The Defense of Scientific Realism

—From “No-Miracle Argument”

Abstract

The No-Miracle Argument (NMA) is one of the main argumentation frameworks of scientific realism. Many rebuttals have been offered by antirealists around NMA, the important of which are the Pessimistic Meta-induction (PMI), the Circular Argument, and the Underdetermination of Theory by Evidence. This essay attempts to defend NMA and scientific realism by refuting these three major refutations.

Keywords: No-Miracle Argument, scientific realism, inference of best explanation, the pessimistic Meta-induction, the Circular Argument, the Underdetermination of Theory by Evidence

The Defense of Scientific Realism

—From “No-Miracle Argument”

In the field of philosophy of science in the second half of the 20th century, scientific realism was one of the most popular topics. Scientific realists believe that science can discover truths about the world and that the theoretical central terms referred. The "No-Miracle Argument"(NMA) is the main argument in defense of this epistemological optimism. NMA is based on Putnam's statement that "scientific realism is the only argument that does not make scientific success a miracle." Modern scientific realists argue that we cannot understand the great success of scientific theories in explaining and predicting unless we acknowledge that the entities, processes, and causal mechanisms in scientific theories are real.

No-Miracle Argument

“The Success of science” and “No-Miracle Argument”

The cornerstone of the scientific realism argument derives from the most distinctive feature of the natural sciences: the great success of science in modern society. Popper was very early in noticing the relationship between theoretical success and scientific truth: scientists believe that their theories are descriptions of the reality or verisimilitude of nature, which is mainly manifested in the improvement and progress of the explanatory power of scientific theories. Popper (1963) argues that scientific progress and success is the necessary measure of scientific truth. If scientific success is accidental, then a hypothesis cannot succeed repeatedly.

J. Smart and J. Maxwell (1963) explicitly argue that the defense of scientific realism should be based on the " explanation of scientific success". For J. Smart et al. "if unobservable theoretical entities do not exist, then the theoretical assertion itself is not well justified, so science is not a true description of the unobservable world, and it cannot possibly explain the success achieved by science and the accurate prediction of the relationship of observable entities (p. 13). In further, they reject an instrumentalist and phenomenalist understanding of scientific theories because they think if the phenomenalist understanding of theoretical entities is correct, then we would have to believe in cosmic coincidence. If so, this means that statements about scientific terms such as electrons have only instrumental value: they merely enable us to predict phenomena at the level of galvanometers and cloud chambers. On the contrary, if we explain the theory from a realist point of view, there is no need for such cosmic coincidences: the existence of electrons makes such variations in the galvanometer and cloud chamber not surprising, and this is exactly what we have predicted (J. Smart, p. 39). J. Maxwell also stresses that the only reasonable explanation for the success of the theory is that the only reasonable explanation for the success the theory is that it is well corroborated, so that it is a true statement and that the entity it refers to exists (Psillos, 1999, p. 73).

R. Boyd builds on previous arguments and directly uses the No-Miracle Argument (NMA) to defend the reliability and rationality of ampliative-abductive reasoning in science (Psillos, 1999, p. 77). Furthermore, he argues for viewing scientific realism as an empirical hypothesis, starting from a naturalistic position, and using the inference to the best explanation (IBE) method to make an argument for scientific realism. Boyd argues that all aspects of scientific methodology are pervaded by theory. Scientific methodology is almost linearly dependent on accepted background theories. It is these background theories that enable scientists to adapt, improve or modify their scientific methods and that lead to correct predictions and experimental success. The best explanation that can be given for the instrumental validity of scientific methodology is that the causal relationships and mechanisms asserted by theoretical statements are responsible for the successful predictions obtained by the scientific method and that these background theoretical statements are approximately true.

