L., 2009, *Abductive Cognition*. Berlin: Springer.
- Maryann, A., 1974, Retrodution: The Rational Instinct. *Transactions of the Charles S. Peirce Society*, 10, 34-43.
- McKay, R.T. and Dennett, D.C., 2009, The evolution of misbelief. *Behavioral and Brain Sciences*, 32, 493-510.
- Millikan, R., 1984, Naturalist Reflections on Knowledge. *Pacific Philosophical Quarterly*, 65, 315-334.
- Musgrave, A., 1988, The Ultimate Argument for Scientific Realism. In: *Relativism and Realism in Science*, Dordrecht, Kluwer, 229-252.
- Munz, P., 1993, *Philosophical Darwinism*, London, Routledge.
- Nozick, R., 2001, *Invariances*, Cambridge (MA), Harvard University Press.
- Orzack, S.H. and Forber, P., 2010, Adaptationism. In: *The Stanford Encyclopedia of Philosophy*, <http://plato.stanford.edu/archives/fall2010/entries/adaptationism/>.
- Paavola, S., 2005, Peircean abduction: Instinct or inference? *Semiotica*, 153, 131-154.
- Peirce, C.S., 1931-1958, *Collected Papers of Charles Sanders Peirce* (CP), Cambridge (MA), Harvard University Press.
- Plotkin, H., 1997, *Darwin Machines*, Cambridge (MA), Harvard University Press.
- Psillos, S., 1999, *Scientific Realism*, New York, Routledge.

-- 2002, Simply the Best: A Case for Abduction. In: *Computational Logic: Logic Programming and Beyond. Essays in Honour of Robert A. Kowalski. Part II*, Berlin, Springer, 605-625.

--, 2011, An Explorer Upon Untrodden Ground: Peirce on Abduction. In: *Handbook of the History of Logic. Volume 10. Inductive Logic*, Amsterdam, Elsevier, 117-151.

Putnam, H., 1975, *Mathematics, Matter and Method*, Cambridge, Cambridge University Press.

Rescher, N., 1977, *Methodological Pragmatism*, Oxford, Blackwell.

-- 2003, *Epistemology*, Albany (NY), SUNY Press.

Resnik, M., 1989, Adaptationist Explanations. *Studies in History and Philosophy of Science*, 20, 193-213.

Ruttkamp, E., 2002, *A model-theoretic realist interpretation of science*, Dordrecht, Kluwer.

Saatsi, J. and Vickers, P., 2011, Miraculous Success? Inconsistency and Untruth in Kirchoff's Diffraction Theory. *The British Journal for the Philosophy of Science*, 62, 29-46.

Sage, J., 2004, Truth-Reliability and the Evolution of Human Cognitive Faculties. *Philosophical Studies*, 117, 95-106.

Sankey, H., 2008, *Scientific Realism and the Rationality of Science*, Burlington, Ashgate.

-- 2010, Witchcraft, Relativism and the Problem of the Criterion. *Erkenntnis*, 72, 1-16.

-- 2011, Epistemic relativism and the problem of the criterion. *Studies in History and Philosophy of Science*, 42, 562-570.

-- 2012, Scepticism, relativism and the argument from the criterion. *Studies in History and Philosophy of Science*, 43, 182-190.

Schurz, G., 2008, Patterns of abduction. *Synthese*, 164, 201-234.

Sebeok, T.A. and Umiker-Sebeok, J., 1983, «You Know My Method»: A Juxtaposition of Charles S. Peirce and Sherlock Holmes. In: *The Sign of Three. Dupin, Holmes, Peirce*, Bloomington, Indiana University Press, 11-54.

Sextus Empiricus, 1976, *Outlines of Pyrrhonism*, Cambridge (MA), Harvard University Press.

Shanahan, T., 1986, The First Moment of Scientific Inquiry: C. S. Peirce on the Logic of Abduction. *Transactions of the Charles S. Peirce Society*, 22, 449-466.

Sher, G., 2004, In Search of a Substantive Theory of Truth. *The Journal of Philosophy*, 101, 5-36.

- Stanford, P.K., 2000, An Antirealist Explanation of the Success of Science. *Philosophy of Science*, 67, 266–284.
- Sterpetti, F., forthcoming, Formalizing Darwinism, Naturalizing Mathematics. *Paradigmi*.
- Stich, S., 2011, *Collected papers. Volume 1*. Oxford, Oxford University Press.
- Tarski, A., 1944, The semantic conception of truth and the foundations of semantics. *Philosophy and Phenomenological Research*, 4, 341–376.
-- 1969, Truth and proof. *Scientific American*, 220, 63–77.
- Thomson, P., 1995, Evolutionary Epistemology and Scientific Realism. *Journal of Social and Evolutionary Systems*, 18, 165–191.
- Worrall, J., 1989a, Fix It and Be Damned: A Reply to Laudan. *The British Journal for the Philosophy of Science*, 40, 376–388.
-- 1989b, Structural Realism: The Best of Both Worlds? *Dialectica*, 43, 99–124.
-- 2008, Theory-change in science. In: *The Routledge Companion to Philosophy of Science*, New York, Routledge, 281–291.
- Wray, K.B., 2013, Success and truth in the realism/anti-realism debate. *Synthese*, 190, 1719–1729.