***Scientific Realism, Approximate Truth and Contingency in Science***

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**1. Introduction**

Could the historical development of the sciences have led to the emergence of alternative theoretical approaches? Could we have come to rationally accept scientific theories radically different from, or even incompatible with our currently best confirmed theories? Are the results of successful science contingent? Ian Hacking brings up the issue of contingency in science when discussing social constructivism ([Hacking 1999: 68-80](#_ENREF_10)). According to him, social constructivists view science as contingent, while scientific realists tend to argue that the results of successful science are inevitable (see also [Hacking 2000: 61](#_ENREF_11)).

The alignment of scientific realism with “inevitabilism”, and of constructivism with “contingentism” has since been called into question. Léna Soler argues that although the issues of *realism vs. constructivism* and *inevitabilism vs. contigentism* may be psychologically connected, the two conflicts do not coincide (Soler 2008: 230-231). Howard Sankey shows that scientific realism does not necessarily go hand in hand with inevitabilism (Sankey 2008). And Gregory Radick claims that both *anti-realist inevitabilist* and *realist contingentist* interpretations of the history of science are conceivable (Radick 2005: 23-25).

In this paper, I continue the discussion, focusing on scientific realists‘ conceptions of the historical development of science. In agreement with Sankey and Radick I argue that the core theses that constitute scientific realism as a philosophical doctrine do not imply a strong form of inevitabilism. However, as I will show, things get more complicated once we focus not only on the core theses, but also on the pictures of the history of science that realists present when justifying and defending their views. I argue that realists can acknowledge some degree of contingency in the history of science, but not the type of contingency that is typically embraced by the social constructivist. The realist can thus fall on either side of the *inevitability vs. contingency* conflict, but even when falling on the contingency side, she will disagree with the constructivist about how much and what type of contingency there is in science.

**2. Mapping the debates**

Scientific realism as a philosophical doctrine is often defined by reference to a set of core theses. It has metaphysical, semantic and epistemic components. The metahysical component affirms the existence of a mind-independent reality. The semantic component holds that scientific theories are to be understood literally. And the epistemic component states that the truth-values of scientific theories can be determined by ordinary scientific methods and that our best-confirmed scientific theories are typically (approximately) true. Each of the three components is controversial, but recent debates have come to focus primarily on the epistemic aspects of realism (For definitions of realism in terms of the epistemic status of theories, see Boyd 1990, Psillos 1999).

The contingency vs. inevitability debate, in contrast, is not a debate about the epistemic status of theories. Rather, it is a debate about the possibility of alternatives to current science and about the general patterns of scientific development (for definitons see Ben-Menahem 1997, Soler 2008).

For example, Steven Weinberg, one of the rare explicit defenders of inevitabilism, argues that research in physics progresses towards certain fixed points. According to him, science is teleologically driven towards the discovery of a final theory and different research trajectories starting from different initial conditions would, if successful, ultimately converge on this final theory (Weinberg 2001).

On the contingentist side, Andrew Pickering may serve as an example. He argues that at crucial points in the history of high energy physics – the discovery of the weak neutral current, the discovery of partons, the discovery of charm flavored quarks, etc. – events could have taken a different turn. Scientists could have decided to accept different experimental results and theoretical interpretations, and subsequent developments could have led to the emergence of a physical science radically different from the one we know today (Pickering 1984).

The fact that realism is a doctrine about the epistemic status of theories while the contingency debate focuses on the historical processes of science complicates the task of mapping the two issues. In the following, I pursue two strategies. First, I investigate whether the realist core theses, taken by themselves, have any implications for the contingency vs. inevitability debate. Second, I analyze how the historical pictures presented by realists relate to the contingency issue.

**3. Core theses**

Regarding the relations of implication that hold between the core theses of scientific realism and philosophical positions in the contingency vs. inevitability debate, there are two questions to ask. First, do the core theses imply inevitabilism? As Sakey shows, this is not the case. Inevitabilism, understood as the view that alternative successful sciences would inevitably converge on the same final theory, does not follow from the metaphysical, semantic and not even from the epistemic commitments of realism. The idea that scientific methods can determine which theories are true and that our best confirmed theories are typically approximately true, does not imply that the process of science will inevitably lead to the discovery of a final theory (Sankey 2008: 161).

Second and conversely, do the core theses of realism rule out contingency? Radick argues that they do not, because metaphysical realism is compatible with contingentism (Radick 2005: 25). But we might expect the epistemic component of realism to have stronger negative implications. If the truth values of scientific theories are determined by ordinary scientific methods, how much room is there for contingency? And if our actual theories are approximately true, would scientific method have allowed us to accept different theories?

Perhaps surprisingly, the answer is yes. We could have accepted different (although perhaps not radically different) theories. In order to show that this is the case, we have to cash out in more detail how the central terms of the epistemic thesis – terms like scientific method and approximate truth – are understood by realists. This is why in the next step, I turn to the historical pictures of science that realists have developed.

**4. Historical pictures**

I discuss two examples, Richard Boyd’s reliabilist conception of scientific methodology and Stathis Psillos’ continuist vision of truth preservation. As I show, neither Boyd nor Psillos are inevitabilists. Rather, both allow for the contingentist view that the history of science could have led to the acceptance of alternative theories.

