

# Progress as Approximation to the Truth: A Defence of the Verisimilitudinarian Approach

Gustavo Cevolani · Luca Tambolo

Received: 19 August 2011 / Accepted: 23 January 2012 / Published online: 14 February 2012  
© Springer Science+Business Media B.V. 2012

**Abstract** In this paper we provide a compact presentation of the verisimilitudinarian approach to scientific progress (VS, for short) and defend it against the sustained attack recently mounted by Alexander Bird (2007). Advocated by such authors as Ilkka Niiniluoto and Theo Kuipers, VS is the view that progress can be explained in terms of the increasing verisimilitude (or, equivalently, truthlikeness, or approximation to the truth) of scientific theories. According to Bird, VS overlooks the central issue of the appropriate grounding of scientific beliefs in the evidence, and it is therefore unable (a) to reconstruct in a satisfactory way some hypothetical cases of scientific progress, and (b) to provide an explanation of the aversion to falsity that characterizes scientific practice. We rebut both of these criticisms and argue that they reveal a misunderstanding of some key concepts underlying VS.

## 1 Introduction

The nature of progress has traditionally been a central concern for philosophers of science (see, e.g., the surveys by Dilworth 2008; Losee 2004; and Niiniluoto 2011a). Starting from the mid-1980s, a new approach to this old-age issue has emerged, based on the view that scientific progress can be accounted for in terms of the *increasing verisimilitude* or, equivalently, *truthlikeness*, or *approximation to the truth*, of our theories. More specifically, the supporters of this approach claim that

---

G. Cevolani (✉)

Department of Philosophy, University of Bologna, Piazza Sassatelli 26, 41057 Spilamberto,  
Modena, Italy  
e-mail: g.cevolani@gmail.com; gustavo.cevolani@unibo.it

L. Tambolo

Department of Philosophy, Languages, and Literatures, University of Trieste,  
Via Ponte Albano, 51 40037 Sasso Marconi, Bologna, Italy  
e-mail: l\_tambolo@hotmail.com

such theory-changes as the transition from Newton's to Einstein's theory are progressive because, although the new theory is, strictly speaking, presumably false, it is estimated to be closer to the truth than the superseded one: increasing verisimilitude, or decreasing distance from the truth, is the key ingredient for progress. Developed by such authors as Ilkka Niiniluoto (1984, 1987, 1999a) and Theo Kuipers (1987, 2000), this account of progress revolves around explications of the notion of verisimilitude that succeed in avoiding the well-known logical problems encountered by Karl Popper's (1963, 1972) original definition of the concept. Following Festa (2007), we shall call this view of progress the 'verisimilitudinarian' approach to scientific progress (VS, for short).

A number of authors (Bird 2007, 2008; Liu 1999, 2004; Northcott 2011; Piscopo and Birattari 2010) have recently challenged the viability of VS as a general account of progress. It seems to us that many of their criticisms stem from misunderstandings of some key concepts underlying VS. Since it would be impossible, within a single paper, to deal with all the criticisms raised by these authors, here we shall focus on the sustained attack mounted on VS by Alexander Bird—which is the most comprehensive and detailed recent critique of VS, and, we believe, especially representative of the above mentioned misunderstandings. In Bird's view, VS suffers from two major flaws. First of all, VS is characterized by an unacceptable lack of interest in the issue of the grounding of scientific beliefs in the evidence. This lack of interest, Bird claims, can easily be spotted when one considers cases in which the scientific community is presented with a highly verisimilar belief which has been arrived at, for instance, by sheer luck, and such that there is no good epistemic reason to embrace it. In such cases, Bird argues, the champions of VS take the belief under discussion as an instance of progress—and this fact alone shows that VS can not be the right account of scientific progress.

According to Bird, the above discussed flaw of VS is the reason underlying its second major shortcoming: if the aim of scientific inquiry is assumed to be the search for verisimilitude (or truth—Bird's arguments are intended to apply to both of these cognitive goals), then it is impossible to account for the aversion to falsity that characterizes scientific practice. In fact, Bird argues, the craving for verisimilar (or true) beliefs can, in principle, be satisfied by lucky guesses, since any belief has at least a chance of being verisimilar (or true). Therefore, someone who seeks verisimilar (or true) beliefs ought to be prepared, at least in cases in which there is no sufficient evidence available, to advocate the policy of believing at random. In sum, VS turns out to be totally insensitive to the issue of falsity avoidance: it says 'nothing about false beliefs being bad' (2008, p. 281).

In this paper, we shall rebut the above criticisms of VS. To this purpose, we shall proceed as follows. In Sect. 2, the key tenets of VS will be outlined. A special emphasis will be put on the distinction between the logical problem of verisimilitude and the epistemic problem of verisimilitude. While the former consists in spelling out what it means for a theory to be more verisimilar than another, assuming that the truth is known, the latter consists in estimating the relative verisimilitude of theories, given the available evidence, but without knowing the truth. In Sect. 3 a hypothetical example of scientific progress devised by Bird, allegedly demonstrating that VS is insensitive to the grounding of scientific beliefs in the evidence will be discussed. It will be argued

that such an example, far from revealing some inadequacy of VS, can quite naturally be dealt with, within VS, as an unproblematic case in which real progress and estimated progress do not go hand in hand. In Sect. 4 it will be argued that, since aiming at highly verisimilar theories means aiming at finding true beliefs and avoiding false beliefs, VS provides a straightforward explanation of the aversion to falsity that characterizes scientific practice—and this shows that VS has quite interesting things to say about false beliefs being bad. This becomes apparent, it will be claimed, as soon as the notions of verisimilitude and progress as increasing verisimilitude are appropriately construed and distinguished from the notions of approximate truth and progress as accumulation of approximate truths. Finally, in Sect. 5 some remarks concerning the present state of VS will be offered.