H. Putnam (1975) builds on Boyd's understanding of scientific realism as an empirical hypothesis by stating that the realism about empirical science rests on two main arguments, which we can roughly divide into a negative argument and an affirmative argument. The negative argument is that the various instrumentalist and operationalist philosophers have undoubtedly been unsuccessful in explaining the success of science, showing that most scientific statements are best not explained as philosophical at all (p. 73). Putnam (1982) advocates "scientific realism as convergence "(p. 195). He argues that the affirmative argument of realism is the only philosophy that does not resort to miracles for the success of science. The theoretical terms used in mature science typically refer to something, and the theories embraced by mature science are typically close to the truth. The same terms refer to the same things, even if they appear in different theories (Putnam, 1975, p. 72-73).

As a result of the efforts of the above-mentioned realists, the No-Miracle Argument has its full form：

1) Mature scientific theories are empirically successful.
2) Scientific realism is the best explanation for the empirical success of mature scientific theories.
3) Scientific realism asserts that mature scientific theories are (approximately) true descriptions of the world, are (approximately) true. Their central terms referred.
4) Thus, mature scientific theories are (approximately) true and their central terms referred.

Putnam and Boyd's importance is in switching the defense of scientific realism from a transcendental argument to a naturalistic defense: the realist defense is not an a priori epistemology, but part of an empirical-naturalistic programme that holds that realism is the best empirical hypothesis for a successful explanation of science (Psillos, 2009, p. 15). According to the NMA, the instrumental reliability of scientific methodology is best explained by the fact that background theories are approximately true. These background theories are derived from abductive reasoning. Therefore, it is reasonable to believe in the reliability of these inferences because it yields approximately true theories. The reliability of abductive reasoning is not a transcendental truth, but an empirical assertion. We gain the reliability of abductive reasoning through experience.

Inference of Best Explanation and the Logic Structure of No-Miracle Argument

Following the move towards naturalism in the defense of realism, the question of the relationship between experience and theory becomes fundamental to the argument for scientific realism. If scientific realism is understood as a theoretical hypothesis, the question of the corroborative relationship between empirical evidence and the hypothesis needs to be examined to determine whether this hypothesis is true.

The NMA argument is not deductive or inductive, but abductive. The abductive argument is also commonly referred to as the inference to the best explanation (IBE). This type of reasoning assumes that a hypothesis is true if it provides a better account of the evidence than other hypotheses (Mizrahi, 2012, p. 132). The reasoning form of the NMA can be summarized as follows (Lyons, 2020, p. 892).

(1)Scientific theory T is extremely successful；

(2) If T is true, then of course T will be successful.

(3) The truth of T thus provides an explanation for the empirical success of T.

(4) In fact, the truth of T provides a good account of T's success.

(5) There is no explanation for this phenomenon other than the NMA；

(6) We cannot explain the success of T except in terms of its truth.

(7) There is thus reason to believe that T's success shows that T is true.

Based on the above analysis, we can understand NMA in this way: the empirical success of science is the best explanation for the consistency of a scientific theory with the real structure it describes. Scientific realism explains the truth of a scientific theory through its success. In the practice of science, if all the predictions made according to a scientific theory come true, then the theory correctly reflects the objective world, which means the theory is approximately true. Only scientific realism can explain the empirical success of science in its applications and predictions. Anti-realism can only attribute the success of science to miracles or pure luck.

Three kinds of Important Critiques on NMA

The Basic Arguments of the PMI and the Critical Analysis

NMA faces three main criticisms. The first criticism is the most important and persistent challenge to scientific realism - the Pessimistic Meta-induction (PMI).