Boyd’s justification of realism draws on a version of the no-miracles argument, according to which the best explanation for the success of science is the (approximate) truth of its theories (Putnam 1975: 73). Boyd argues that since scientific methodology is theory-laden its reliability can only be explained if we assume that the background theories which inform methodological principles are already approximately true (Boyd 1980, 618–21). But for Boyd the approximate truth of background theories ensures not only that science is instrumentally successful. It also enables scientific methodology to refine and correct existing theoretical knowledge, such that later theories “are successively more accurate and more comprehensive” (Boyd 1980: 623).

Although he speaks of successfive approximation to the truth, Boyd is not an inevitabilist. For him, progress does not “have the exact truth as an asymptotic limit” (Boyd 1990: 355) and thus does not lead to the inevitable discovery of a final theory. There is no general measure of approximate truth. Determining whether and in which respects a theory is closer to the truth than its predecessor is always a contextual judgment.

Moreover, for Boyd contingency plays a significant role in the history of science. Since reliable methodology depends on true theories, at some point in the early history of science, an initial stock of approximately true theories needed to emerge. This emergence cannot be explained by reliable methodology. The historical origins of science are “logically, epistemically, and historically contingent” (Boyd 1990: 366).

Boyd’s realist historical picture is thus compatible with a contingency claim. Since scientific progress as Boyd describes it does not lead towards convergence on a final theory, we could have ended up accepting different theories from the actual ones if the initial conditions of the scientific process had been different.

My second example for a realist view of history that allows for contingency is given by Psillos’ defense of realism against Larry Laudan’s pessimistic meta-induction. Laudan had argued that many past successful theories are now understood to be either non-referring or false. Measured against the historical record, the view that the empirical success of a theory provides warrant for its approximate truth is thus mistaken (Laudan 1981).

Attempting to reconcile the historical record with the idea that empirically successful theories are also typically approximately true, Psillos draws on a strategy of selective confirmation. He argues that the confirmational import of successful prediction is selective: it warrants only those theoretical constituents that are responsible for the empirical success of the theory (Psillos 1999: 108–09). Psillos then claims that success-generating parts of past theories are typically preserved in later stages of the scientific process, such that there is historical continuity in success-generating theoretical posits.

This argument is the basis for an optimistic induction about the development of science. According to Psillos, science is characterized by an accumulation of secured truths, reaching “a rather stable and well-supported network of theoretical assertions and posits which is our best account of what the world is like” (Psillos 1999: 104).

Clearly, Psillos’ vision does not commit to the inevitabilist view that science progresses towards a final theory. Stable truths accumulate according to Psillos, but they need not approximate a final and complete theory.

Psillos also allows for some degree of contingency in the history of science. His only constraint on theory creation is that truths are preserved. But in his continuist picture we could have contingently discovered different truths and accumulated a different set of “invariant and stable elements” (Psillos 1999: 109) disjointed from the accumulated results of our actual science.

**5. A conflict after all**

We have seen that realism does not imply an inevitabilist convergence view. We have also seen that realism is compatible with an acknowledgement of contingency in the history of science. Realism can fall on either side of the “contingency” vs. “inevitability” conflict.

But what about the intuion that the contingency issue is one of the “sticking points” in debates between realists and social constructivists? In the remainder of this paper, I argue that there is indeed a type of contingency incompatible with realism and it is this type of contingency that is ususally embraced by the constructivist.

Studies of scientific controversies in the sociology of scientific knowledge have been a central locus for contingency claims about science (Examples can be found in Barnes et al. 1996, Collins 1985, Pickering 1984, Pinch 1986). Controversy studies use situations of disagreement to highlight the role of contingent social factors in shaping the results of scientific research processes. A typical social constructivist argument is as follows.

In a conflict about which of competing scientific results to accept, methodology, rationality and evidence underdetermine the decision. Local and historically variable factors have to join for a decision to be reached. Which of the different results becomes accepted is therefore a context sensitive affair, shaped by local historical circumstances. In a given situation of theory choice, the outcomes of the decision process would be different, if the contingent, local factors were different.

We can generalize this argument into ahistorical picture. In this picture, situations of multiple rational acceptability recurr repeatedly along the historical trajectory of scientific research. In each situation in which a decision about competing results is made, contingent local factors shape the course of research. As a result, scientific development is erratic, meandering and unpredictable. It does not follow a fixed, predetermined pattern.

We can now see why social constructivist contingency and the realist historical picture are incompatible. First, while in the realist view of the history of science we could have come to accept alternative theories, the demand that these alternatives be approximately true places some constraints on just how different they could have been. Presumably, the alternatives could not have been incompatible with our actual best-confirmed theories. The social constructivist is more radical in this regard. According to her, we could not only have come to accept different, but even radically different, incompatible theories.

Second, while realism allows some degree of contingency in the history of science, it also has to assume that there is a stable pattern of scientific change that favors truth-preserving continuities in science over discontinuities, or else the no-miracle argument breaks down. Social constructivist contingentism, in contrast, denies that there is a stable pattern of scientific development that would ensure continuity, accumulation and progress. To the extent that realism has to secure general patterns of scientific development, it is thus incompatible with the social constructivist view that scientific decision making is shaped by local, contingent factors and thus fundamentally unpredictable.

We can conclude that there is a genuine conflict between realism and social constructivism as regards the issue of contingency in science. But the realist and the constructivist should not be seen as arguing over whether science is contingent or inevitable. Rather, they should be seen as arguing about how much and what type of contingency there is in the historical processes of science.

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