## 2 The Verisimilitudinarian Approach to Scientific Progress

The idea that progress can be explained in terms of the increasing verisimilitude of scientific theories was first proposed by Popper (1963, 1972). After Miller (1974) and Tichý (1974) independently proved that, on the basis of Popper's explication of the notion of verisimilitude, a false theory can never be closer to the truth than another (true or false) theory, such authors as Miller (1978), Niiniluoto (1984, 1987, 1999a), Oddie (1986), Kuipers (1987, 2000), Schurz and Weingartner (1987, 2010) developed (partially conflicting with each other) post-Popperian theories of verisimilitude. These theories, based on explications of verisimilitude that succeed in avoiding the problems encountered by Popper's definition, are, so to speak, the 'starting point' of VS.<sup>1</sup>

As previously mentioned, according to the supporters of VS, such theory-changes as that from Newton's to Einstein's theory are progressive because, although the new theory is, strictly speaking, presumably false, we have good reasons to believe that it is closer to the truth than the superseded one: increasing verisimilitude is the key ingredient for progress. Thus, the key tenets of VS can be briefly formulated as follows: (1) since some false theories are closer to the truth than others, a false but highly verisimilar theory can constitute a genuine approximation to the truth, and hence an instance of progress, when adopted to replace a less verisimilar theory; (2) we can devise methods to fallibly assess, on the basis of the available evidence, which among two competing theories is closer to the truth. Although the supporters of VS do not constitute a philosophical school characterized by absolute unanimity,<sup>2</sup> these tenets form the hardcore of a full-blown realist and fallibilist theory of scientific progress.

<sup>1</sup> A survey of the history of theories of verisimilitude is provided by Niiniluoto (1998). See also Oddie (2008) and, for a technical comparison of the main positions, Zwart (2001). For an introduction to VS in the context of a general discussion of different theories of scientific progress see Niiniluoto (2011a). Kuipers' and Niiniluoto's contributions to VS are discussed at length, respectively, in Festa et al. (2005a, b) and in Pihlström et al. (2007).

<sup>2</sup> Disagreements can be recorded both on the level of the definition of the notion of verisimilitude (cf. Niiniluoto 1998 and Zwart 2001) and on the more general level of the methodological significance of this concept (see for instance Kiesepää 1996a and Zamora Bonilla 1992, 1996, 2000).

In a thought-provoking paper entitled ‘What Is Scientific Progress?’ (2007), and in a subsequent exchange with Rowbottom (see Bird 2008; Rowbottom 2008, 2010), Bird proposes a wide-ranging discussion of the relative merits of three competing theories of scientific progress. The epistemic approach to scientific progress (E), supported by Bird, is the view that progress is the accumulation of knowledge. The semantic approach (S) is defined by Bird as the claim that ‘progress is the accumulation of true scientific beliefs’, or as the related view that it is ‘a matter of increasing verisimilitude’ (2007, p. 65). Finally, the functional-internalist approach (FI), advocated among others by Kuhn and (1962/1970) and Laudan (1978, 1984, 1996), considers progress as a matter of the success of a scientific theory or field in performing such functions as puzzle-solving and problem-solving—that is, in performing functions such that the practising scientists are in a position to judge whether the function has been fulfilled.

It seems to us that, while Bird’s criticism of FI is substantially correct, his arguments against S are far from compelling. However, before presenting our replies to them, an important remark is due. As mentioned above, Bird defines S as the thesis that scientific progress is the accumulation of truths, or a matter of increasing verisimilitude. It is not entirely clear how many philosophers currently embrace S, understood in the sense that progress is the accumulation of true scientific beliefs. In any case, Bird himself openly admits that the view of progress as the accumulation of truths ‘has had few explicit supporters’ (2007, p. 65).<sup>3</sup> We contend that the criticisms raised by Bird against the claim that progress is the accumulation of truths, though they may perhaps turn out to be effective, do not hurt VS. What we shall be defending here is VS, and VS only; the burden of defending the view of progress as the accumulation of truths lies entirely with its supporters.

For the purposes of the present paper, a broad, informal characterization of the notion of verisimilitude, which captures some of the very basic insights underlying VS, will be sufficient. A theory is highly verisimilar if it says many things about the target domain, and if many of these things are (almost exactly) true. Thus, the (degree of) verisimilitude of a theory must depend on both 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. In Popper’s words, verisimilitude ‘represents the idea of *approaching comprehensive truth*. It thus combines truth and content’ (Popper 1963, p. 237, emphasis added). Intuitively, it is easy to see that verisimilitude requires both content and accuracy. As an example, let us consider  $n$  logically independent atomic propositions  $p_1, \dots, p_n$  within a given language, and suppose that  $(p_1$  and ... and  $p_n)$  is the maximally informative true description of (the relevant fragment of) a certain domain of inquiry. Thus,  $(p_1 \& \dots \& p_n)$  can be construed as ‘the (whole or comprehensive) truth about the world’ in the given language. Then, theories  $(p_1)$  and  $(\neg p_2)$  are equally informative, in that both make a single claim about the domain at issue—however only the former is true, hence it is more verisimilar than the latter. On the other hand,  $(p_1)$  and  $(p_1 \& p_2)$  are equally accurate, since both are

<sup>3</sup> Rowbottom, however, seems to be one of them. In his rejoinder to Bird, he explicitly endorses (a qualified version of) S, according to which ‘science makes progress by discovering new truths’ and ‘excluding falsehoods’ (2010, p. 245). In any case, Rowbottom clearly distinguishes S and VS as different accounts of progress—a distinction that, on the contrary, Bird completely overlooks.

true—however the latter is more informative, hence it is more verisimilar than the former.

An important consequence of the fact that verisimilitude is a combination of truth and content is that a false theory may be more verisimilar than a true one. In fact, a true theory may be too weak or ‘cautious’ to be highly verisimilar, whereas a very informative or ‘bold’ theory may be highly verisimilar, although false. For instance, assuming that the truth is  $(p_1 \& \dots \& p_n)$ , the false theory  $(p_1 \& \dots \& p_{n-1} \text{ and } \neg p_n)$  will be more verisimilar than the true theory  $(p_1)$ , since the former provides us with much more (true) information about the world (recall that  $p_1, \dots, p_n$  are logically independent atomic propositions). The fact that both truth and content are necessary ingredients of verisimilitude becomes completely clear in the case of tautologies. A tautology is true, but has empty content, i.e., it does not convey any factual information about the world. Accordingly, many false but informative theories are more verisimilar than tautologies.

