Studies in History and Philosophy of Science 44 (2013) 590–593

Contents lists available at SciVerse ScienceDirect

Studies in History and Philosophy of Science

journal homepage: www.elsevier.com/locate/shpsa

Discussion

Truth may not explain predictive success, but truthlikeness does

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ARTICLE INFO

Article history:
Received 15 February 2013
Received in revised form 11 May 2013

Keywords:
Scientific realism
Predictive success
Underdetermination
Truth
Verisimilitude
Truthlikeness

ABSTRACT

In a recent paper entitled "Truth does not explain predictive success" (*Analysis*, 2011), Carsten Held argues that the so-called "No-Miracles Argument" for scientific realism is easily refuted when the consequences of the underdetermination of theories by the evidence are taken into account. We contend that the No-Miracles Argument, when it is deployed within the context of sophisticated versions of realism, based on the notion of truthlikeness (or verisimilitude), survives Held's criticism unscathed.

1. Introduction

Underdetermination has been characterized as the "simple, incontestable fact that observational evidence is logically inconclusive with respect to the truth of [a] theory" (Leplin, 2004, p. 119). Based on underdetermination, various arguments, coming in varying degrees of scope and strength, have been put forward against realism. The fundamental insight underlying all these arguments is that the realist's inference from the success of a theory T to the (approximate) truth of T cannot be granted, given underdetermination, on purely logical grounds, and so requires additional justification of some kind, which may be difficult, if not impossible, to provide (Laudan, 1981; Niiniluoto, 1999).

The recession-proof literature on the issue of underdetermination and realism has recently been enriched by an exchange between Held (2011, 2012), who has attacked realism, and Morganti (2011, 2012), who has defended it. With a view to adding something new to this exchange, here we suggest a reply to Held along different lines from Morganti's, with which we do not take issue. In a paper entitled "Truth does not explain predictive success" (2011), Held has argued that the so-called "No-Miracles Argument" (NMA) for scientific realism is easily refuted when the consequences of the underdetermination of theories by the evidence are taken into account. Were Held's alleged refutation of NMA successful, realists would be deprived of what is sometimes referred to as no less than "the ultimate argument" for realism (after van Fraassen, 1980, p. 39). Therefore, a reply on the part of the realists seems to be urgently needed. In what follows, after briefly introducing Held's criticism of NMA (Section 2), we provide such a reply, and argue that NMA, when it is deployed within the context of sophisticated versions of realism, based on the view that approximation to the truth is the main cognitive aim of scientific inquiry, survives Held's criticism unscathed (Section 3). We conclude by suggesting more generally, following Niiniluoto (1999, 2013), that a verisimilitudinarian version of NMA seems well suited to meet the challenges posed to realism on the basis of underdetermination (Section 4).

2. Held's criticism of NMA

Broadly speaking, NMA is the thesis that the success enjoyed by scientific inquiry would be an inexplicable fact, if scientific theories

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http://dx.doi.org/10.1016/j.shpsa.2013.05.004

were not (at least approximately) true descriptions of (some of the relevant features of) the world. In this regard, Hilary Putnam famously claimed that realism is "the only philosophy that doesn't make the success of science a miracle" (1975, p. 73).

As Held (2011) puts it, NMA is the claim that the best explanation of the predictive success of a theory is provided by its truth. According to him, a straightforward refutation of NMA is readily available. Such a refutation is based on the "simple, incontestable fact that observational evidence is logically inconclusive with respect to the truth of [a] theory" (Leplin, 2004, p. 119). This means that, as both realists and antirealists agree, evidence underdetermines theories, in the sense that the truth of a theory cannot be deduced from its predictive success. From this, the possibility that a successful theory is false immediately follows. This fact alone is sufficient, Held argues, to show that a theory's truth "cannot be an explanation of its success" (2011, p. 234). Therefore, NMA is refuted: an explanation of a theory's success "must be compatible with the assumption that this theory is false" (2011, p. 234).

