Online ISSN 2424-6158. PROBLEMOS 2017 92
DOI: http://dx.doi.org/10.15388/Problemos.2017.92.10905

Pažinimo filosofija

CRITIQUES OF MINIMAL REALISM*

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Abstract. *Saatsi's minimal realism holds that science makes theoretical progress. It is designed to get around the pessimistic induction, to fall between scientific realism and instrumentalism, and to explain the success of scientific theories. I raise the following two objections to it. First, it is not clear whether minimal realism lies between realism and instrumentalism, given that minimal realism does not entail instrumentalism. Second, it is not clear whether minimal realism can explain the success of scientific theories, given that it is doubtful that theoretical progress makes success likely. In addition to raising these two objections, I develop and criticize a new position that truly falls between realism and instrumentalism.*

Keywords: *instrumentalism, middlism, minimal realism, scientific realism, theoretical progress*

Juha Saatsi (2015) has developed an original position that he calls minimal realism. It holds that science makes theoretical progress. It is designed to get around the pessimistic induction, to fall between scientific realism and instrumentalism, and to explain the success of scientific theories. Minimal realism is a venerable position that enriches the debate over what epistemic attitude we should take toward our best theories. The position is more than worthy of your consideration, if you think that the pessimistic induction is correct, if you have been seeking a position that is neither realism nor instrumentalism, or if you have been looking for a new explanation for the success of scientific theories.

This paper is organized as follows. In Section 1, I explicate what minimal realism asserts and show how it differs from realism and instrumentalism. I argue that minimal realism is no different from Moti Mizrahi's (2013a) relative realism. In Section 2, I argue that on close analysis, it is not clear whether minimal realism falls between realism and instrumentalism, given that minimal realism does not entail instrumentalism. In addition, I develop and criticize a new position that truly falls between realism and instrumentalism. In Section 3, I argue that it is not clear whether

* This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2016S1A-5A2A01022592).

This paper improved a lot thanks for anonymous referees' useful comments.

minimal realism can explain the success of scientific theories, given that it is doubtful whether theoretical progress makes success likely.

1. Minimal Realism

In order to understand what minimal realism asserts, we need to compare it with realism. P. Kyle Stanford defines realism as "the position that the central claims of our best scientific theories about how things stand in nature must be at least probably and/or approximately true" (2006: 6). Stanford's definition of realism is no different from Richard Boyd's and Hilary Putnam's definition of realism that "terms in mature scientific theories typically refer (this formulation is due to Richard Boyd), and the theories accepted in a mature science are typically approximately true" (Putnam 1975: 73). So realism asserts that successful theories are (approximately) true, and that their key terms (typically) refer.

What does it mean to say that a theory is successful? Larry Laudan answers that "a theory is 'successful' so long as it has worked well, i.e., so long as it has functioned in a variety of explanatory contexts, has led to confirmed predictions and has been of broad explanatory scope" (1981: 23). Thus, to say that a theory is successful implies that *some* of its observational consequences are true. It is for this reason that Alan Musgrave says that to say that a theory makes novel predictions because it is empirically adequate is like saying that "some crows are black because all crows are" (1988: 242). Laudan's definition of "success" plays an important role in my critical discussion of minimal realism below.

Minimal realism says that "science as a matter of fact makes *theoretical* progress in the sense that theories better supported by scientific evidence (by and large) latch better onto unobservable reality" (Saatsi 2015: 12). What does it mean to say that a theory has better latched onto unobservable reality than another theory? Saatsi answers that *T'* latches better onto unobservable reality than *T*, "if and only if *T'* is more empirically adequate than *T*, and the boost in empirical adequacy is accounted for by a difference in the respective provisions of veridical representations" (2016: 13). Note that Saatsi cashes out the notion of latching in terms of representation. Given that a belief is true if and only if it correctly *represents* the world, Saatsi's conception of theoretical progress comes down to the suggestions that theoretical progress is made if and only if new theories are closer to truths and empirical adequacy than old theories, and that getting closer to empirical adequacy is explained in terms of getting closer to truth. For example, theoretical progress was made when the oxygen theory displaced the phlogiston theory because the oxygen theory was closer to the truth and empirical adequacy than the phlogiston theory, and the former was closer to empirical adequacy than the latter because the former was closer to the truth than the latter.