The Pessimistic Meta-induction (PMI). In A confutation of convergent realism, Laudan (1981) proposes the Pessimistic Meta-induction (PMI) that appeals to the falsity of past theories to undermine our belief in the truth of present-day theories (p. 19-49). Laudan argues that the realist assertions about the relationship between truth, referent, and success are unreasonable. He argues that the only connection between "the terms of a scientific theory referred" and "the success of a scientific theory" is that "a scientific theory is approximately true". A theory can only be (approximately) true if its central terms referred. And the (approximate) truth of a theory can indicate scientific success. However, Laudan gives several examples from the history of science that break the link between “central terms referred” and the “theoretical success”: a theory with a central term referred may not be successful. The central terms of many successful theories are not referred. At the same time, Laudan breaks the link between “theoretical success” and “approximately true”, since the history of science is full of successful theories that have been proven false. Based on these cases, Laudan concludes, by simple inductive reasoning, that the best scientific theories nowadays are likely to be proven false in the future, and that their central terms are likely to be proven non-referential.

He builds his Pessimistic Meta-inductive argument by criticizing the "upward path" of the realists from "the success of theory" to "the theory as true". The argument is as follows:

(1) Assume that the success of the theory is a reliable test of its truth value.

(2) Most of today's scientific theories are successful.

(3) Therefore, most theories today are true.

(4) Most past theories are false because they differ in many important respects from present-day theories.

(5) Many past theories that were ultimately proven wrong were successful.

(6) Therefore, the success of a theory is not a reliable test of its truth value.

(1)(2)(3) are claims of scientific realism criticized by Laudan. The truth of (4) is based on the assertion that many past theories contain terms that seem to us now to be non-referential, and so these theories are false. The truth of (5) is based on the examples cited by Laudan of scientific theories that have appeared in the history of science, which were successful but ultimately proved to be false. Based on premise (5), he concludes inductively that the success of science is not a reliable test of scientific theories being true. Therefore, premise (1) is false. And premise (1) is the basis of the No-Miracle Argument, the central argument of scientific realism. Therefore, the NMA is invalid, and the claims of scientific realism are false.

The picture of scientific knowledge presented by Laudan's argument is as follows: at a given moment in history there is a series of scientific theories that are true or false, but their truth value is something that we cannot directly experience. However, the success or unsuccess of these theories is something that we can observe. This picture is consistent with the scientific knowledge picture of scientific realism. Thus, the challenges of scientific realists have focused on premises (4) and (5). Some science realists argue that premise (4) is not valid because some of the central terms of past theories referred, so PMI is not valid. Other scientific realists argue that Laudan's examples from the history of science are not sufficient to support premise (5), because some of these examples cannot be considered truly empirically successful, and others can be seen as approximately true. Therefore, PMI does not stand. The above refutation is not novel and will not be discussed too much. I will focus my analysis on the two main refutations raised against the inductive basis of PMI to defend the NMA, which are False Positives Fallacy and Turnover Fallacy.

False Positives Fallacy. Peter J. Lewis (2001) argues that PMI faces a fundamental argumentative error, namely False Positives Fallacy (p. 371-380). A false positive is an error when test results incorrectly indicate the presence of a condition when it doesn’t exist. False positives often play an important role in hypothesis testing. The reliability of a test is therefore determined by the false-positive rate and false-negative rate. If a test has a small false-positive and a small false-negative rate, it can be regarded as reliable. How small the false-positive rate and false-negative rate will be determined by the specific context.

Scientific realists believe that the success of a theory is a reliable test of its truth value. In this case, the false-positive rate represents the situation where “the theory is false but successful”; the false-negative rate represents the situation where the "theory is true but not successful". "Theoretical success is a reliable test of theoretical truth" means that both false-positive rate and false-negative rate are small. We can derive from "most of the present-day scientific theories are successful" that "most of the present-day scientific theories are true". This argument is as follows：

We use P(T) to represent the ratio of true theories and P(S) to represent the ratio of success theories. False-positive rate p indicates the rate of "false but successful" theories. So, $p=P(\neg T\cdot S)/P(\neg T)$. False-negative rate q indicates the rate of “true but not successful”. So, $q=P(T\cdot\neg S)/P(T)$.

Assuming that the total number of theories is C, we can calculate that：

The rate of success theory P(S)= (The number of "successful and true" theories + The number of "successful but false" theories) / Total number of theories.