For most verisimilitude theorists, verisimilitude co-varies with content (logical strength) among true theories: i.e., if  $T$  and  $T'$  are both true, and if  $T'$  is logically stronger than  $T$ , then  $T'$  is also more verisimilar than  $T$ .<sup>4</sup> This condition, however, does not hold amongst false theories, since logically stronger falsities may well lead us farther from the truth: if  $T$  and  $T'$  are both false, the more verisimilar theory will be the one implying less—or less serious—falsities. To sum up: verisimilitude is a ‘mixture’ of two ingredients, truth and content. If truth were the only ingredient, then all truths, including the tautology, would be equally (and maximally) verisimilar; and, vice versa, if only content were relevant, then a plain contradiction would be closer to the truth than any other theory. Thus, devising highly verisimilar theories is a ‘game of excluding falsity and preserving truth’ (Niiniluoto 1999a, p. 73).

The champions of VS did not fail to notice the obvious fact that in most interesting cases ‘the truth’ is simply unknown, so that the *estimated verisimilitude* of competing theories, not their verisimilitude, is the crucial point of interest for an account of scientific progress. Accordingly, the theory of verisimilitude has traditionally been seen as addressing both a logical and an epistemic problem.<sup>5</sup> The *logical* problem of verisimilitude amounts to the preliminary definition of an appropriate notion of verisimilitude, allowing for a comparison of any two theories with regard to their closeness to the, supposedly known, truth. The *epistemic* problem of verisimilitude, on the other hand, amounts to the definition of an appropriate notion of estimated verisimilitude by which the estimated closeness to the unknown truth of any two theories could be compared on the basis of the available evidence.

Verisimilitude theorists have proposed different methods to deal with the issue of estimated verisimilitude. For instance, within the context of his ‘critical scientific realism’, Niiniluoto (1987, 1999a) defines a quantitative notion of ‘expected

<sup>4</sup> To continue the example above, if  $(p_1 \& \dots \& p_n)$  is ‘the truth’, then  $(p_1 \& p_2)$ , being logically stronger, is also more verisimilar than  $(p_1)$ . However, it should be noted that, according to Oddie (1986), logically stronger true theories are not necessarily more verisimilar than weaker ones.

<sup>5</sup> See, e.g., Niiniluoto (1987, p. 263) and (1998, p. 20); Zwart (2001, pp. 4–5, 121); Festa (2007, p. 96).

verisimilitude' in Bayesian terms, providing a measure  $EV_s(T|e)$  of the degree of estimated closeness to the truth of any theory  $T$  given the evidence  $e$ . This definition is based both on a suitably defined measure of verisimilitude  $V_s$  and on an underlying epistemic probability distribution  $P$  over the set of the relevant alternative states of affairs  $C_1, \dots, C_m$ . Niiniluoto proposes a number of methods to measure the degree of verisimilitude  $V_s(T, C_i)$ , expressing the closeness or similarity of a theory  $T$  to a given state of affairs  $C_i$ .<sup>6</sup> Degrees of probability  $P(C_i|e)$  express instead rational degrees of belief in the truth of each alternative state, given the evidence. The expected degree of verisimilitude of  $T$  is then calculated by summing up the verisimilitude of  $T$  in each state multiplied by the corresponding probability (Niiniluoto 1987, p. 269):

$$EV_s(T|e) = \sum_i V_s(T, C_i) P(C_i|e)$$

If, as VS assumes, verisimilitude is the main cognitive goal of science, then the choice between competing theories should be based on their expected verisimilitude, construed as the relevant 'epistemic utility' guiding the acceptance of scientific hypotheses. In Niiniluoto's approach, this idea can be explicitly formulated in the form of the following 'rule of acceptance' (1987, p. 416): 'Accept on evidence  $e$  that theory  $T$  which maximizes the value  $EV_s(T|e)$ '.

A non-quantitative way to deal with the issue of estimated verisimilitude has been proposed by Kuipers within the context of a systematic defense of his preferred epistemological position, which he calls 'constructive realism'. Although here it will be impossible to do full justice to all the details of his discussion, it must be mentioned that Kuipers advocates a methodological rule, called the 'Rule of Success' (2000, p. 114), which can be phrased as follows: 'If a theory  $T'$  has so far proven to be more successful than a theory  $T$ , then eliminate  $T$  in favour of  $T'$ , at least for the time being'. The Rule of Success is the core of Kuipers' 'HD-evaluation' of theories, i.e., a sophisticated version of the hypothetico-deductive method characterized by the recommendation to 'take falsified theories seriously' (2000, p. 95). According to Kuipers, one ought not 'to be distracted by something which turns out to be irrelevant for approaching the truth, viz., that a theory is false' (2000, p. 124). In fact, a theory which has been conclusively falsified can still be the best at our disposal, i.e., it can still be closer to the truth than the available alternatives. As a consequence, if a given theory  $T$  has, so far, proven to be the most successful (the best) among the available alternatives, one may make what Kuipers calls an 'Inference to the Best Theory' (2000, p. 171; see also 2004)—that is, one is justified in tentatively concluding, for the time being, that  $T$  is the closest to the truth among the available alternatives.<sup>7</sup> Indeed, although the Rule of Success is claimed to be functional for truth approximation, Kuipers hastens to add that its use cannot guarantee that the chosen theories will automatically turn out to be closer to the truth. However, for the purposes of the present

<sup>6</sup> For a detailed discussion and comparison of such methods, see Niiniluoto (1987, Chap. 6), where his favorite *min-sum measure* is defended as the most adequate measure of verisimilitude (cf. also Niiniluoto 1999b, Sect. 3.5).

<sup>7</sup> Of course, the HD-evaluation of the empirical merits of theories is complicated by a number of well-known factors, such as, for instance, the fact that the derivation of predictions from a theory requires the use of auxiliary hypotheses (2000, pp. 107–110).

paper, what really matters is that, contrary to what Bird claims—also Kuipers' version of—VS provides us with an 'evidence-dependent partial ordering' (2000, p. 113) of theories with regards to their estimated verisimilitude.