Minimal realism thus defined is distinct from realism. The difference between them is that while realism claims that successful theories are *close* to truths, minimal realism claims that successful theories are *closer* to truths than their precursors. The difference is huge, as some writers (Wray 2008: 323, Mizrahi 2013a, Park 2017: 325) have noted. Suppose that T_1 and T_2 are completely false, i.e., that they are far from being true, but that T_1 is slightly closer to the truth than T_2. In such a case, T_1, although utterly false, is closer to the truth than T_2. The difference

between realism and minimal realism can be illustrated by the following example. The standard model of particle physics claims that an atom is composed of electrons, neutrons, and protons, that neutrinos travel at the speed of light, that the Higgs field enables particles to have mass, and so forth. Realism affirms, while minimal realism denies, that such theoretical claims are true. Minimal realism only claims that the standard model is better than its forerunner. The superiority of the standard model over its predecessor does not entail that the theoretical claims are true. Nor does it entail that neutrinos and the Higgs field are real.

My foregoing interpretation of minimal realism can be strengthened by the following considerations. First, minimal realism is intended to fall "between Stanford's neo-instrumentalism and his demanding conception of realism" (Saatsi 2015: 11). If, however, minimal realism asserts that the aforementioned theoretical claims of the standard model are true, it collapses to realism as defined by Stanford, Boyd, and Putnam. Second, Saatsi states explicitly that theoretical progress does not yield theoretical knowledge, saying that "science can make theoretical progress that does not boil down to accumulation of knowledge" (2015: 13). So we do not know, for example, that neutrinos travel at the speed of light.

Why do I fuss about the difference between realism and minimal realism? Readers of Saatsi's paper should be careful when he says that "a realist attitude can be maintained in the face of the historical evidence" (2015: 2). His sentence gives the impression that we can believe that our best theories are (approximately) true, or that the aforementioned theoretical claims are true, in spite of the pessimistic induction that since past theories were ousted, present theories will also be ousted. On closer analysis, however, his sentence means that we cannot have realist beliefs due to the pessimistic induction. His expressions "realist attitude" and "minimal realism" are all misleading to unwary readers. In my view, "theoretical progressivism" is a better nomenclature than "minimal realism" because it captures what he has in mind and would not mislead readers.

Does minimal realism assert that successful theories are approximately empirically adequate[1]? In other words, does it say that they are close to empirical adequacy? My answer is no. Concerning observables, minimal realism only asserts that present theories are closer to empirical adequacy than past theories. Saatsi says that theories' latching better and better onto reality "drives theories' increasing empirical adequacy" (2015: 13). Thus, theoretical progress is connected with empirical progress. But Saatsi never says that theoretical progress is connected with approximate empirical adequacy. It appears that he is aware of the enormous difference between being closer to empirical adequacy and being close to empirical adequacy.

In sum, Saatsi has achieved his goal of staking out a position that avoids the pessimistic induction. The pessimistic induction does not refute minimal realism, which holds, to repeat, that present theories are closer to truths and empirical adequacy than past theories, though the pessimistic induction does refute the realist position that past and present theories are true and empirically adequate.

[1] A theory is approximately empirically adequate if "most of its observational consequences are true" (Park 2009: 117, footnote).

How does minimal realism differ from instrumentalism regarding theoretical progress? Instrumentalism is the view that our best theories "are powerful conceptual tools for action and guides to further inquiry" (Stanford 2006: 24). Instrumentalists do not contend that present theories are closer to truths than past theories. They can only contend that present theories are better instruments for organizing our thoughts about observables than past theories. So minimal realism is distinct from instrumentalism concerning unobservables.

