Scientific Progress: Why Getting Closer to Truth is Not Enough

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Abstract: The aim of this discussion note is to contribute to the ongoing debate over the nature of scientific progress. I argue against the semantic view of scientific progress, according to which scientific progress consists in approximation to truth or increasing verisimilitude. If the semantic view of scientific progress were true, then scientists would make scientific progress simply by arbitrarily adding true disjuncts to their hypotheses or theories. Given that it is not the case that scientists would make scientific progress simply by arbitrarily adding true disjuncts to their hypotheses or theories, it follows that the semantic view of scientific progress is false.

Alexander Bird's (2007) paper on scientific progress has generated an exchange between Bird (2008) himself, Darrell Rowbottom (2008), (2015), and Ilkka Niiniluoto (2014) over the nature of scientific progress. Bird (2007) defends the epistemic view of scientific progress, according to which scientific progress consists in the accumulation of knowledge. Bird (2008) characterizes the epistemic view of scientific progress as follows:

(E) An episode constitutes scientific progress precisely when it shows the accumulation of scientific knowledge (Bird 2008, p. 279).

Against Bird and (E), Rowbottom (2008) defends the semantic view of scientific progress, according to which scientific progress should be understood in terms of truth, not knowledge. Bird (2008) characterizes the semantic view of scientific progress as follows:

(S) An episode constitutes scientific progress precisely when it either (a) shows the accumulation of true scientific belief, or (b) shows increasing approximation to true scientific belief (Bird 2008, 279).

In another paper on scientific progress, Rowbottom (2010, p. 245) endorses (S) explicitly when he writes:

I wish to emphasise that the semantic view of scientific progress, which Bird (2007) correctly takes me to prefer as an alternative to the epistemic view, only requires that *science makes progress by discovering new truths*. Such truths could take the form of 'T_1 is approximately empirically adequate in the class of circumstances C', or even 'T_2 is false', and so on (emphasis added).

Niiniluoto (2014) criticizes Rowbottom's arguments for (S) over (E), but he also defines scientific progress in semantic terms. Specifically, he argues that "scientific progress can be defined by increasing verisimilitude" (Niiniluoto 2014, p. 77). For Niiniluoto (2014, p. 75),

"Historical case studies, which illustrate progress as increasing truthlikeness include shifts from Ptolemy to Snell's law of refraction," among others. Rowbottom (2015) has responded to Niiniluoto (2014) and the debate continues. (See also Niiniluoto 2015.)

More recently, Finnur Dellsén (2016) has argued for an understanding-based account of scientific progress. According to the "noetic account" of scientific progress, science "makes cognitive progress precisely when it increases our understanding of some aspect of the world" Dellsén 2018a, p. 451). Seungbae Park (2017) criticizes the noetic account and argues in favor of an epistemic or knowledge-based account, along the lines of (E), as opposed to an understanding-based account of scientific progress. Dellsén (2018a) has responded to Park (2017) and the debate continues. (See also Dellsén 2018b.)

The aim of this discussion note is to contribute to this ongoing debate over the nature of scientific progress. (See also Cevolani & Tambolo 2013, Mizrahi 2013, and Mizrahi & Buckwalter 2014.) In what follows, I will sketch an argument against the semantic view of scientific progress, i.e., (S).

Suppose that T_1 and T_2 are two utterly false theories. In Niiniluoto's notation: $Tr(T_1,C^*) = Tr(T_2,C^*)$, where "Truthlikeness [is] understood as distance from the target C^* which is the most informative true statement in [a semantically determinate language] L" (Niiniluoto 2014, p. 74). In other words, T_1 and T_2 are equally as far from the truth as possible. Now suppose that scientists argue as follows:

1. T_2

2. T_2 or squares are rectangles (by Addition from 1)

Since the second disjunct of (2) is true by definition, (2) is true even if the first disjunct, i.e., T_2, is utterly false. This means that (2) is closer to the truth than (1) is. Since T_1 and T_2 are two utterly false theories, by stipulation, it follows that (T_2 ∨ squares are rectangles) is now closer to the truth than T_1. In Niiniluoto's notation: $Tr(T_1,C^*) < Tr(T_2$ ∨ squares are rectangles,$C^*)$. On (S), then, we would have to say that the move from (1) to (2) is progressive, even though T_2 is an utterly false theory.

If this is correct, then it means that scientists would make scientific progress simply by applying the inference rule of Addition to their hypotheses or theories, regardless of whether those hypotheses or theories are true. By doing so, they are guaranteed to make scientific progress, even if their hypotheses or theories are utterly false, as long as they add a disjunct that is true by definition. I take this to be a result that proponents of (S) would not want to accept.

To block this unacceptable consequence of their view, then, perhaps proponents of (S) could argue that adding non-scientific disjuncts to scientific hypotheses or theories does not count as *scientific* progress precisely because what is being added is not *scientific*. Even though "squares are rectangles" is true by definition, it is not a *scientific* truth.