In both of the above mentioned formulations, the notion of estimated verisimilitude allows us to say that a theory  $T'$  seems more verisimilar than a theory  $T$ , i.e., that it is reasonable to claim that  $T'$  is more verisimilar than  $T$  on the basis of available evidence. As a consequence of the above mentioned distinction between the logical and the epistemic problem of verisimilitude, progress can be characterized within VS both as *real progress* (or progress in the logical sense), construed as increasing verisimilitude, and as *estimated progress* (or progress in the epistemic sense), construed as increasing estimated verisimilitude (Niiniluoto 1999a, 2011a). Within VS, then, the step from  $T$  to  $T'$  is said to be progressive (in the sense that it constitutes real progress) if and only if  $T'$  is more verisimilar than  $T$ , while the step from  $T$  to  $T'$  is said to seem progressive (in the sense that it constitutes estimated progress), given the available evidence, if and only if the verisimilitude of  $T'$  is *estimated* higher than the verisimilitude of  $T$  on the basis of that evidence.

To sum up: within VS, the (whole) truth is seen as the ideal goal of inquiry. Nevertheless, it seems extremely unlikely that we shall ever be able to reach such a goal, since as far as we know even our best theories may well be false. As a consequence, the main cognitive goal of scientific research is assumed to be the search for highly verisimilar theories, i.e., theories which, though presumably false, are close to the truth. (Notice that the maximally verisimilar theory is the truth itself; thus, aiming at highly verisimilar theories also means to aim at the truth seen as the ideal goal of inquiry.) In this respect it is worth mentioning that, as Niiniluoto (1999a, p. 201) pointed out, the supporters of VS need not embrace the view that 'all actual steps of theory change in science have been and will be progressive'. Rather, they claim that science has been progressive 'on the whole'—which is compatible 'with the possibility that some steps in the development of science have been regressive'. Accordingly, scientific inquiry is seen, within VS, as an endeavour aimed at the search for theories which, given the available evidence, can reasonably be considered, at least for the time being, as the most verisimilar among the alternatives. The increasing estimated verisimilitude of our theories can then be seen as a fallible, but reliable indicator of genuine progress towards the truth.<sup>8</sup>

The above outline of the basic features of VS will serve as a starting point for rebutting, in Sects. 3 and 4, Bird's criticisms against it.

### 3 Verisimilitude, Real Progress, and Estimated Progress

In order to show that the semantic approach to progress (S) is affected by an unacceptable lack of interest in the grounding of scientific beliefs in the evidence, Bird (2007, pp. 65–67) deploys a hypothetical example in which, he claims, our intuitions concerning the nature of progress are at variance with S.

<sup>8</sup> For detailed case studies of progress as increasing verisimilitude see Niiniluoto (1994); Cools et al. (1994); Hetttema and Kuipers (1995); Kieseppä (1996b, Chap. 7); Votsis and Schurz (2011).



Suppose that a scientific community has formed its beliefs by using a method  $M$  which is very weak or even irrational (e.g., astrology), and that by sheer luck  $M$  has yielded a sequence of true (or increasingly verisimilar) beliefs.<sup>9</sup> Suppose, moreover, that these beliefs are embraced by the community only because they were generated by the use of  $M$ , and that they do not have any independent confirmation. Now imagine that, at time  $t$ , some researcher realizes that  $M$  is flawed, and that this researcher somehow manages to persuade the other members of the community to start using a different, reliable method  $M_1$  for the generation of true (or increasingly verisimilar) beliefs. As a consequence, the beliefs generated before  $t$  are dropped.<sup>10</sup>

Our intuitions, Bird claims, tell us that in this scenario the scientific community starts to make progress exactly at  $t$ . In fact, although the beliefs generated by  $M$  before  $t$  are true (or increasingly verisimilar), they lack appropriate grounding in the evidence: there is no good epistemic reason to embrace these beliefs, which therefore cannot qualify as a contribution to progress. On the contrary, since according to S progress is the accumulation of true beliefs, or a matter of increasing verisimilitude, the supporters of S are forced to admit that the scientific community did make progress before  $t$ . In fact, the beliefs generated by  $M$  before  $t$  are *ex hypothesi* true (or increasingly verisimilar), regardless of how they were generated. In Bird's view, the fact that S leads to such a counter-intuitive, unacceptable conclusion shows that it cannot be the right account of progress.

We contend that, while the above example might perhaps be a cause for concern for some version of the view of progress as the accumulation of true scientific beliefs, the verisimilitudinarian approach to progress (VS) survives Bird's criticism completely unscathed. Indeed, it seems to us that Bird is far too hasty in dismissing VS on the basis of his intuitions concerning the nature of progress.

In order to see why, let us recall the distinction between real and estimated progress. Such a distinction is motivated by the fact that there is no way to ascertain whether a given belief exhibits a genuine correspondence to 'the real world': progress, construed as real progress, is something to which we have limited epistemic access. For this reason, there may well be cases in which, for whatever cause, real progress is achieved, although we do not have good epistemic reasons to think that it has been achieved. Nevertheless, there are ways to fallibly assess the verisimilitude of a belief. As previously illustrated, within VS the step from a theory  $T$  to a theory  $T'$  is considered as progressive if and only if the verisimilitude of  $T'$  is estimated higher than the verisimilitude of  $T$  on the basis of the available evidence: progress, construed as estimated progress, is something to which we do have epistemic access. In light of the distinction between real and estimated progress, the champions of VS can easily diagnose that Bird discusses a scenario in which, although real progress is achieved (the beliefs arrived at before  $t$  are *ex hypothesi* increasingly verisimilar), no estimated progress is achieved (we do not have good

<sup>9</sup> According to Bird, 'whether one prefers to couch [such an argument] in terms of accumulating truth or increasing verisimilitude is immaterial' (2007, pp. 65–66); however, as we argue, the view of progress as increasing verisimilitude eschews Bird's criticism.