So far as I can tell, the content of minimal realism is the same as that of Mizrahi's (2013a) relative realism. Relative realism holds that our best theories are comparatively true. To say that "T_1 is comparatively true is to say that T_1 is closer to the truth than competitors T_2, T_3, …, T_n" (Mizrahi 2013a: 401). On this account, a theory is comparatively true as long as there is a theory that is worse than it. Suppose that T_1 and T_2 are utterly false. Even so, T_1 is comparatively true insofar as it is slightly closer to the truth than T_2. Mizrahi accepts this possibility, saying that "T_1 is comparatively true, no matter how far from the truth T_1 is *absolutely speaking*" (2013a: 401). Note that Mizrahi recognizes the profound difference between being closer to truth and being close to truth.

My previous criticism against minimal realism applies no less to relative realism. Relative realism is committed neither to the approximate truth of the standard model nor to the existence of neutrinos and Higgs field. It is only committed to the superiority of the standard model over its predecessor. It follows that "comparativism" or "progressivism" is a better nomenclature than "relative *realism*". In general, a position is closer to antirealism than realism, if it is committed neither to approximate truths of theories nor to the existence of theoretical entities.

What motivated Mizrahi to develop relative realism? It was his observation that when theories compete with one another, we can judge at best which one is better than others on the basis of whether they have theoretical virtues, such as simplicity, explanatory power, predictive power, manipulative power, unificatory power, and fruitfulness. But we cannot tell whether the best of the rival theories is close to the truth. In other words, we can make a relative evaluation of whether a theory is closer to the truth than its competitors, but we cannot make an absolute evaluation of whether a theory is close to the truth.

There are a similarity and a difference between Mizrahi's relative realism and Saatsi's minimal realism. The similarity is that both approaches affirm that our best theories are closer to truths and empirical adequacy than their competitors, but not that they are *close* to truths and empirical adequacy. The difference between the two approaches is that while it was the problem of underdetermination that led Mizrahi to develop relative realism, it was the pessimistic induction that led Saatsi to develop minimal realism. Thus, Mizrahi and Saatsi have reached the same conclusion independently of each other from different premises.[2]

[2] An anonymous referee objects that my understanding of Saatsi's minimal realism is faulty. Saatsi's minimal realism goes beyond the idea of approximation to the truth. But my reconstruction of it, however, pushes it back to the idea of approximation to the truth.

The referee's worry can be eased by the consideration of the difference between being closer to the truth and being close to the truth, i.e., being approximately true. Of course, minimal realism does not say

2. A Middle Way?

Saatsi contends that minimal realism falls "between Stanford's neo-instrumentalism and his demanding conception of realism" (2015: 11). In other words, he claims that minimal realism asserts less than realism but more than instrumentalism about science. He (2015: 11) cites Stanford who defines realism as "the position that the central claims of our best scientific theories about how things stand in nature must be at least probably and/or approximately true" (2006: 6) and who defines instrumentalism as the position that our best scientific theories "are powerful conceptual tools for action and guides to further inquiry" (Stanford 2006: 24).

Instrumentalism as defined by Stanford, however, is ambiguous about what it is committed to. What percentage of the observational consequences of our best theories does instrumentalism claim are true? Stanford's definition of instrumentalism is compatible with three different interpretations, namely, that some, most, or all observational consequences of our best theories are true. Which of these three alternatives is the best interpretation? It is uncharitable to interpret instrumentalism as implying that all observational consequences of our best theories are true, given that Stanford (2006) is the exponent of the problem of unconceived alternatives that since past scientists could not ideate present theories that supplanted past theories, present scientists cannot ideate future theories that will supplant present theories. The problem of unconceived alternatives implies that not all observational consequences of past and present theories are true. So we are left with the two alternatives: some or most observational consequences of our best theories are true. The latter is the more reasonable interpretation for the following three reasons.

First, Stanford's claim that our best theories "are powerful conceptual tools for action and guides to further inquiry" (2006: 24-25) indicates that instrumentalists believe that the tools that have worked will continue work, i.e., that theories that have been successful will continue to be successful. Instrumentalists are not inductive sceptics. They believe not only what our best theories say about past events but also what they say about future events. It appears, then, that it is more reasonable to interpret instrumentalism as implying that most of what our best theories say about observables is true than as implying that just some of what they say about observables is true.