At first glance, one may get the impression that Held is making the obviously false claim that underdetermination logically entails the negation of NMA. This would amount to attributing to realists the view that the success-to-truth link—the realist's "Upward Path," as Laudan (1981, pp. 32–36) called it—must be without exceptions, i.e., a deductive link. If this were the case, then Held's criticism of NMA would be a cause for concern only for the kind of naïve realist that Worrall (2011, p. 159) has labeled the "gung ho realist," i.e., someone who claims that we must always believe in the truth of our currently accepted successful theories. However, this cannot be the case, since Held (2011, p. 233) seems to be well aware of the fact that NMA is an abductive, i.e., a non-deductive, inference. This means that NMA does not amount to the claim that the success of a theory entails its truth. Rather, NMA is the thesis that the success of a theory is a *fallible indicator* of its truth—indeed, this is how all sophisticated realists understand NMA (consider, for instance, such "critical" or "fallibilist" realists as Kuipers (2000), Niiniluoto (1999), Psillos (1999), and many others). Moreover, all sophisticated realists readily acknowledge that highly successful theories are typically, strictly speaking, false, if only because they involve the use of various idealizing assumptions (see, e.g., Psillos, 1999, 265 ff.). As a consequence, they typically maintain that the best explanation of the success of a theory is provided either by its approximate truth (or accuracy), or by its verisimilitude (or truthlikeness)—and not by its truth *simpliciter*.[1] Note that this does in no way rule out that, at least in some cases, it is the truth of theories that explains their success. Indeed, since the (whole) truth about a given domain is the maximally informative true description of the domain, truth is a limiting case of truthlikeness; in other words, the maximally verisimilar (or truthlike) theory is the truth itself; therefore, no real contrast exists between truth and truthlikeness as far as their role in explicating the success of scientific theories is concerned. In light of such remarks it should be quite clear that NMA, when it is deployed within the context of sophisticated versions of realism, is not at all threatened by the possibility of the existence of successful false theories.

In any case, it seems to us that Held is trying to make a more interesting point. Suppose that a theory T is successful with respect to evidence E, in the sense that T entails E, and suppose that E is true. This means that our actual world, w, is an E-world, i.e., one of the possible worlds where E is true (Held, 2011, p. 234). The realist suggests that, given the success of T, we are justified in thinking that w either is a $(T \,\&\, E)$-world or is a $(\neg T \,\&\, E)$-world which however is close to a $(T \,\&\, E)$-world; to put it differently, the realist suggests that T is at least approximately true. Thus, Held argues, the realist owes us an argument to the effect that we have some reason to think that T is actually in the neighborhood of w.

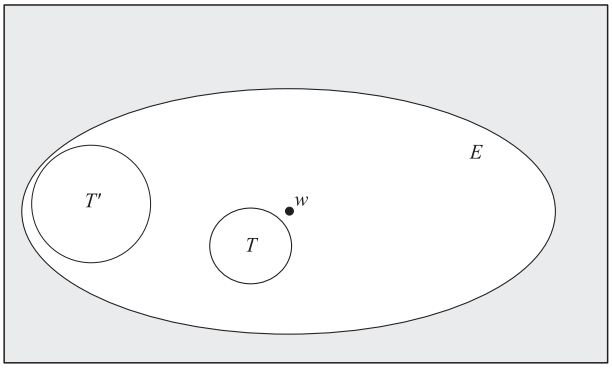

Fig. 1. The comparative challenge: discriminating between two successful theories.

3. A verisimilitudinarian rebuttal of Held's criticism

A picture may help in clarifying the challenge that Held poses to the realist. In Fig. 1, both evidence E and theory T are represented as the corresponding sets of possible worlds which are models of E and T, respectively. Since T entails E, we know that T is somewhere within E, although we do not know exactly where; in any case, it can be represented by the T-circle including all the $(T \,\&\, E)$-words. Moreover, since we are assuming that E is true, we also know that the actual world, w, can be represented as a dot located anywhere within E.

Held's challenge to the realist can be now rephrased as follows: given underdetermination, the area of E outside the T-area, which includes the $(\neg T \,\&\, E)$-worlds, is (densely) populated by other theories which are also successful, because, just like T, they entail E: an example is T'. Since the actual position of w is unknown, how can the realist act as if one knew that T is close to w, or at least closer than T' to w? In other words: why should the realist be allowed to draw w as in Fig. 1, in the neighborhood of T instead of T'? Here, Held (2011, p. 234) seems to think that the only possible satisfactory answer on the part of the realist would be to show that, were T not true, T would not be successful—to put it differently: that if the T-area did not include w, or at least, were not in the neighborhood of w, then the T-area would lie partially outside the E-area (i.e., the T-area would partially overlap with the gray area in Fig. 1). This fact alone, he seems to suggest, debunks NMA; but as we mentioned above, no sophisticated realist would be prepared to defend the claim that the success of T entails its (approximate) truth. In any case, Held's challenge to the realist consists in putting forward a good argument to the effect that T is successful because of its approximate truth or verisimilitude—and therefore, in providing reasons to embrace NMA.

Here the realist is confronted with an instance of the well-known problem to which we shall refer as "the comparative challenge:" if the available evidence does not allow us to discriminate between two theories T and T', both of which have so far not been falsified, how is rational theory-choice possible? It should be clear that the comparative challenge is a cause for concern for realists as well as for antirealists. In fact, to mention but one example, a con-

[1] A theory is approximately true, or accurate, if it is close to being true (roughly, if many of the things it says are true), whereas it is truthlike, or verisimilar, if it is close to the (whole) truth about a domain (i.e., if it says many things—it is informative—and many of these things are—almost exactly—true). Since approximate truth is only one "ingredient" of truthlikeness, a theory with a high degree of approximate truth, but which does not convey much information, may well possess a low degree of truthlikeness (Niiniluoto, 1987, pp. 176–177 and 217 ff.).

structive empiricist needs a method for appraising theories in the face of underdetermination no less than the realist does (see, e.g., Busch, 2009). Accordingly, various theoretical virtues, like high (prior) probability, simplicity, informativeness, etc., have been proposed as guides for theory-choice.