<sup>10</sup> Notice that, although Bird discusses *sequences* of true (or increasingly verisimilar) beliefs, his example is aimed at undermining S also when the case of only *one* true (or increasingly verisimilar) belief lacking appropriate grounding in the evidence is taken into account.



epistemic reason to think that these beliefs are increasingly verisimilar). Bird's main criticism of VS, we contend, no longer looks as compelling as it may *prima facie* seem, when one considers a fact that Bird fails to acknowledge and that VS accounts for in a very natural way—i.e., that real progress and estimated progress do not necessarily go hand in hand.

Moreover, contrary to what Bird seems to believe, VS fully acknowledges that evidence-dependent estimates of the verisimilitude of theories play a key role in the theory-choices made by scientific communities. In this respect, we may say that VS has a well-developed 'epistemic side', aimed at exerting control over the beliefs that a scientific community embraces, which works as a kind of filter that minimizes cases of acceptance of beliefs lacking appropriate grounding in the evidence. Such an epistemic side allows the champions of VS to deal quite well with cases, as the one envisaged by Bird, in which changes in the knowledge-gathering methods employed by the scientific community take place (or in which the estimates of the verisimilitude of theories are subject to revision in light of new evidence).

In order to appreciate this, note that, according to VS, if a given theory  $T'$  has, so far, proven to be the best (that is the one estimated as the most verisimilar, on the basis of the available evidence) among the available alternatives, one is justified in concluding, at least for the time being, that  $T'$  is the closest to the truth among the available alternatives. Of course, it may happen that the scientific community comes to accept  $T'$  as a case of progress for what later turn out to be entirely wrong reasons. For instance,  $T'$  may have been generated by a flawed method and lack independent confirmation, or it may have been wrongly estimated as more verisimilar than its predecessors (or competitors) only because, at a certain point in time, all the available evidence accidentally favoured it. Such cases, however, are dealt with by VS in a straightforward manner. For instance, in warning against the perils of 'instant rationality' (2000, p. 113) Kuipers suggests that, when the estimated verisimilitude of a theory  $T'$  is higher than that of a theory  $T$ , one should not just rest content with the hypothesis that  $T'$  is more verisimilar than  $T$ . Rather, one ought to further test this hypothesis, by producing as much evidence as possible in favour of  $T$ . Only if, after serious testing, the estimated verisimilitude of  $T'$  remains higher than that of  $T$ , then one is justified in considering  $T'$  as an instance of estimated progress and concluding, at least for the time being, that  $T'$  is the closest to the truth among the available alternatives (On this, see also Kuipers 2009).

To sum up, our discussion in the present section shows that, pace Bird, his hypothetical example fails to demonstrate the insensitivity of VS to the issue of the grounding of scientific beliefs in the evidence. In the next section we shall argue that, contrary to Bird's claim, the champions of VS are far from being prepared to advocate a believe-at-random-and-hope-for-the-best policy in the acceptance of beliefs.

#### 4 Aversion to Falsity, Verisimilitude, and Approximate Truth

In the previous section we rejected Bird's claim that VS is characterized by an unacceptable lack of interest in the issue of the grounding of scientific beliefs in the evidence. We shall now consider his second objection, according to which VS does

not account for the aversion to falsity that characterizes scientific practice (Bird 2007, pp. 85–86; 2008, pp. 280–281). In Bird's view, this latter shortcoming of VS follows from the former. In fact, he claims, aversion to falsity is a 'requirement of reliability' that cannot be explained by the approaches to progress which take truth to be the main aim of inquiry:

If true beliefs are desired, then that desire will be satisfied by a lucky guess. So a truth-seeker who has nothing else to go on ought to believe at random since that will maximise true belief. The important point here is that desiring truth does not entail that one desires to avoid falsehood (Bird 2007, p. 85).

In order to rebut this objection it will be sufficient to point out that, according to VS, truth (alone) is *not* the aim of inquiry. Instead, VS maintains that *informative truth* or verisimilitude—i.e., a combination of truth and content—is the main cognitive aim of science; as a consequence, progress is viewed as an approximation to the whole truth, or increasing verisimilitude. As noted in Sect. 2, a theory is highly verisimilar precisely when it says many things about the world and many of these things are true, and *hence few are false*. Thus, aiming at highly verisimilar theories is, by definition, a 'game of excluding falsity and preserving truth'. In fact, VS can be construed as a thorough explication of 'the complex aim of achieving truth subject to the proviso that falsity is [...] avoided' (Bird 2007, p. 85; cf. also p. 88, note 19). In other words, even granted that a 'truth-seeker' is only interested in maximising true beliefs, a verisimilitude-seeker will attempt to avoid falsehoods, besides accumulating truths. In his reply to Bird, Rowbottom (2008, p. 277) touches on this point by noting that a theory that is accepted by a community although it lacks an appropriate grounding in the evidence may include, besides some true 'lucky' guesses, also many false claims about the world. Consequently, the theory may well be not verisimilar, and accepting it would not constitute a progress towards truth. However, judging from his rejoinder to Rowbottom, one gets the impression that Bird does not take into proper account the methods that the champions of VS have proposed for assessing that there is, exactly as he requires (2008, p. 280), a 'preponderance of true beliefs over false beliefs', including the evaluation of the 'additional weight' assigned to 'the more significant ones'.

In this connection, Bird's attack against VS is apparently based on a misunderstanding of the notion of progress as increasing verisimilitude. In fact, it seems that Bird has in mind, as the main target of his criticism, the view of progress as the accumulation of truths, and that he considers VS as a milder variation of this view, characterized by the thesis that progress is not just the accumulation of truths, but the accumulation of approximate truths. There are at least two mistakes involved here. First of all, verisimilitude should not be conflated with approximate truth; and secondly, the accumulation of (approximate) truths does not guarantee increasing verisimilitude.