Second, it is not clear how our best theories can be powerful conceptual tools for action and guides for further inquiry, if just some, but not most, of their observational consequences are true. Suppose that a scientific theory has been making true predictions, and hence that it has been proven that some of its observational consequences are true. Will it continue to make true predictions? If merely some of its observational consequences were true, and if you believe so, you would only be

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that our best current theories are approximately true. It does imply, however, that they are closer to truths than their predecessors, as we noted above. Consider also that Saatsi intended minimal realism to be a thesis that falls "between Stanford's neo-instrumentalism and his demanding conception of realism" (Saatsi, 2015: 11). Stanford defines realism in terms of approximate truth, as we have seen earlier in this section. Therefore, if minimal realism is not connected with the notion of approximation to truth at all, it is not clear how Saatsi can say that minimal realism falls between realism and instrumentalism.

entitled to believe that it is *possible* that it will continue to make true predictions. After all, there is no reasonable basis for you to choose the belief that it will continue to make true predictions over the belief that it will run into anomalies and cease to make true predictions. By contrast, if most of its observational consequences were true, and if you believe so, you would be entitled to believe that it is *likely* that it will continue to make true predictions. After all, there is a reasonable basis for you to choose the belief that it will continue to make true predictions over the belief that it will run into anomalies and cease to make true predictions. The reasonable basis is that the theory has more true observational consequences than false observational consequences. Thus, the instrumentalist belief that our best theories will continue to be powerful conceptual tools indicates that instrumentalists believe that most observational consequences of our best theories are true.

Third, according to Laudan's definition of success, to say that a theory is successful implies that some of its observational consequences are true. If we interpret instrumentalism as implying that some observational consequences of our best theories are true, instrumentalism boils down to the position that our best theories are merely successful. A problem with this position is that it is absurd, since scientific realists and antirealists agree that our best theories are successful. The agreement is the very starting point of the debate between them. They also agree that scepticism is an absurd position:

> Skepticism is an ugly threat; a philosophical position which leads to skepticism reduces itself to absurdity. (Ladyman, Douven, Horsten, and van Fraassen 1997: 317)

Ladyman et al. (1997) do not define scepticism, but they do not mean Cartesian scepticism. After all, the scientific realism debate is not about whether scientific claims can be defended from Cartesian scepticism. Scepticism in this context is the position that our best scientific theories are merely successful, i.e., the position that does not go beyond the starting point of the debate between scientific realists and antirealists. It follows that if instrumentalism is only committed to the truth of some observational consequences of our best theories, it is an absurd position that Ladyman et al. have in mind. So we should interpret instrumentalism as claiming that most of the observational consequences of our best theories are true.[3]

Let me now turn to the question of whether minimal realism falls between realism and instrumentalism as defined by Stanford. My response to this question is that it is not clear what the correct

[3] The referee objects that I misunderstood instrumentalism. Instrumentalism claims that a scientific theory is not a description of the world but an instrument for making predictions and manipulations. In contrast, realism claims that a scientific theory is not an instrument but a description. The debate between realists and instrumentalists is not over what percentage of the observational consequences of our best theories are true but over whether our best theories are instruments or descriptions.

Once we consider the pessimistic induction, however, it becomes apparent that we should distinguish between the ambitious instrumentalist position that a theory is empirically adequate and the modest instrumentalist position that it is approximately empirically adequate. The ambitious position falls prey to the pessimistic induction, whereas the modest position does not. Moreover, Saatsi has developed minimal realism with the view to getting around the pessimistic induction, and he has set out to develop a position that falls between realism and instrumentalism. So we need to investigate whether instrumentalism claims that our best theories are empirically adequate or approximately empirically adequate.

answer is. Minimal realism clearly claims less than realism. An interesting question is whether minimal realism claims more than instrumentalism. Concerning unobservables, minimal realism claims more than instrumentalism, for minimal realism claims, but instrumentalism does not, that present theories are closer to truths than past theories. So the issue comes down to whether minimal realism claims more than instrumentalism concerning observables. If it does, then minimal realism lies between realism and instrumentalism; but if it does not, the matter is much less clear.[4]