This response on behalf of proponents of (S) will not do, however, for we could easily use other disjuncts, which would be considered scientific, to make the same point. For example,

substitute "squares are rectangles" with the formula for the area of an ellipse, i.e., $A = ab\pi$. That is:

3. T_2

4. T_2 or $A = ab\pi$ (by Addition from 3)

Again, since the second disjunct of (4) is true, (4) is true even if the first disjunct, i.e., T_2, is utterly false. This means that (4) is closer to the truth than (3) is. Since T_1 and T_2 are two utterly false theories, by stipulation, it follows that $(T_2 \lor (A = ab\pi))$ is now closer to the truth than T_1. In Niiniluoto's notation: $\text{Tr}(T_1, \text{C}^*) < \text{Tr}(T_2 \lor (A = ab\pi), \text{C}^*)$. On (S), then, we would have to say that the move from (3) to (4) is progressive, even though T_2 is an utterly false theory.

In this case, one would be hard pressed to deny that $A = ab\pi$ is scientific. After all, it figures prominently in Kepler's laws of planetary motion, according to which the orbits of the planets are elliptical. Surely, Kepler's laws of planetary motion count as *scientific* laws. If this is correct, then it remains an unacceptable consequence of the semantic view of scientific progress, (S), that scientists could make scientific progress simply by applying the inference rule of Addition to their hypotheses or theories to add true disjuncts arbitrarily, regardless of whether those hypotheses or theories are true. By doing so, they are guaranteed to make scientific progress, even if their hypotheses or theories are utterly false, as long as they add a disjunct that is guaranteed to be true. Again, I take this to be a result that proponents of (S) would not want to accept. For it would mean that any scientific hypothesis or theory could be made true by arbitrarily adding a true disjunct to it. Take the example of N-rays used by Bird (2007), (2008)

and Rowbottom (2008). As before, suppose that scientists apply the inference rule of Addition to the N-rays hypothesis and add a true disjunct to it. That is:

5. N-rays

6. N-rays or X-rays (by Addition from 5)

Since there are X-rays, (6) is true even though there are no N-rays. This means that (6) is closer to the truth than (5) is. In Niiniluoto's notation: Tr(N-rays,C*) < Tr(N-rays ∨ X-rays,C*). On (S), then, we would have to say that the move from (5) to (6) is progressive, even though the N-rays hypothesis is false. Again, this result would not be acceptable to proponents of (S) for it means that scientists could make scientific progress on any scientific theory whatsoever simply by arbitrarily adding a true disjunct to it. This, in turn, would make scientific progress *arbitrary*.

Proponents of (S) might also try to block this unacceptable consequence of their view by insisting that truths about squares, ellipses, and X-rays are not new, but scientific progress is made when new truths are discovered. As Rowbottom (2010, p. 245) puts it, "science makes progress by discovering *new* truths" (emphasis added). But this response on behalf of proponents of (S) will not do, either. Although "squares are rectangles" is not a new truth, (T_2 ∨ squares are rectangles) is. Similarly, $A = ab\boldsymbol{\pi}$ is not a new truth, whereas (T_2 ∨ ($A = ab\boldsymbol{\pi}$)) is. Accordingly, restricting scientific progress to new truths is not enough to avoid this unacceptable consequence of (S), namely, that scientists could make scientific progress simply by arbitrarily adding truths to hypotheses or theories to make new truths, such as (N-rays ∨ X-rays).

Proponents of (S) might insist that trivial consequences of old truths do not count as new truths. But this response on behalf of proponents of (S) will not work, either. To see why, consider two scientific communities, each believes in the utterly false theory T_2. Now, let N be a new scientific proposition that one scientific community then adds to its currently held belief in T_2 by applying the rule of Addition, whereas the other scientific community adds the negation of N by applying the rule of Addition. That is:

Scientific Community A   Scientific Community B

7. T_2 9. T_2

8. $T_2 \lor N$ 10. $T_2 \lor \sim N$

Either (8) or (10) will be a new scientific truth, given that T_2 is utterly false by stipulation. On (S), one of these scientific communities, either A or B, will have made scientific progress. But again, it is not the case that either scientific community A or scientific community B makes scientific progress simply by believing an arbitrary consequence of what it already believes. For that would make scientific progress *arbitrary*.

To sum up, my argument against the semantic view of scientific progress, (S), can be summed up as follows:

1. If the semantic view of scientific progress were true, then scientists would make scientific progress simply by arbitrarily adding true disjuncts to their hypotheses or theories, regardless of whether those hypotheses or theories are true.

2. It is not the case that scientists could make scientific progress simply by arbitrarily adding true disjuncts to their hypotheses or theories, regardless of whether those hypotheses or theories are true.

Therefore,

3. The semantic view of scientific progress is false.

If my argument is sound, then scientific progress is not simply a matter of accumulating truths (Rowbottom 2015, p. 102) or increasing approximation to truth (Niiniluoto 2014, p. 75). Contrary to (S), there must be more to scientific progress than just getting closer to the truth.

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