The number of "successful and true" theories=The number of “true theories”-The number of "true but not successful" theories=P(T) *C-P(T)*q*C= (1-q) *P(T)*C.

The number of "successful but false" theories=The number of “false theories” *p=P(¬T) *p*C.

Because $P(T)+P(\neg T)=1$, $P(\neg T)=1-P(T)$.

The ratio of successful theories P(S)= [(1-q) *P(T)*C+P(¬T)*p*C]/C = [(1-q)*P(T)*C+(1-P(T)*p*C]/C = (1-q-p)*P(T)+p.

If success is a reliable test of truth, then the values of p and q are both small. At this point P(S) is proportional to P(T) and the scale factor is 1. This means that if success is a reliable test of truth and most theories today are successful, then most theories today are true.

Laudan (1981) asserts that if we judge the truth of a theory based on whether its central terms referred, then the number of false theories among the successful theories of the past is much greater than the number of true theories, from which he inferred that success is not a reliable test of truth. However, this inference is also untenable (p. 35).

Laudan argues that the number of "successful but false" theories is much greater than the number of "successful and true" theories, which means that the false-positive rate is much greater than the true-positive rate. Let us assume that the rate of “the theory as true “is 1/25. The false-positive rate and false-negative rate are the same, both being 1/5 in the process of testing success as a truth value. In this case, the probability that a randomly selected theory is true and successful is 1/25 x 4/5 = 4/125; the probability that a randomly selected theory is false but successful is 24/25x1/5=24/125. Based on this result, we can expect that the number of theories that are false but successful is much greater than the number of theories that are true and successful. However, this does not prevent us from continuing to use "success" as a reliable tool for detecting truth values. The historical evidence given by Laudan merely shows that there were very few true theories at a given time. The number of “successful but false" theories is far greater than the number of "successful and true" theories. However, this does not infer that theory success is not a reliable tool for truth testing.

A point of clarification here is that realists believe that “the success of a theory is a reliable test of its truth”, not that “the success of a theory implies a high probability of its occurrence”. If Laudan wants to conclude that “success is not a reliable test of truth”, he must show that either the false-positive rate or false-negative rate is high. According to the algorithm of false-positive rate, Laudan’s goal would be achieved if he could show that either A) a random sample of many false theories, most of which are successful; or B) there are some historical periods in which most of these theories were successful and most of them were eventually proven false. Then he could successfully prove that “the success of a theory cannot be used as a reliable test of truth value”. However, Laudan simply took a random sample from among the successful theories, most of which were false. The rate thus obtained is not the false-positive rate, nor does it refute the scientific realists’ argument for “success as a reliable test of truth”.

Turnover Fallacy. Marc Lange offers a second counterargument to the inductive basis of PMI. marc Lange (2002) argues that all PMIs have a turnover fallacy. Thus, they are all invalid. Juha Saatsi (2005) uses a very simple example to express the basic idea of turnover fallacy：

“On my campus, for instance, most of the various student organizations that have at one time or another been officially registered have never possessed a membership roll longer than fifty. Hence, regarding the student groups currently in existence, we should believe (in the absence of any further information) that probably, most will never grow beyond fifty members. My point is not going to be that such a conclusion cannot be justified. But I wish to point out a fallacy involved in arguing for it through this sort of pessimistic induction. The key to this fallacy is turnover.”

Now let's examine the turnover fallacy in PMI. The inductive premise of PMI is that there are far more widely accepted but false theories in the history of science than there are widely accepted but true theories. This is a cumulative assertion, an accumulation of widely accepted but false theories from all past historical periods. Although this premise is true, it cannot reasonably be used as a basis for induction, leading to the conclusion that most theories now are likely to be proven false in the future. Such a reasoning process has a turnover fallacy. It may well be the case that most theories are now stable over a long historical period. Many changes in theories are simply changes in the "predecessors" of certain current theories.