If it were the case that minimal realism entails instrumentalism, then minimal realism would claim more than instrumentalism; however, it does not. As I have argued above, it is reasonable to interpret instrumentalism as asserting that our best theories are approximately empirically adequate. But minimal realism does not entail such an assertion because it is possible that a theory makes theoretical progress and yet is far less than approximately empirically adequate, i.e., there are cases in which T_1 is theoretically better than T_2 and yet T_1 is completely empirically inadequate, as we have already seen in the section on minimal realism. Suppose again that T_1 is closer to the truth than T_2, but that they are both utterly false and only 2% and 1% of the observational consequences of T_1 and T_2, respectively, are true. In such cases, T_1 is not even approximately empirically adequate and so cannot be a powerful conceptual tool for action.

Minimal realists might complain that it is unfair to talk about the cases in which both T_1 and T_2 are utterly false. Why not talk about the cases in which T_1 and T_2 are both approximately true? In such cases, both theories are (approximately) empirically adequate, so minimal realism entails instrumentalism.

There are two problems with this complaint. First, the existence of such cases does not drive out the possibility that there are other cases in which both T_1 and T_2 are completely false and therefore completely empirically inadequate. The mere possible existence of the latter cases is enough to refute the contention that minimal realism entails instrumentalism. Second, minimal realists cannot appeal to the cases in which T_1 and T_2 are approximately true because such cases entail the existence of theoretical knowledge, which minimal realists deny. If minimal realists appeal to the cases in which T_1 and T_2 are approximately true, they are, in effect, admitting that instrumentalism is entailed by not minimal realism but instead by realism.[5]

A position would fall between realism and instrumentalism if it were to claim that

[4] What is Saatsi's position on this issue? He (2015) does not explain how minimal realism falls between realism and instrumentalism.

[5] The referee objects that it is absurd that if both T_1 and T_2 are completely false, they are completely empirically inadequate. The history of science suggests that false theories, such as the phlogiston theory, the caloric theory, and the ether theory, had a lot of true observational consequences.

A standard realist reply to such an objection is that some theoretical assumptions of past theories were true, although other theoretical assumptions were false, so it is problematic to say that past theories were completely false (Psillos 1999: 113). The referee, however, would object that approximation to truth is hardly measurable, so it is not clear whether it is legitimate to attribute 'approximate truth' to past theories.

This objection is so serious that it cannot be adequately dealt with in this paper. Suffice it to say here that although there is no precise definition of "approximate truth", it is a viable predicate insofar as there are clear cases and counter-cases, just as although there is no precise definition of "middle-aged", it is a viable predicate as long as there are clear cases and counter-cases (Park 2014: 272).

our best theories are closer to truths than their competitors, and that they are powerful conceptual tools for action, or if it were to claim that our best theories are closer to truths than their competitors, and that they are (approximately) empirically adequate. This position is not minimal realism, but it lives up to Saatsi's goal of developing a position that falls between realism and instrumentalism. After all, it asserts less than realism but more than instrumentalism about science. Let me call it middlism, for it is truly in the middle between realism and instrumentalism. Middlism leaves it open whether our best theories are empirically adequate or approximately empirically adequate, enshrining the realist argument that present theories are more successful than past theories, so past and present theories might be on different boats. The argument has been advanced by Jarrett Leplin (1997: 141), Gerald Doppelt (2007: 111; 2014), Saatsi (2009: 358), Michael Devitt (2011: 292), Seungbae Park (2011: 80), Ludwig Fahrbach (2011: 1290), and Mizrahi (2013b). Middlism is a tempting position for those who are (i) looking for a position that lies between realism and instrumentalism, (ii) looking for a position that gets around the pessimistic induction, and (iii) sceptical that our best theories are (approximately) true.

Middlism, however, is susceptible to the accusation of holding a double standard with respect to observables and unobservables. What is the reason for believing that our best theories have almost reached empirical adequacy, but that they can only get closer and closer to truths? In other words, what is the reason for believing that they have almost reached the empirical goal, but that they are only closer to the theoretical goal than their competitors? Middlists take some epistemic risk when they infer that our best theories are (approximately) empirically adequate. Why not take the full epistemic risk as realists do and believe that they are (approximately) true?