Regarding the former confusion (indeed quite common in the literature—see Niiniluoto 1998, pp. 18–19) one should note that, whereas verisimilitude is a combination of (approximate) truth and content—i.e., it is closeness to the whole truth—approximate truth or accuracy is *closeness to being true*.<sup>11</sup> Consider again

<sup>11</sup> For this distinction, see in particular Hilpinen (1976); Niiniluoto (1987, pp. 176–177 and 218–219; 1998, p. 18; 1999a, pp. 72–73); Weston (1992, pp. 54–56 and Sect. 10).

the example discussed in Sect. 2, where  $(p_1 \& \dots \& p_n)$  is ‘the truth’:  $(p_1 \text{ and } \neg p_2)$  is closer to being true—more accurate, more approximately true—than  $(p_1 \& \neg p_2 \& \neg p_3)$ , since the former theory entails only one falsehood out of two claims, whereas the latter makes three claims, two of which are false. The difference between approximate truth and verisimilitude is easily appreciated if one notices that all true theories are equally (and maximally) approximately true, since all what they say is true, but they may have very different degrees of verisimilitude. The central point of interest here is that approximate truth is only one ‘ingredient’ of verisimilitude: a theory may be accurate without being informative—and hence without being verisimilar. Consider once again the above example: although  $(p_1 \& \neg p_2)$  is more accurate than  $(p_1 \& \neg p_2 \& \neg p_3)$ , it may well be verisimilar to a very low degree, if  $n$  is high. A quantitative example may illustrate the difference between verisimilitude and approximate truth still more clearly (cf. Niiniluoto 1987, p. 177). Suppose that one has to estimate the height of Mont Blanc, and assume that its true value is  $h = 4810$  m. The statement ‘ $h$  is between 1,000 and 4,809 m’ is approximately true, since it is very close to the truth, but also quite weak and uninformative. For this reason, it may well be a worse guess than the less accurate but much sharper claim that  $h$  is between 4,700 and 4,800 m. Note also that all true statements—for instance, the claims ‘ $h$  is between 1,000 and 6,000 m’ and ‘ $h$  is between 4,500 and 5,000 m’—are all equally accurate but may well vary according to their ‘degree of sharpness’, i.e., to their informative content. To be sure, a highly verisimilar theory has to be approximately true as well (Niiniluoto 1998, p. 23), but the opposite does not hold.

Let us now turn to the distinction between increasing verisimilitude and accumulation of (approximate) truths. Within VS, the step from a theory  $T$  to a theory  $T'$  is considered as progressive when  $T'$  is (estimated as) more verisimilar than  $T$ : increasing verisimilitude is the key ingredient for progress. As it turns out, however, Bird’s attack is directed against a different target. More precisely, Bird (2007, p. 75 and Sect. 3.3, in particular) seems to believe that the step from  $T$  to  $T'$  is progressive, according to VS, when  $T$  is (approximately) true and  $T'$  is obtained from  $T$  by adding to it at least a single (approximate) truth. Consequently, progress gets confused with the accumulation of (approximate) truths: in fact, Bird claims that ‘where there is increasing verisimilitude there is also [according to VS] the accumulation of truth’ (2007, p. 77). This claim, however, is false, since the accumulation of (approximate) truths is neither a necessary nor a sufficient condition for increasing verisimilitude, i.e., for progress according to VS. In this respect one should recall, first of all, that a false (or falsified) theory  $T'$  may well be (estimated as) more verisimilar than a true or approximately true theory  $T$ , and hence be an instance of progress when adopted to replace  $T$ . This shows that increasing verisimilitude does not necessarily imply the accumulation of (approximate) truths. Secondly, as suggested by the examples considered above, accumulating (approximate) truths is not sufficient, in general, to obtain highly verisimilar theories. Indeed, it may happen that adding an approximately true, or even true, statement to a (false) theory  $T$  leads to a less verisimilar theory  $T'$ . For instance, suppose (cf. Niiniluoto 2010, p. 197) that  $T$  states that the height of Mont Blanc, indicated by  $h$ , is 1,000 or 4,809 m, and that the true value of  $h$  is 4,810 m. If  $T'$  is

obtained from  $T$  by adding to  $T$  the *true* statement that  $h$  is 1,000 or 4,810 m, then  $T'$  is the theory that  $h$  is 1,000 m, and is then *less* verisimilar than  $T$ .

The discussion in the present section shows that also Bird's second criticism of VS should be rejected. When the notions of verisimilitude (as opposed to approximate truth) and of progress as increasing verisimilitude (as opposed to accumulation of approximate truths) are appropriately construed, VS turns out to be perfectly equipped to account for the aversion to falsity that characterizes scientific practice.

## 5 Concluding Remarks

In this paper we defended the verisimilitudinarian approach to scientific progress (VS) against the criticisms raised by Bird (2007, 2008). In Sect. 3 we showed that Bird's hypothetical example of progress, allegedly demonstrating the insensitivity of VS to the grounding of scientific beliefs in the evidence, can be dealt with, within VS, as a case in which real progress and estimated progress do not go hand in hand. In Sect. 4 we argued that, when scientific progress is appropriately characterized as a matter of increasing verisimilitude (as opposed to the accumulation of truths, or of approximate truths), VS provides a very natural explanation of aversion to falsity: indeed, devising highly verisimilar theories is precisely a 'game of excluding falsity and preserving truth'.

Of course, we do not mean to imply that VS is without problems, or that it is the only viable approach to progress. As cursorily noted in Sect. 2, the discussion is very much alive also among scholars deeply involved in research on verisimilitude—as testified, for instance, by the polemical exchange between Zamora Bonilla (1992, 2000) and Kieseppä (1996a) concerning the epistemic problem of verisimilitude. Nevertheless, our discussion shows that, as an account of progress, VS is a much more serious and lively contender than Bird believes.<sup>12</sup> This becomes especially apparent when one takes into account some recent developments of this research programme, such as, for instance, the issue of truth approximation through belief change. Bird touches on this issue when he claims that a 'significant problem' (2007, p. 75) with VS is that it is not clear in what sense the addition of a single true or approximately true belief to the corpus of the scientists' beliefs leads that corpus, considered as a whole, closer to the truth. This question is different from, although certainly related to, the question of whether scientific progress can be accounted for in terms of increasing verisimilitude, and it is attracting a great deal of attention among scholars involved in research on verisimilitude.<sup>13</sup> Niiniluoto (1999b, 2010)

<sup>12</sup> In this paper, we limited ourselves to a defence of VS against the criticisms raised by Bird. Nevertheless, it seems worth mentioning that Bird's epistemic account of progress, which views progress as the accumulation of knowledge, suffers from a number of problems that VS eschews quite naturally. For instance, as forcefully argued by Rowbottom (2010), since an increase in knowledge requires an increase in true beliefs, it is difficult to see how the epistemic approach can account for progress in cases, such as the transition from Kepler's to Newton's theory, in which false theories replace false theories. On this, see also Niiniluoto (2011a, Sect. 3.5).