In any case, we contend, a straightforward response to the comparative challenge is provided by the so-called "verisimilitudinarian approach" to scientific inquiry (henceforth: VS), originally proposed by Popper (1963) and later developed by many other scholars (see Niiniluoto, 1998 for a survey and Cevolani & Tambolo, 2012 for an informal presentation). In a nutshell, VS suggests that, although one cannot *know* the relative positions of T, T', and w within the E-area, it is nevertheless possible to put forward tentative, fallible *estimates* of such positions—i.e., of the relative verisimilitude of T and T'—based on the available evidence.

As noted in Section 2, a theory T is highly verisimilar if it approximates "the (whole) truth" about the target domain, i.e., if it is close or similar to (the most complete true description of) the actual world w. Thus, the verisimilitude of T depends both on its content, i.e., how much the theory says, and its accuracy, i.e., how much of what the theory says is in fact true. Verisimilitude theorists have proposed a number of methods to measure the degree $\mathrm{Vs}(T, w_i)$ of closeness or similarity of T to any given possible world w_i. The higher $\mathrm{Vs}(T, w_i)$, the more similar T is to w_i; and were w_i the actual world w, the more *veri*similar (or *truth*like) T would be. With reference to Fig. 1, if w were indeed the actual world, then T would be highly verisimilar, because it is both informative (since T so to speak excludes many possible worlds, the T-circle is small) and approximately true, i.e., very close to w; on the other hand, T' would be less verisimilar, because it is both less informative (the T'-circle is bigger than the T-circle) and farther from the truth than T.

Since w is usually unknown, the problem—referred to in the literature as the *epistemic problem* of verisimilitude (see, e.g., Oddie, 1987, chap. 7; Niiniluoto, 1987, chap. 7; Kuipers, 1987, Sections 7 and 9)—is that of estimating the verisimilitude of any two theories T and T' on the basis of the available evidence. A way of tackling this problem has been proposed by Niiniluoto (1987, 1999), who defines the notion of *expected verisimilitude* in Bayesian terms and puts forward a measure $E\mathrm{Vs}(T|E)$ of the estimated closeness to the truth of any theory T given the evidence E. Intuitively, expected verisimilitude is a combination of the similarity of T to each one of the relevant alternative states of affairs $w_1, \ldots, w_n$, and of the probability, given the evidence, that each of these possible worlds w_i is the actual world w. More formally, given an epistemic probability distribution P over the set of the relevant possible worlds $w_1, \ldots, w_n$, with $P(w_i \mid E)$ expressing the rational degree of belief that w_i is the actual world given evidence E, the expected verisimilitude of T is calculated by summing up the similarity of T to each w_i multiplied by the corresponding probability (cf. Niiniluoto, 1987, chap. 7 for the details):

$$E\mathrm{Vs}(T|E) = \sum_{w_i} P(w_i|E)\mathrm{Vs}(T, w_i)$$

The notion of expected verisimilitude provides the realist with a method to answer the comparative challenge. In fact, even if both T and T' are empirically successful, it is well possible that, given the same evidence E, the former is estimated as more verisimilar than the latter, i.e., that $E\mathrm{Vs}(T|E) > E\mathrm{Vs}(T'|E)$. When our estimates of the relative verisimilitude of T and T' lead us to tentatively conclude that T is closer to w than T', the situation can be graphically represented as in Fig. 1. The figure illustrates a situation in which, although T and T' have been so to speak "lucky," since so far they have not been falsified by E, E has nevertheless eliminated many of the possible worlds which lie in the neighborhood of T', while many of the worlds in the neighborhood of T have been "saved," or left untouched. In such situations, where $E\mathrm{Vs}(T|E) > E\mathrm{Vs}(T'|E)$, one *is* justified in drawing w closer to T than to T', since E seems to indicate that T is closer to the truth than T'. Thus, while at first sight T and T' seem to be on a par epistemically, since they both entail E, E may nonetheless allow us to discriminate between the two.

But before concluding, there is one objection to the above line of reasoning that must be addressed. As pointed out by an anonymous referee, held sometimes speaks of "entirely false" (2011, p. 233), or "downright false" (2012, p. 22), theories as debunking NMA. One could then take Held's challenge to the realist to consist in the following question: how can the realist rule out the possibility, not just of false successful theories, but of *completely* false theories which are nonetheless successful?