In order to meet this objection, middlists might appeal to an insight of Bas van Fraassen (1980). In the literature, realists accuse van Fraassen of holding a double standard with respect to observables and unobservables, i.e., they claim that if he believes that successful theories are empirically adequate, he should also believe that they are true. There is no reason for taking different attitudes towards observables and unobservables. Van Fraassen famously retorts that "it is not an epistemological principle that one might as well hang for a sheep as for a lamb" (1980: 72). In other words, from the fact that antirealists take some epistemic risk and believe that successful theories are empirically adequate, it does not follow that they should take the full epistemic risk as realists do and believe that they are true. Middlists might capitalize on van Fraassen's insight in order to defend middlism, saying that from the fact that they believe that our best theories are (approximately) empirically adequate, it does not follow that they should also believe that they are (approximately) true.

Such a defence of middlism, however, is not convincing. If you are accused of holding a double standard, you have the burden of explicating the relevant difference between two groups of objects towards which you are taking different attitudes. This point is clear in philosophy of mathematics. Can we believe that theoretical entities, such as neutrinos and quarks, are real without also believing that mathematical entities, such as

numbers and circles, are real? The answer is no, according to such eminent philosophers of mathematics as Willard V. O. Quine (1980: 45), Putnam (1979: 347), Alan Baker (2005: 225), and Mark Colyvan (2006: 226-227). They argue that a double standard is involved in believing that theoretical entities are real, but that mathematical entities are not. So if you believe that theoretical entities are real, but that mathematical entities are not, you have the burden of explicating the relevant difference between theoretical and mathematical entities that entitles you to believe that theoretical entities are real, but that mathematical entities are not. You cannot adhere to your old position by saying that it is not an epistemological principle that one might as well hang for a sheep as for a lamb, i.e., by saying that from the fact that you believe that theoretical entities are real, it does not follow that you should also believe that mathematical entities are real. Such a defence of a philosophical position has the potential to proliferate dogmatism in philosophy. So middlists also have the burden of explicating the relevant difference between observables and unobservables that entitles them to believe that although present theories have nearly reached empirical adequacy, they are merely closer to truths than past theories.

If middlists stick to middlism without accepting their burden of expounding the relevant difference, they look worse than scientific realists who reject mathematical realism without accepting their burden of expounding the relevant difference. After all, there is a sharp distinction between mathematical and theoretical entities, whereas there is no such sharp distinction between observables and unobservables. Mathematical and theoretical entities are different kinds of things in that mathematical entities are atemporal, aspatial, and non-causal, whereas theoretical entities are temporal, spatial, and causal. In contrast, observables and unobservables are not different kinds of things, for they are all temporal, spatial, and causal. Moreover, they are in a continuum, as Grover Maxwell (1962) points out. Even if there is such a fundamental difference between mathematical and theoretical entities, philosophers of mathematics agree that if you take different epistemic attitudes towards them, you have the burden of explaining why you take different attitudes towards them. Given that there is no such fundamental difference between observables and unobservables, middlists have a *heavier* burden to explain why they take different attitudes toward them. This criticism applies not only to middlists but also to instrumentalists who believe that observables are real, but that unobservables are not.

In sum, minimal realism and middlism can be compared as follows. Minimal realism does not hold a double standard with respect to observables and unobservables, but it does not fall between realism and instrumentalism. By contrast, middlism falls between realism and instrumentalism, but it holds the double standard with respect to observables and unobservables. Middlists cannot divert the charge of holding the double standard by appealing to van Fraassen.

Minimal realists might object that the fact that a theory is successful implies not that *some* of its observational consequences are true, but that *most* of its observational consequences are true. Given that minimal realists admit that our best theories are successful, minimal realism asserts implicitly that they are approximately empirically adequate. It follows that minimal realism en-

tails instrumentalism, and that it is identical with what I have termed above as middlism.