For inductive reasoning to be valid in PMI, the conclusion that "most theories are likely to be false now" requires the use of a stronger non-cumulative historical premise: most theories that were widely accepted during most of the past, and were widely accepted during that period, appear to be false now. By induction, we can conclude that most of the theories that are accepted now will appear to be false in the future. Only an induction based on the state of the theory at a particular time in the past, rather than the cumulative state of the theory, does not involve a turnover fallacy. However, even if we are informed by examination that most theories accepted at a particular time appear to be false in the present, it does not infer that most theories accepted at most times in the past appear to be false in the present. The factual situation may well be that most of the theories that were widely accepted at one historical period are still accepted today. It is just that most of the theories that were once accepted are now discarded because of the turnover rate of other theories from other periods.

In addition, the anti-realists must face the problems of how the theory is individuated and how the historical periods are divided. Therefore, trying to get a more reasonable and stronger basis for induction is very difficult for the anti-realists.

In summary, Lange argues that PMI relies on the induction that "there are many false theories in the history of science" to conclude that "any of our current theories may be falsified and discarded in the future". This reasoning has a turnover fallacy and is therefore invalid.

Circular argument and the Critical Analysis

"NMA is a circular argument". The second major criticism of the NMA is that the NMA is viciously circular and question-begging. This criticism argues that the NMA employs inference to best explanation (IBE) and presupposes the reliability of the IBE. However, the reliability of the IBE itself is precisely what scientific realism states. That in other words, the NMA presupposes what its conclusion states and is, therefore, a false circular argument. This criticism is represented by A. Fine, who points out that realists are not free to assume the validity of a principle whose own validity is still being debated (Fine, 1986, p. 161). He also points out that realism based on the IBE lacks argumentative validity because it uses "arguments whose own credibility remains in question" (Fine, 1991, p. 82). Thus, "on the whole, scientific realism lacks a rational defense" (Fine, 1986, p. 163).

Premise Circularity or Rule Circularity. A typical circular argument is that the conclusion and the premises are the same. However, the fact that the premises are the same as the conclusion is not sufficient to show that the argument is a false circular argument. According to R.B. Braithwaite (1953), an argument is judged to be an erroneous circular argument on the basis that it provides a reason for accepting a statement, but the reason (or one of the reasons) used is the statement. Such false circular arguments are called premise circularity. That is, the argument of the premise loop is to argue for the truth-value of some statement A, but the truth-value of A is already presupposed in the premise. Such an argument is not convincing.

In his defense of inductive reasoning, R.B. Braithwaite also refers to another kind of circular argument, the rule circularity. In such an argument, the premises are P1, P2, ..., Pn, and a conclusion Q is obtained using an inference rule R. Q has the following logical property: it implicitly states that the inference rule R used in the argument is reliable. In general, the argument of a rule circularity is an example of the inference rule proved by its conclusion. The difference between a premise cycle and a rule cycle is that the conclusion of a rule circularity argument is not one of its premises. The reason provided for the truth value of the argument is not the conclusion itself. Thus, a rule circularity argument is not a false circular argument.

The NMA is a rule circularity argument. The premise of the NMA: Scientific methodology is theory loaded and it has gained widely accepted instrumental success. Conclusion of the NMA: The background theories of scientific methodology are approximately true. Since these background theories are obtained by first-order reasoning, which together with the conclusion of the NMA, infers the reliability of the abductive reasoning itself. Thus, accepting the reliability of the abductive reasoning must require that the conclusion of the NMA's argument, which is the background theory, be true. The NMA is not a false premise circular argument because there are no assumptions about the approximate truth value of the theory in the premises. Moreover, NMA does not guarantee transcendentally that the conclusion is necessarily true, and the truth value of NMA's conclusion (that the theory is approximately true) assumes that "this is the best explanation of the premises". However, it is possible that the conclusion "theory is approximately true" is not the best explanation of the premises. In other words, it is possible that the conclusion of the NMA is false. Therefore, the NMA is not a false premise circular argument.

