The Ultimate Argument Against Convergent Realism and Structural Realism: The Impasse Objection

Paul Hoyningen-Huene

Abstract The target of the impasse objection is any kind of scientific realism that bases its plausibility on the stable presence of some X in a sequence of theories. For instance, if X is a set of theoretical entities that remains stable even over some scientific revolutions, this may be taken as support for convergent scientific realism about entities. Likewise, if X is a similarly stable set of structures of theories, this may be taken as support for (convergent) structural realism. The impasse objection states that the conceded stability of X could also be due to the existence of an empirically extremely successful though ontologically significantly false theory. In this case, the inference from the stability of X to the probable reality of X would become invalid. The paper closes with a discussion of several counter-objections to the impasse objection.

1 The Targets of the Impasse Objection

The argument that I shall present in this paper concerns some, but certainly not all sub-positions of scientific realism. First, it does not concern plain scientific realism that states that our best mature scientific theories are just true with respect to the postulated theoretical entities and their properties. Second, it does not concern any form of entity realism in which manipulability is the main resource for claims to reality. Third, it does not concern all forms of structural realism that either bracket the general defense of realism or do not use the "structural continuity

P. Hoyningen-Huene (✉)
Institute of Philosophy, Leibniz Universität Hannover, Im Moore 21,
D – 30167 Hannover, Germany
e-mail: hoyningen@ww.uni-hannover.de

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claim" in its defense (I shall explain further below what I mean by the "structural continuity claim"). By contrast, the argument presented in this paper firstly concerns convergent scientific realism about entities (CSRE). Secondly, it concerns all forms of structural realism (SR) that do base their plausibility on the "structural continuity claim". Finally, in more general terms, it concerns any form of realism about X that bases its plausibility on the continuous presence of X in a sequence of theories. For convergent scientific realism about entities, X would be some theoretical entities; in structural realism, X would be some structures. In addition, X could be, e.g., some properties.

Let me first deal with convergent scientific realism about entities (CSRE). It is a doctrine (or rather a family of doctrines) that roughly states that we are fairly safe to make the following two core assumptions (compare, e.g., (Sankey 2004)):

1. Accepted mature scientific theories are approximately true, which means in particular that the theoretical entities postulated by them really exist (e.g., electrons, quarks, fields, big bang, selection pressures, continental plates, etc.).
2. Scientific statements about the properties of these unobservable entities become more and more accurate in the course of scientific development.

The following assumption may be seen as optional, although it is part of the name "convergent scientific realism about entities":

3. In the course of scientific development, the sequence of accepted mature scientific theories converges to a true theory.

However, for several reasons one might be reluctant to embrace assumption 3, and I shall discuss some of these reasons further below.

In the following, I shall drop the cumbersome clause "that we are fairly safe to make" these assumptions which I used when introducing them. This clause takes care of their general fallibility which is usually conceded by realists. I shall simply say that convergent scientific realism about entities makes the two above-mentioned assumptions without meaning to deny their general fallibility.

What are the main arguments for convergent scientific realism about entities (CSRE)? All arguments start from the uncontroversial observation that since the seventeenth century, there is a successive improvement of scientific theories with respect to their empirical performance. This progress is interpreted in the sense of CSRE for the following two reasons. First, in most cases theoretical objects introduced into modern science stay there for good. Most importantly, these theoretically postulated entities usually survive subsequent changes of theory. Admittedly, there are some exceptions to this rule, but according to most adherents of CSRE, these exceptions can more or less elegantly be explained away. The claim underlying this first line of reasoning may be called the "entity continuity claim". The second main argument for CSRE is the much discussed so-called miracle argument; it is sometimes referred to as the "ultimate argument for realism". Basically, the argument states that the spectacular success of science can only be understood if science gets its theoretical postulates at least approximately right;

otherwise the success of science would be a complete miracle (and miracles usually do not exist as everyone knows). The argument becomes most persuasive if the mentioned "success of science" is further specified, namely as the repeatedly demonstrated ability of science to produce so-called use-novel predictions. "Use-novel predictions" of a theory are empirical predictions of it that were not inbuilt into it during its construction. In other words, the theory in question somehow manages to have additional empirical content that was not put into it but that it produced itself, by its own resources. What are these resources? Mainly it's theoretically postulated entities and their properties, and although their choice was motivated to account for some known empirical phenomena, they are able to account for more, sometimes even for empirical phenomena unknown at the time of the invention of the theory. The bending of starlight around the sun was such a case: not inbuilt into Einstein's General Theory of Relativity, it was nevertheless predicted by it and was somewhat later empirically confirmed to exist. Wouldn't this prediction be really miraculous if the basic assumptions of Einstein's theory were wide off the mark?