Since it is far from clear what is a completely false theory, dealing with such objection is not easy, and one must note that Held is not particularly forthcoming concerning the notion of "an *entirely* false theory making true predictions" (Held, 2011, p. 233, italics added). A precise definition of "complete falsity" (as well as of "success") would be needed, in order to evaluate the possibility of there being a successful but completely false theory. Although such a definition is clearly beyond the scope of the present discussion, three remarks are in order.

First of all one may note that, if a theory T is logically closed, then T simply cannot be "completely false" in the sense of entailing only false statements, since all logically closed (true or false) theories entail at least all the tautologies; so one is typically confronted not with completely false theories, but with theories which are very far from the truth. As another anonymous referee noted, Held may perhaps be interpreted as pointing to the challenge of distinguishing between T and T' in Fig. 1, just as done above (as noted by an anonymous referee). Secondly, verisimilitude theorists have put forward various definitions of what is, in different contexts, the least verisimilar theory, that can be arguably construed as the "complete falsity" about a domain (cf. Niiniluoto, 2003, 28 ff.; Cevolani, Crupi, & Festa, 2011, p. 186). As an example, with reference to Fig. 1, one can define the completely false theory about the domain as the theory which is true in all possible worlds except the actual world w. According to such definition, the complete falsity is just the negation of the whole truth and the weakest among false theories: as one can check, it does not entail any true factual statement about the world and, at least in this sense, is not successful. Thirdly, in all of the other cases, the notion of expected verisimilitude allows one to evaluate the estimated closeness to the truth even of theories which are known to be seriously false. For instance, suppose that the aim of inquiry is to find the value of k parameters $x_1, \ldots, x_k$, characterizing a given object, and that theory T provides estimates $t_1, \ldots, t_k$. Even if one knows, or has reasons to believe, that none of the t_i is correct—i.e., that, due to observational errors, limits of the experimental design or of the measurement apparatus, etc., $t_1 \neq x_1, \ldots, t_k \neq x_k$—$T$ may still be highly verisimilar, since all the t_i may be highly accurate. Along roughly the same lines, one can show how theories which are completely false in the sense of postulating an entirely false ontology (i.e., theories that get everything wrong about the entities and the processes that are actually "out there") can nevertheless be assessed and compared as far as their estimated closeness to the truth is concerned (cf. Niiniluoto, 1999, 126 ff.). In sum, VS is well equipped both to provide adequate explications of the notions of false (and completely false) theories, and to explain how, and to what extent, such theories can (or cannot) be successful.

4. Concluding remarks

Returning now to the verisimilitudinarian response to the comparative challenge (as illustrated in Fig. 1), it needs to be emphasized that we do not know where w actually lies within E. And it is entirely possible that w lies somewhere else, so that T', and

not T, is closer to the truth. But this is exactly what we mean by saying that, within VS, one can make *fallible estimates* of the relative positions of T, T', and w within the E-area. It should therefore be clear why, from the vantage point of VS, the success of science is far from being a miracle: it is a fact that can be reasonably explained by the (increasing) verisimilitude of our theories. This justifies the—fallible and tentative—inference from the success of T to its closeness to the truth, that is, what we may dub a verisimilitudinarian version of NMA (cf. Niiniluoto, 1999).

Such version of NMA, we argued, can easily escape Held's criticism, for at least two reasons. First of all, the possibility of the existence of a false successful theory is readily granted by the proponents of VS—indeed, that scientists deal most of the time with false theories is the starting point of VS. Moreover, on the epistemic level, a verisimilitudinarian version of NMA seems to be well suited to meet the comparative challenge. In fact, granted that the success of T does not entail its truth, and that many other theories like T' are successful with respect to the same evidence E, T may still be estimated as more verisimilar than each of its rivals on E, and then fallibly accepted as the best theory at disposal. In this precise sense, even conceding that, as Held claims, truth does not explain predictive success, closeness to the truth does. Therefore, we conclude, NMA, when it is deployed within the context of sophisticated versions of realism, based on the view that truthlikeness (or verisimilitude) is the main cognitive aim of science, survives Held's criticism unscathed.

Acknowledgements

For suggestions and criticisms on the material upon which this discussion is based, thanks are due to Mario Alai, Gregor Betz, Vincenzo Crupi, Pierdaniele Giaretta, Valeriano Iranzo, Jan-Willem Romeijn, Jesús Zamora Bonilla. We thank Roberto Festa, and two anonymous referees, for insightful comments on a previous version of the piece. Gustavo Cevolani acknowledges financial support from Grant CR 409/1-1 from the Deutsche Forschungsgemeinschaft (DFG) as part of the priority program *New Frameworks of Rationality* (SPP 1516); Luca Tambolo acknowledges financial support from PRIN grant *Probability, Confirmation and Verisimilitude*.

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