Let me point out two problems with this move. First, if minimal realism coincides with middlism, minimal realists face the difficulty that I raised against middlism above. Why hold a double standard toward observables and unobservables? Second, the proffered interpretation of success goes contrary to Musgrave's and Arthur Fine's interpretation of success. According to Musgrave (1988: 242), to say that a theory enjoys novel success because it is empirically adequate is similar to saying that *some* crows are black because all crows are black. According to Arthur Fine (1991: 82), instrumentalists can say that a theory is successful because it is useful, and this instrumentalist explanation is better than the realist explanation (Putnam 1975: 73) because instrumental usefulness is what is minimally required to explain the success of a theory. However, if the proffered definition of success is right, Fine's proposal amounts to a vacuous explanation that a theory is approximately empirically adequate because it is approximately empirically adequate.

Why should we choose middlism over realism and instrumentalism? This question is legitimate and worthy of pursuing. Unfortunately, I delineated middlism in this paper not to defend it but to show that minimal realism is not a middle position between realism and instrumentalism, and that Saatsi failed to achieve the goal of developing such a position. Consider also that I accused middlism of containing a double standard regarding observables and unobservables, which indicates that I do not endorse it. I leave the task of defending it to those who are looking for a position that is neither realism nor instrumentalism.

3. Explanation of Success

Can minimal realism explain the success of scientific theories? Saatsi says that it can and claims that theories are successful because they are theoretically better than their competitors:

> In particular, science can make theoretical progress in the sense of theories' latching better and better onto reality in a way that drives theories' increasing empirical adequacy and enables them to make novel predictions. (2015: 12)

Note that according to Saatsi, theories make novel predictions because they made theoretical progress. Thus, he would say, for example, that Einsteinian mechanics is successful because it made a theoretical improvement over Newtonian mechanics. In short, theoretical progress is responsible for success.

The following two considerations, however, jointly make it dubitable that theoretical progress can explain success. First, Timothy Lyons argues that (approximate) truth cannot explain success because (approximate) truth does not make success likely (2003: 895-899). This paper picks up the presupposition of Lyons's objection to realism that an explanans cannot explain an explanandum unless the explanans makes the explanandum likely. Given that minimal realism is proposed as an alternative to realism, it should be able to withstand a criticism levelled at realism. Second, as we noted in section on minimal realism, even if T_1 is theoretically better than T_2, T_1 might be far from being empirically adequate. Such a theory is not likely to be successful. These two considerations jointly make it doubtful that theoretical progress can explain success (Park 2015: 22).

Minimal realists might reply that if T_1 is theoretically better than T_2, *some* observational consequences of T_1 are likely to be true. After all, even if 0% of the observational consequences of T_2 is true, more than 0% of the observational consequences of T_1 are likely to be true. Moreover, according to Laudan's definition of success, to say that a theory is successful implies that *some* of its observational consequences are true, as we noted in section on minimal realism above. Therefore, theoretical progress is reliably connected with success, and theoretical progress can explain success.

This tempting reply from minimal realists, however, is problematic. It is not the truth of some, but most, observational consequences under which a theory is likely to be successful. For example, the general theory of relativity made amazing true predictions about gravitational lensing, black holes, the bending of light near the sun, and so forth. It is unlikely, although possible, that it could have made such predictions if only 2% of its observational consequences were true. By contrast, it is likely that it can make such predictions if 98% of its observational consequences are true. So a theory is likely to be successful not when *some* of its observational consequences are true but when *most* of its observational consequences are true. To use an analogy, some crows randomly picked from the population of all crows are likely to be black not when some crows are black but when most crows are black. Consequently, T_1 is likely to be successful not when some of its observational consequences are true but when most of its observational consequences are true.

Theoretical progress is such an unrestrained notion that it cannot explain success. To say that T_1 is theoretically better than T_2 admits of a spectrum of diverse cases. To simplify the matter, let me consider only the following three representative cases:

(1) Both T_1 and T_2 are completely false, in which case T_1 and T_2 are completely empirically inadequate.
(2) T_1 is approximately true but T_2 is completely false, in which case T_1 is approximately empirically adequate but T_2 is completely empirically inadequate.
(3) Both T_1 and T_2 are approximately true, in which case both T_1 and T_2 are approximately empirically adequate.