Let us now move on to a short characterization of another brand of convergent scientific realism, "structural realism" (SR; the "convergent" is usually dropped in its name). Historically, SR goes back to the early twenieth century. The more recent discussion of SR begins in 1989 with a paper by John Worrall: "Structural Realism: The Best of Both Worlds?" (Worrall 1996 [1989]). This type of SR concedes a very common counter-argument against CSRE which denies the "entity continuity claim".[1] This counter-argument has been widely used by anti-realists of various kinds. The counter-argument claims that scientific revolutions sometimes drastically change theoretically postulated entities such that the entity continuity claim of CSRE cannot be upheld. In other words, one of the most important historical pillars of CSRE collapses and with it its plausibility. Theoretical entities are thus inappropriate candidates for a realist interpretation of scientific theories. However, structural realists claim that the realist cause is nevertheless not lost as the anti-realists would have it. Instead, SR proposes that theoretical (mathematical) structures are much better candidates for a realist interpretation of scientific theories as they are much more continuous through historical change of theories. Thus, SR replaces the entity continuity claim of CSRE by the "structural continuity claim" (Votsis 2011; see also Lyre 2004, p. 664). According to structural realists, the latter claim is historically much more confirmed than the former and thus a much better basis for realism, i.e., for structural realism. As seen especially clearly in the history of physics, later theories indeed incorporate the mathematical structure of their predecessors. This is evident by, among other things, the limit relations between

[1]There is another type of SR that Holger Lyre has dubbed the "French-Ladyman-type" approach to SR, contrasting it with the "Worrall-type" approach discussed above (Lyre 2010). The French-Ladyman approach applies SR directly to concrete physical theories instead of defending it at length by general arguments at a very abstract level.

theories and their successors. Thus, according to SR there is a historically stable *structural core* in physical theories which is legitimately interpreted as reflecting reality's own structure.

For both brands of realism, for scientific realism about entities and for structural realism, it may appear attractive to assume that the sequence of theories in question indeed converges to a true theory. However, there are several problems connected with this idea. What is exactly meant by the "true theory"? How can the notion "convergence of a sequence of theories" be precisely explicated? And how can the convergence of such a sequence be claimed on the basis of a finite number of elements? The easiest way out of these difficulties is to drop the assumption that the sequence of theories indeed converges to the truth. Thus, in order to defend a particular brand of realism one may only use the "entity continuity claim", or the "structural continuity claim", or any "X continuity claim", respectively, without claiming convergence of the sequence of theories, because the continuity claim suffices for the argument. The basic idea of this argument is: what has been stable through progressive scientific development qualifies as a good candidate for being real. This is an abductive argument: a possible explanation for the presence of the stable element X in the sequence of theories is that its stability is due to its at least approximately representing an aspect of reality. Once this aspect X has been hit upon in the sequence of ever improving theories, subsequent theories won't let go of it.

2 The Impasse Objection

The objection against this kind of reasoning that I am going to state exploits the principal weakness of the abductive argument just given. The argument is independent of what sort of X has been chosen; especially, it both applies to convergent scientific realism about entities and to structural realism as discussed above (Worrall-type). Let us assume that the sequence of theories in question indeed converges to some limit theory. In spite of the tremendous difficulties to spell out exactly what that means, as discussed above, the assumed convergence is certainly not logically impossible. In this case, the realists (of the different brands in question) have to claim, possibly much against their will, that the limit theory is at least approximately true – otherwise the inference to the stable element X in the sequence as being approximately true would collapse. However, there is a possibility that the realists must at least make less plausible than its opposite: that the limit theory is a *fundamentally false* theory that is capable of making *very accurate predictions*. "Fundamentally false" may mean different things to different sorts of realists. For the defender of CSRE it would mean that the entities postulated by the limit theory would be so different from the real entities (described by the true theory) that the limit theory's entities could not count as approximations to the real entities. In other

words: At least some of the terms of the limit theory do not refer to the real entities. For the defender of SR "fundamentally false" would mean that the structure of the limit theory is so different from the structure of the true theory that it would be impossible to say that the limit theory's structure is preserved in the true theory's structure. That the limit theory is capable of making very accurate predictions could mean, for instance, that all its quantitative empirical predictions are correct with a relative accuracy of 10^{-100}. In other words, the limit theory's predictions would be roughly 90 orders of magnitude more accurate than the predictions of the best mature physical theories available today.