<sup>13</sup> On the problem of truth approximation through belief change, see especially Niiniluoto (1999b, 2010, 2011b); Cevolani and Calandra (2010); Kuipers (2011a, b); Schurz (2011); Cevolani et al. (2011).

and others have emphasized that VS does not imply that adding a true or accurate belief to a theory  $T$  necessarily leads to a new theory  $T'$  which is (estimated as) more verisimilar than  $T$ . More generally, no simple principle of the form ‘add to  $T$  a true, approximately true, or verisimilar, belief’ can guarantee truth approximation through belief change. To be sure, many intuitively progressive steps are acknowledged as such by VS (Niiniluoto 1999a, pp. 201–203). In particular, if  $T'$  is obtained from a *true* theory  $T$  by adding a new truth to it, then  $T'$  will be more verisimilar than  $T$ . In fact, among true theories, verisimilitude increases with content (see Sect. 2), exactly as required by Bird (2007, p. 75).

The ongoing development of VS, illustrated by the above example, suggests that this approach can open up fruitful perspectives on progress. Of course, only further work will allow to determine to what extent VS can successfully face new challenges in this area of research. At the very least, our defence of VS shows that it cannot be so easily discarded as an account of progress.

**Acknowledgments** We wish to thank Roberto Festa, Theo Kuipers, Ilkka Niiniluoto, and two anonymous referees for comments on earlier versions of this paper. Gustavo Cevolani acknowledges financial support from PRIN grant 2008 ‘Probability, stability, and invariance’. Luca Tambolo acknowledges financial support from PRIN grant 2008 ‘Probability, confirmation, and verisimilitude. The cognitive structures of “expert” opinion and decision in the empirical sciences and social interactions’.

## References

- Bird, A. (2007). What is scientific progress? *Noûs*, 41, 64–89.
- Bird, A. (2008). Scientific progress as accumulation of knowledge. A reply to Rowbottom. *Studies in History and Philosophy of Science*, 39, 279–281.
- Cevolani, G. & Calandra, F. (2010). Approaching the truth via belief change in propositional languages. In M. Suárez, M. Dorato & M. Rédei (Eds.), *EPSA. Epistemology and methodology of science: Launch of the European Philosophy of Science Association* (pp. 47–62). Berlin: Springer.
- Cevolani, G., Crupi, V., & Festa, R. (2011). Verisimilitude and belief change for conjunctive theories. *Erkenntnis*, 75, 183–202.
- Cools, K., Hamminga, B., & Kuipers, Th. A. F. (1994). Truth approximation by concretization in capital structure theory. In B. Hamminga & N. De Marchi (Eds.), *Idealization VI: Idealization in economics* (pp. 205–228). Amsterdam: Rodopi.
- Dilworth, C. (2008). *Scientific progress. A study concerning the nature of the relation between successive scientific theories* (4th ed.). Berlin/New York: Springer.
- Festa, R. (2007). Verisimilitude, cross classification, and prediction logic. Approaching the statistical truth by falsified qualitative theories. *Mind and Society*, 6, 91–114.
- Festa, R., Aliseda, A., & Peijnenburg, J. (Eds.) (2005b). *Cognitive structures in scientific inquiry. Essays in debate with Theo Kuipers*. Amsterdam/New York: Rodopi.
- Festa, R., Aliseda, A., & Peijnenburg, J. (Eds.) (2005a). *Confirmation, empirical progress, and truth approximation. Essays in debate with Theo Kuipers*. Amsterdam/New York: Rodopi.
- Hettema, H. & Kuipers, Th. A. F. (1995). Sommerfeld’s *Atombau*: a case study in potential truth approximation. In Th. A. F. Kuipers & A. R. Mackor (Eds.), *Cognitive patterns in science and common sense* (pp. 273–197). Amsterdam: Rodopi.
- Hilpinen, R. (1976). Approximate truth and truthlikeness. In M. Przelecki, K. Szaniawski & R. Wójcicki (Eds.), *Formal methods in the methodology of the empirical sciences* (pp. 19–42). Dordrecht: Reidel.
- Kieseppä, I. A. (1996a). On the aim of the theory of verisimilitude. *Synthese*, 107, 421–438.
- Kieseppä, I. A. (1996b). *Truthlikeness for multidimensional, quantitative cognitive problems*. Dordrecht: Kluwer.
- Kuhn, Th. S. (1962/1970). *The structure of scientific revolutions*. Chicago: The University of Chicago Press.