Reliability of the Rule Circular Argument. One skeptical voice says that in a rule circularity argument we must assume the reliability of the argumentative rule itself. If the reliability of the rule is based on the preferential acceptance of the conclusion, then this rule circularity argument is wrong. For we must prove the correctness of the conclusion before we can use the rule to reach it. However, the reliability of the conclusion cannot be proved without accepting the reliability of the rule first. In NMA, the reliability of abductive inference is based on the conclusion (that the background theory is approximately true). However, this conclusion itself is obtained by abductive reasoning.

Epistemological externalists such as A.I. Goldman (1986) reject the above challenge and argue that there is no need to give proof of the reliability of a rule before we can reasonably use it. If the illustration of a rule is treated as a link between a set of premises and a conclusion, what is relevant to the correctness of the conclusion, then, is whether the rule is reliable, not whether the reliability of the rule is defended. The reliability of the rule requires that the individual assumptions are in their proper place, and whether they are in fact in their proper place affects the correctness of the conclusion of the argument. If the inference rule is reliable, then if the premises are true, the conclusion will also be true. Suppose we have a "reasoning machine" and we input some true premises from which it draws its conclusions. If this "reasoning machine" comes to the correct conclusion almost every time, then we will assume that it operates according to some rule of reasoning. Once the correct premises are entered, this rule of reasoning is activated, and the correct conclusion is obtained. However, the "reasoning machine" merely activates the rule, we do not need to identify its reasoning rule or prove its reliability. It is not until the reasoning machine starts to generate some false conclusions that we have reason to doubt its reliability. If this is not the case, there is no need to doubt the reliability of its rules or to argue for their reliability.

Thus, if the rule is reliable, the conclusion obtained using this rule is justified as long as the premises are true. According to externalism, the only requirement we have for a rule circularity argument is that the inference rule used is reliable. A rule circularity argument is no more incorrect than any other argument that uses that rule. The same is true of the No-Miracle Argument. If ordinary scientific theory arguments using abductive reasoning are not incorrect, then neither is NMA.

The Underdetermination of Theory by Evidence（UTE）and Critical Analysis

The core arguments of UTE. A final important refutation of the NMA is the Underdetermination of Theory by Evidence (Van Fraassen, 1980). The Underdetermination of Theory by Evidence (UTE) argues that if two theories are observationally indistinguishable, which means both theories can lead to the same empirical results, then they are also cognitively indistinguishable since they are equally empirically justified. Laudan (1996) calls this conclusion “the egalitarian thesis” (p. 33). So, there is no reason to believe that one is better than the other, still less to accept one as true and the other as false. If we interpret the empirical success of a theory in terms of its approximate truth, then for two ontologically incompatible but empirically equivalent theories, we will have to accept them as true at the same time. This would not be reasonable and would be self-contradictory. Van Fraassen (1980) argues at best, we would regard the empirically successful theory as empirically appropriate, not true. In this view, there is no epistemological basis for scientific realism to conclude that theories are approximately true based on empirical success alone.

Refuting the Proposition of Empirical Equivalence. To argue that "we have no reason to believe that one of the competing theories is true" requires proof that there are indeed two empirically equivalent scientific theories that refer to the theoretical entity but make incompatible assertions about it. According to the Duhem-Quine Thesis, the empirical test of any scientific theory is a test of the whole consisting of the theory and its background knowledge. Thus, a theory with a proper auxiliary hypothesis will be consistent with any evidence. From this, we can conclude that for any set of evidence, any two competing theories T and T', there is always some appropriate auxiliary hypothesis A and A' such that T+A and T'+A' are empirically equivalent. If the above thesis is correct, we cannot distinguish empirically between the two theories.