The limit theory to which the sequence of theories converges would therefore be an impasse from which it would be impossible to get at the true theory by further gradual improvements, keeping the basic entities stable, or finding a new structure of which the old structure is a special case, respectively. The objection is thus that the limit theory could be fundamentally different from the true theory. As we have no means whatsoever to say anything substantial about the limit theory apart from the fact that it is the limit of the sequence of theories in question, we have no means to decide whether or not the limit theory is indeed an impasse – ontologically or structurally far away from the true theory. In this case, the stability of X (entities, structures, or whatever) in the sequence of theories is not a reliable indicator that these theories get X approximately right, justifying the pertinent realism. This is the impasse objection to all forms of convergent realism which base their realism on the stability of X in the sequence of theories. Note especially that the apparent advantage of structural realism over entity realism, namely, that structures are much more stable than entities in the course of scientific development (see, e.g., Worrall 1996 [1989]; Ladyman 2009), is of no help against the impasse objection.

3 Counter-Objections to the Impasse Objection

There is a variety of counter-objections to the impasse objection. Their individual plausibility may strongly depend upon one's own philosophical position. If any of the counter-objections looks silly to someone and not worthy of any serious discussion, I can only apologize; someone else may assess it differently. I shall discuss five counter-objections without judging their strength.

1. A realist may concede the logical correctness of the impasse objection. However, she may hold that the stability of X (theoretical entities, structures, or anything) in the *sequence* of theories, i.e. in *several* theories, especially over revolutionary divides, is somehow more noteworthy than reflected in the impasse objection. After all, the sequence of theories in question so far culminates in our best mature theories. It is thus more likely that the stable X in the sequence of theories *is* real and that therefore, the limit theory is indeed a (or the) true theory.

The counter-objection is that this line of reasoning is fallacious.[2] The stability of entities in the elements of the sequence of theories is only a reflection of the fact *that* the sequence converges and of nothing else. The stability is thus no indicator of the approximate truth of the limit theory.

2. Could not the no-miracles-argument overcome the difficulties posed to realism by the impasse objection? The no-miracles-argument, sometimes called "the ultimate argument" for realism (van Fraassen 1980, p. 39; Musgrave 1988), basically states that the most likely, perhaps even the only explanation for the success of science is realism about non-observables. Following this line of reasoning, the miracle argument would state that the incredible success of the limit theory, say, as in the example above, a relative accuracy of 10^{-100} in empirical predictions, would be a miracle if this theory were not very close to the true theory. As there are no miracles, it is extremely likely that the limit theory is at least approximately true.

The counter-objection to this line of reasoning is that it uses a form of the miracle argument that is too unsophisticated, equating the success of science with unqualified predictive success. As the recent discussion of the no-miracles-argument has shown that it works, if it works at all (which has been doubted by several authors for different reasons, see among many others, e.g. (Frost-Arnold 2010; Hoyningen-Huene 2011), only on the basis of *use-novel predictions* that a theory produces (Worrall 1985, 1989, pp. 148–149; Carrier 1991, pp. 26–28; Earman 1992, pp. 114–115; Leplin 1997; Psillos 1999, p. 106, 2006, p. 133). As I pointed out earlier, "use-novel predictions" were not used in the construction of the theory in question such that it comes as a surprise that the theory is capable of making them, suggesting that this is due to the theory getting something fundamentally right. However, we do not know at all whether the limit theory is capable of producing use-novel predictions; there is no indication whatsoever that the limit theory will be capable of making use-novel predictions. Therefore, the miracle argument does not help to establish that the limit theory is at least approximately true – it does not apply to the limit theory, even according to its defenders, and does therefore not eliminate the impasse objection.