(1) represents the cases in which even if T_1 is theoretically better than T_2, T_1 is not even approximately empirically adequate. (2) represents the cases in which T_1 is theoretically far better than T_2, T_1 is approximately empirically adequate, and T_2 is completely empirically inadequate. (3) represents the cases in which T_1 is approximately empirically adequate but not because it is theoretically better than T_2. These three cases indicate that there is no interesting connection between theoretical progress and approximate empirical adequacy. It is not the case that theoretical progress is a reliable indicator of approximate empirical adequacy, i.e., that if T_1 is theoretically better than T_2, T_1 is likely to be approximately empirically adequate.[6] It is natural that theoretical progress is not a condition under which a theory is likely to be successful.

[6] It is not theoretical progress but approximate truth that is reliably connected with approximate empirical adequacy. This conclusion naturally follows from Leplin's (1997: 23) contention that truth explains empirical adequacy.

There is more reason for thinking that theoretical progress cannot explain success. Suppose that scientists opened a new field of research, that they devised a theory for the first time in the field, and that it was successful. Why was it successful? It is wrong to say that it was successful because it was theoretically better than its predecessor, for it did not have a predecessor. The point is that a theory can be successful independently of whether it is closer to the truth than its competitor, i.e., independently of whether it has a worse competitor. Theoretical progress is simply an irrelevant factor to the production of success. So it is wrong to invoke theoretical progress to explain success. Given that theoretical progress is the key theoretical resource of minimal realism, minimal realism is, by nature, incapable of explaining the success of scientific theories.

In my view, theoretical progress can explain at best empirical progress. Suppose again that 2% and 1% of the observational consequences of T_1 and T_2, respectively, are true. It is legitimate to say that T_1 is empirically better than T_2 because T_1 is theoretically better than T_2. Let me emphasize, though, that it is one thing to explain why T_1 is empirically better than T_2, and that it is an entirely different thing to explain why T_1 is successful.

Conclusions

Saatsi developed minimal realism to overcome the pessimistic induction, to stake out an intermediate position between realism and instrumentalism, and to explain the success of scientific theories. He achieved the first goal, but not the second goal and the third goal. Minimal realism does not entail instrumentalism, so it is not clear whether it falls between realism and instrumentalism. Nor is it clear whether theoretical progress makes success likely, and hence whether theoretical progress can explain success. In addition, it is not minimal realism but middlism that falls between realism and instrumentalism. Middlism, however, is vulnerable to the charge of embedding a double standard with respect to observables and unobservables.

Let me draw a philosophical moral from my discussion on minimal realism. Believing less is good from the point of view of the principle of economy. If you believe less, your belief has a lower chance of being false. Minimal realists believe less than realists, so they run less risk of being wrong than realists. Believing less, however, comes with the cost of being able to explain less. Simply put, "Believe less. Explain less."

This paper improved a lot thanks for anonymous referees' useful comments. This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2016S1A5A2A01022592).

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MINIMALIOJO REALIZMO KRITIKA

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Santrauka. Pasak Juhos Saatsi pasiūlyto minimaliojo realizmo, vyksta teorinė mokslo pažanga. Ši koncepcija sukurta pesimistinei indukcijai įveikti, vidurio pozicijai tarp mokslinio realizmo ir instrumentalizmo užimti bei mokslo teorijų sėkmei paaiškinti. Šiame straipsnyje pateikiami du prieštaravimai minimaliajam realizmui. Pirma, nėra aišku, ar minimalusis realizmas išties yra tarp realizmo ir instrumentalizmo, nes instrumentalizmas neplaukia iš minimaliojo realizmo. Antra, nėra aišku ar minimalusis realizmas gali paaiškinti mokslo teorijų sėkmę, nes abejotina, ar teorinė pažanga daro sėkmę tikėtiną. Be šių dviejų prieštaravimų, straipsnyje formuluojama ir kritikuojama nauja pozicija, kuri iš tikrųjų atsiduria tarp realizmo ir instrumnetalizmo.

Pagrindiniai žodžiai: instrumentalizmas, midlizmas, minimalusis realizmas, mokslinis realizmas, teorinė pažanga

Įteikta 2017.02.08
Priimta 2017.08.12