- Kuipers, Th. A. F. (2000). *From instrumentalism to constructive realism. On some relations between confirmation, empirical progress, and truth approximation*. Dordrecht: Kluwer.
- Kuipers, Th. A. F. (1987). A structuralist approach to truthlikeness. In Th. A. F. Kuipers (Ed.), *What is closer-to-the-truth?* (pp. 79–99). Amsterdam: Rodopi.
- Kuipers, Th. A. F. (2004). Inference to the best theory, rather than inference to the best explanation. Kinds of abduction and induction. In F. Stadler (Ed.), *Induction and deduction in the sciences* (pp. 25–51). Dordrecht: Kluwer.
- Kuipers, Th. A. F. (2009). Comparative realism as the best response to antirealism. In C. Glymour, W. Wei & D. Westerstahl (Eds.), *Logic, methodology and philosophy of science. Proceedings of the thirteenth international congress* (August 9–15, 2007, Beijing) (pp. 221–250). London: College Publications.
- Kuipers, Th. A. F. (2011a). Basic and refined nomic truth approximation by evidence-guided belief revision in AGM-terms. *Erkenntnis*, 75, 223–236.
- Kuipers, Th. A. F. (2011b). Dovetailing belief base revision with (basic) truth approximation. Forthcoming in the proceedings of the *Logic, reasoning and rationality* conference (Gent, September 20–22, 2010).
- Laudan, L. (1978). *Progress and its problems. Towards a theory of scientific growth*. Berkeley: The University of California Press.
- Laudan, L. (1984). *Science and values*. Berkeley: The University of California Press.
- Laudan, L. (1996). *Beyond positivism and relativism. Theory, method, and evidence*. Boulder: Westview.
- Liu, C. (1999). Approximation, idealization, and laws of nature. *Synthese*, 118, 229–256.
- Liu, C. (2004). Laws and models in a theory of idealization. *Synthese*, 138, 363–385.
- Losee, J. (2004). *Theories of scientific progress. An introduction*. London/New York: Routledge.
- Miller, D. (1974). Popper's qualitative theory of verisimilitude. *The British Journal for the Philosophy of Science*, 25, 166–177.
- Miller, D. (1978). On distance from the truth as a true distance. In J. Hintikka, I. Niiniluoto & E. Saarinen (Eds.), *Essays on mathematical and philosophical logic* (pp. 415–435). Dordrecht: Kluwer.
- Niiniluoto, I. (1984). *Is science progressive?*. Dordrecht: Reidel.
- Niiniluoto, I. (1987). *Truthlikeness*. Dordrecht: Reidel.
- Niiniluoto, I. (1994). Approximation in applied science. In M. Kuokkanen (Ed.), *Idealization VII: Structuralism, idealization, and approximation* (pp. 127–139). Amsterdam: Rodopi.
- Niiniluoto, I. (1998). Verisimilitude: the third period. *The British Journal for the Philosophy of Science*, 49, 1–29.
- Niiniluoto, I. (1999a). *Critical scientific realism*. Oxford: Oxford University Press.
- Niiniluoto, I. (1999b). Belief revision and truthlikeness. In B. Hansson, S. Halldén, N.-E. Sahlin & W. Rabinowicz (Eds.), *Spinning ideas: Internet Festschrift for Peter Gärdenfors*, <http://www.lucs.lu.se/spinning/>. Accessed 1 Dec 2011.
- Niiniluoto, I. (2010). Theory change, truthlikeness, and belief revision. In M. Suárez, M. Dorato & M. Rédei (Eds.), *EPSA. Epistemology and methodology of science: Launch of the European Philosophy of Science Association* (pp. 189–199). Berlin: Springer.
- Niiniluoto, I. (2011a). Scientific progress. In E. Zalta (Ed.), *The Stanford encyclopedia of philosophy* (Summer 2011 ed.). <http://plato.stanford.edu/archives/sum2011/entries/scientificprogress/>. Accessed 1 Dec 2011.
- Niiniluoto, I. (2011b). Revising beliefs towards the truth. *Erkenntnis*, 75, 165–181.
- Northcott, R. (2011). Verisimilitude: a causal approach. *Synthese*. doi:10.1007/s11229-011-9895-7.
- Oddie, G. (1986). *Likeness to truth*. Dordrecht: Reidel.
- Oddie, G. (2008). Truthlikeness. In E. Zalta (Ed.), *The Stanford encyclopedia of philosophy* (Fall 2008 ed.). <http://plato.stanford.edu/archives/fall2008/entries/truthlikeness/>. Accessed 1 Dec 2011.
- Pihlström, S., Raatikainen, P., & Sintonen, M. (Eds.). (2007). *Approaching truth: Essays in honour of Ilkka Niiniluoto*. London: College Publications.
- Piscopo, C., & Birattari, M. (2010). A critique of the constitutive role of truthlikeness in the similarity approach. *Erkenntnis*, 72, 379–386.
- Popper, K. R. (1963). *Conjectures and refutations*. London: Routledge and Kegan Paul.
- Popper, K. R. (1972). *Objective knowledge. An evolutionary approach*. Oxford: Clarendon Press.
- Rowbottom, D. P. (2008). N-rays and the semantic view of scientific progress. *Studies in History and Philosophy of Science*, 39, 277–278.
- Rowbottom, D. P. (2010). What scientific progress is not: against Bird's epistemic view. *International Studies in the Philosophy of Science*, 24, 241–255.

- Schurz, G. (2011). Verisimilitude and belief revision. With a focus on the relevant element account. *Erkenntnis*, 75, 203–221.
- Schurz, G., & Weingartner, P. (1987). Verisimilitude defined by relevant consequence-elements. A new reconstruction of Popper's original idea. In Th. A. F. Kuipers (Ed.), *What is closer-to-the-truth?* (pp. 47–78). Amsterdam: Rodopi.
- Schurz, G., & Weingartner, P. (2010). Zwart and Franssen's impossibility theorem holds for possible-world-accounts but not for consequence-accounts to verisimilitude. *Synthese*, 172, 415–436.
- Tichý, P. (1974). On Popper's definition of verisimilitude. *The British Journal for the Philosophy of Science*, 25, 155–160.
- Votsis, I., & Schurz, G. (2011). A frame-theoretic analysis of two rival conceptions of heat. *Studies in History and Philosophy of Science*. doi:[10.1016/j.shpsa.2011.10.010](https://doi.org/10.1016/j.shpsa.2011.10.010).
- Weston, T. (1992). Approximate truth and scientific realism. *Philosophy of Science*, 59, 53–74.
- Zamora Bonilla, J. (1992). Truthlikeness without truth: a methodological approach. *Synthese*, 93, 343–372.
- Zamora Bonilla, J. (1996). Verisimilitude, structuralism, and scientific progress. *Erkenntnis*, 44, 25–47.
- Zamora Bonilla, J. (2000). Truthlikeness, rationality, and scientific method. *Synthese*, 122, 321–335.
- Zwart, S. D. (2001). *Refined verisimilitude*. Dordrecht: Kluwer.