However, even if any two competing theories can be made to appear empirically equivalent by appropriate adjustments, it does not mean that they can be equally corroborated. Inductivists argue that the degree of evidential support for an auxiliary hypothesis is usually reflected in the degree of evidential support for the entire body of theory. Although two theories may appear to be empirically equivalent and capable of introducing the same evidence, it is the two theoretical systems that are empirically equivalent, but the auxiliary hypotheses within them do not share the same degree of evidential support. Therefore, it is unlikely that the competing theories are equally supported by the evidence.

What is more necessary to pursue is the validity of the Duhem-Quine Thesis itself. Because the Duhem-Quine Thesis is only practically valid if we can always find meaningful auxiliary hypotheses. A. Grünbaum (1960) and J. Worrall (1950) respectively argue that it is entirely uncertain whether we can always find meaningful auxiliary hypotheses. We are not able to construct empirical equivalence theories universally.

Laudan (1996) further argues that it is because the observational consequence of a theory can only be determined by the theory together with auxiliary hypotheses that empirical equivalence over time cannot be guaranteed. Suppose that there are two competing theories T and T' sharing the same empirical consequence at moment t. If all the theories must be assisted by auxiliary hypotheses to derive observational consequences, then there is no guarantee that the empirical consequence shared by T and T' will be monotonically increasing, or that in the future the two theories' empirical consequences will remain the same. Because the two theories will require different auxiliary hypotheses at other times, new auxiliary hypotheses may not always be found. Even if we do find new auxiliary hypotheses, the generation of new empirical evidence may produce a different degree of corroboration for the new auxiliary hypotheses. In this way, the two theories can be distinguished from each other. The above view is supported by evidence from the history of science. For example, the light particle theory and the light fluctuation theory were once empirically equivalent and were able to explain phenomena such as the linear propagation of light and the reflection of light equally well. However, subsequent phenomena of light interference, light diffraction, and light polarization have confirmed the light fluctuation theory, making the two theories no longer empirically equivalent.

Even if there were some truly empirically indistinguishable theories, this fact would not threaten realism. For "the existence of some empirically equivalent theory" is a local proposition, not a global proposition. It is only when empirically equivalent theories are shown to be a global phenomenon that they become a threat to scientific realism. There is no relevant evidence to suggest that it does. The history of science has often seen seemingly empirically equivalent theories distinguished by further evidence. Examples include the light fluctuation theory/light particle theory mentioned above, and Ptolemaic astronomy/Copernican astronomy.

Therefore, truly empirically equivalent cases have been very difficult to find. Even if a truly empirically equivalent theory exists, this phenomenon is only local, not global. Local cognitive blindness does not deny the ability of scientific theories to gain truth globally.

A Plain Defense of Abductive Reasoning

I argued previously that it is not necessary to give proof of the reliability of a reasoning rule before we reasonably use that rule. However, the reliability of the rules of abductive reasoning remains the focus of questioning. I will give a very plain response to this: if we have no reason to doubt common sense reasoning in everyday life, then we have no reason to doubt abductive reasoning in science either.

Van Frassen (1980) argues that the common use of hypothetical reasoning in common-sense reasoning does not justify the abductive reasoning in science. He argues that abductive reasoning about observables is acceptable, but that abductive reasoning about unobservable is problematic. However, if there is something observable but not yet observed by us, we need to reason based on present experience to derive some unobserved but observable thing which is the cause that underlies or generates the present experience. If according to Van Fraassen's position, we can only judge what is observed, then we would be following Humean skepticism. Such a position leaves us with very little to believe, and our epistemology would become very miserable.

I argue that if we have no reason to doubt the legitimacy of common-sense abductive reasoning in daily life, we also have no reason to doubt the legitimacy of abductive reasoning in science. For in both cases the type of reasoning and its defense is the same. We make potential explanations for the phenomena discovered given the background knowledge we already have and select the best one from among them. Once this explanation is accepted, we look for further evidence to support the explanation, thus determining how much confidence we have in the explanation, whether it can be tested, and so on. We internalize this process by developing reliable background knowledge. This whole process is one of reasoning, not subjective intuition. Reasoning in this context is abductive reasoning.