3. Perhaps a different application of the miracle argument could refute the impasse objection. Let us assume that in the sequence of theories, there is a theory that admits of use-novel predictions (as indeed many physical theories do). Then the

[2]This is a situation that also occurs in the sciences. For instance, in the mid 1970s there was a variety of apparently different two-dimensional lattice models that agreed in their predictions of certain crucial thermodynamic properties. Therefore, these predictions appeared to be model independent and thus especially trustworthy. However, at a conference in 1977, the Australian physicist Rodney J. Baxter presented a model that showed that most of the current models were special cases of his own more general model (see Baxter 1977). Consequently, the confidence in the model-independency of the predictions due to their production by apparently different models immediately collapsed.

miracle argument can be applied to this theory. Granting for the moment the validity of the miracle argument, we get an abductive argument that this theory is probably approximately true. If this particular theory in the sequence of theories is approximately true, then also all its successor theories will be approximately true because they represent gradual improvements of it. If all its successor theories are approximately true, then also the limit theory of this sequence (if existing) is approximately true.

The counter-objection to this application of the miracle argument runs as follows. Given the assumption that the sequence of theories converges to a limit theory, there is an alternative explanation for the capability of a theory in the sequence to produce use-novel predictions. All predictive power of the theories in the sequence, including the perhaps surprising capability of producing use-novel predictions, is explained by their convergence to the empirically extremely successful limit theory. The only property of the limit theory that is relevant for this explanation is its extreme empirical success. Thus, this explanation for the capability of a theory in the sequence to produce use-novel predictions is independent of whether the limit theory is fundamentally false or approximately true. Therefore, from the capability of a theory in the sequence to produce use-novel predictions nothing can be inferred about the truth or falsity of the limit theory. Therefore, it is also completely open whether a theory in the sequence that admits of use-novelty predictions is approximately true.

4. Due to the radical nature of the impasse objection, one may be tempted to neutralize it by assimilating it to extremely general and fundamental skeptical arguments like Cartesian doubt or doubt about the existence of an external world. According to this line of reasoning, the impasse objection presents only a logical possibility and is not really a serious argument; it derives from a fundamentally skeptical stance. Fundamental skepticism is always a logical possibility and cannot be refuted. However, fundamental skepticism is sterile and should be dismissed. Therefore, also the impasse objection should be dismissed.

The counter-objection to this line of reasoning refutes the supposition that the impasse objection derives from a fundamentally skeptical stance. The impact objection has the form of an absolutely normal mathematical argument. If someone claims that some mathematical object O has property F, this claim can be challenged by demonstrating that O may have the property non-F. In our case, the mathematical object O is the converging sequence of theories. The claimed property F of O is that the limit theory is at least approximately true. The impasse objection doubts that and shows that the limit theory could also be fundamentally false. Thus, the impasse objection objects to the very specific transition from the (conceded) fact of convergence to a property of the limit, namely, to be an approximately true theory. The impasse objection specifically states that this is a *non sequitur*. It thus belongs to a category of very specific arguments different from the class of very general skeptical arguments.

5. In the impasse objection, the burden of proof is illegitimately shifted. It is not the (CSRE, SR, or X) realist who has to show that the limit theory is at least approximately true. On the contrary, it is the opponent of realism who has to establish that the limit theory is not at least approximately true.

The counter-objection to this line of reasoning appears to be fairly clear, although it is admitted that in general the burden of proof issue is rather thorny. In our case, it is clear that the realist claims something more specific than the opponent, namely that the limit theory is at least approximately true. The opponent only claims that the limit theory is *either* at least approximately true *or* radically false. In other words, the opponent only contends that the possibility of a radically false limit theory has not been excluded. It seems obvious that the more specific claim must be argued. Here is a very similar case. If I claim that the limit of some converging sequence of numbers is between 1 and 10, and you claim that the limit is 5, then you must justify your more specific claim. The case can also be made on the basis of the counter-objection to the third objection, above. The opponent claims that in general the inference from the existence of a limit theory to a specific property of the limit theory (approximate truth) is not valid whereas the realist claims that in the particular given case it is. It is then the realist who has to present an argument why in the particular case the inference is indeed valid.

4 Conclusion

An often used core argument supporting various kinds of scientific realism is the stability of some X (theoretical entities, structures, or whatever) in the historical sequence of theories. The impasse objection states that this continuity could also be produced by a fundamentally false but empirically very accurate limit theory. If this is correct, then the stability of X in the historical sequence of theories is not an indicator of X's representing something real, and does thus not support the respective kind of realism. Even after the discussion and, hopefully, refutation of five counter-objections to the impasse objection, I cannot claim that there are not other and possibly much stronger counter-objections. Therefore, it is certainly not excluded that the given "ultimate" argument against a specific support of some kinds of realism will share the fate of other supposedly ultimate arguments, namely, to be quite transitory.

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