The persuasive power of hypothetical reasoning in daily life and science cannot be ignored. As generally, there is no reason to be skeptical about it. Rather, skepticism about adductive reasoning itself needs to be better argued. If abductive reasoning is used in daily life with ontological presuppositions and is accepted as a matter of course. Then we should also accept its use in science.

Conclusion

Each of the three main rebuttals to the NMA presented above can be forcefully countered by the scientific realists. Scientific realism has also developed more refined theoretical hypotheses such as structural realism in the face of anti-realist refutations. So far, the NMA of scientific realism has still been a success. I hope to defend the plausible status of scientific realism and strengthen people's confidence in knowing the truth through science by defending the NMA.

References

Braithwaite, R. B. (1953). *Scientific Explanation a Study of the Function of Theroy, Probability and Law in Science*. CUP Archive, 274-278.

Fine, A. (1986). Unnatural attitudes: Realist and Instrumentalist Attachments to Science. *Mind*, *95*(378), 161.

Fine, A. (1986). Unnatural attitudes: Realist and Instrumentalist Attachments to Science. *Mind*, *95*(378), 163.

Fine, A. (1991). Piecemeal realism. *Philosophical Studies: An International Journal for Philosophy in the Analytic Tradition*, *61*(1/2), 82.

Goldman, A. I. (1986). *Epistemology and cognition*. Harvard University Press.

Grünbaum, A. (1960). The Duhemian argument. *Philosophy of science*, *27*(1), 75-87.

Lange, M. (2002). Baseball, pessimistic inductions and the turnover fallacy. *Analysis*, 62(4), 281-285.

Laudan, L. (1981). A confutation of convergent realism. *Philosophy of science*, *48*(1), 19-49.

Laudan, L. (1981). A confutation of convergent realism. *Philosophy of science*, *48*(1), 35.

Laudan, L. (1996). *Beyond positivism and relativism: Theory, method, and evidence*, 33.

Laudan, L. (1996). *Beyond positivism and relativism: Theory, method, and evidence*.57-59.

Lewis, P. J. (2001). Why the pessimistic induction is a fallacy. *Synthese*, *129*(3), 371-380.

Lyons, T. D. (2020). Scientific realism and the stratagema de divide et impera. *The British Journal for the Philosophy of Science*, 892.

Mizrahi, M. (2012). Why the ultimate argument for scientific realism ultimately fails. *Studies in History and Philosophy of Science Part A*, 43(1), 132.

Popper, K. (1963). Science: Conjectures and refutations. *Conjectures and refutations*, 346.

Psillos, S. (1999). *Scientific Realism: How Science Tracks Truth*. Psychology Press, 73.

Psillos, S. (1999). *Scientific Realism: How Science Tracks Truth*. Psychology Press, 77.

Psillos, S. (2009). *Knowing the structure of nature: Essays on realism and explanation*. Springer, 15.

Putnam, H. (1975). Philosophical Papers: Volume 1, *Mathematics, Matter and Method*, 73.

Putnam, H. (1982). Three kinds of scientific realism. The Philosophical Quarterly (1950-), 32(128), 195.

Putnam, H. (1975). Philosophical Papers: Volume 1, *Mathematics, Matter and Method*, 72-73.

Saatsi, J. T. (2005). On the pessimistic induction and two fallacies. *Philosophy of science*, *72*(5), 1088-1098.

Smart, J. J. C. (1963). Philosophy and Scientific Realism, 13.

Smart, J. J. C. (1963). Philosophy and Scientific Realism, 39.

Van Fraassen, B. C. (1980). *The scientific image*. Oxford University Press.

Worrall, J. (1982). Scientific realism and scientific change. *The Philosophical Quarterly (1950-)*, *32*(128), 201-231.