The Realist and Selectionist Explanations for the Success of Science

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Abstract
According to realists, theories are successful because they are true, but according to selectionists, theories are successful because they have gone through a rigorous selection process. Wray claims that the realist and selectionist explanations are rivals to each other. Lee objects that they are instead complementary to each other. In my view, Lee's objection presupposes that the realist explanation is true, and thus it begs the question against selectionists. By contrast, the selectionist explanation invokes a scientific theory, and thus it is not clear whether it is a realist explanation or an antirealist explanation. Finally, the six new arguments for scientific realism in the literature truly complement the no-miracles argument.

Keywords
Lee, Realist Explanation, Selectionist Explanation, Wray

1. Introduction

Some scientific theories are successful; for example, evolutionary theory and the oxygen theory explain and predict many phenomena. Can we justifiably believe that such theories are true? If so, what justifies our belief? Scientific realists and antirealists offer different answers to these questions.

Scientific realists' answer is positive. To justify their answer, they provide what is known as the no-miracles argument (Putnam, 1975, p. 73), which roughly holds that the success of false theories would be miraculous, but the success of true theories is not, and hence the truth of theories best explains their success.[1] This explanation, which will be referred to as "the realist explanation" hereafter, is an answer to the questions: what enables theories to be successful? What mechanism is responsible for their impressive performance? The realist explanation implies that the semantic property of being true enables theories to be successful, i.e., that the realist semantic property underlies their impressive performance.

In response, antirealists have advanced antirealist alternatives, explanations that are allegedly not committed to the truth of successful theories. There are nine such proposals in the literature (Park, 2014). Within this antirealist tradition, K. Brad Wray (2018) puts forward the selectionist explanation, which he takes to be an antirealist rival to the realist explanation. It roughly holds that theories are successful because they have survived a rigorous selection process. Keep in mind that Wray advances the selectionist explanation within the antirealist tradition, and that the selectionist explanation appeals to evolutionary theory.

Kok Yong Lee (2021) objects that the selectionist explanation sheds light on the evolutionary history in which successful theories persisted while unsuccessful theories perished; by contrast, the realist explanation sheds light on the mechanism that is responsible for the success of theories. Thus, the realist and selectionist explanations are not rivals to each other, and they are in fact complementary to each other, shedding light on the semantic and historical aspects, respectively, of successful theories.

This paper jumps into this intriguing debate between these two philosophers. The outline of my discussion is as follows. In Section 2, I lay out the selectionist explanation in detail, comparing it with other explanations of the success of theories. In Section 3, I unpack Lee's

[1] For the sake of brevity, this paper does not distinguish between truth and approximate truth.

objection to it in detail. In Section 4, I argue that Lee's objection presupposes that the realist explanation is true, and thus that it begs the question against selectionists. In Section 5, I argue that the selectionist explanation invokes a scientific theory, and thus it is not clear whether it is a realist explanation or an antirealist explanation. In Section 6, I argue that the six new arguments for scientific realism in the literature truly complement the no-miracles argument.

This paper can be useful to those who aim to use evolutionary theory to defend or attack scientific realism, to those who wonder how they could complement the no-miracles argument, and to those who aim to explore what is involved in making use of a scientific theory for philosophical theorizing about science.

2. The Selectionist Explanation

Wray's selectionist explanation holds that theories are successful because, to summarize, they went through a rigorous selection process in which successful theories persisted while unsuccessful ones perished. The theories that survived the rigorous selection process might be true or might be false; it does not matter whether they are true or false. Even if they are true, we can explain their success without assuming that they are true. Accordingly, "the inference from success to truth is unwarranted" (Wray, 2018, p. 171).

Let me compare the selectionist explanation with the realist one to make explicit what the former says. Both explanations have the same explanandum – that certain scientific theories are successful – but they have different explanantia. The explanans of the realist explanation is that successful theories are true; by contrast, the explanans of the selectionist explanation is that successful theories persisted while unsuccessful theories perished during their evolutionary history. It appears, therefore, that they are rival explanations to each other.

Let me compare Wray's explanation with another selectionist explanation that might be called "the empiricist explanation": theories are successful because they underwent a rigorous selection process in which empirically adequate theories persisted while empirically inadequate theories perished. What is the difference between saying that theories are successful and saying that they are empirically adequate? To say that a theory is successful is to say, among other things, that some of what is says about phenomena are true, while to say that it is empirically adequate is to say that all of what it says about phenomena are true. The empiricist explanation is committed to the empirical adequacy of successful theories, while Wray's explanation is not. Wray's explanation would be endorsed by those who believe that an aim of science is to produce successful theories, and that scientists have achieved the aim in some fields of science. By contrast, the empiricist explanation would be endorsed by those who believe that an aim of science is to generate empirically adequate theories, and that scientists have achieved the aim in some fields of science. It appears that Wray's explanation encounters less epistemic risk than the empiricist explanation, although they are both selectionist explanations (or different variants of the selectionist explanation).

Why do I make the distinction between Wray's explanation and the empiricist explanation? Antirealists might initially advance Wray's explanation, thinking that it is preferable to encounter less epistemic risk. As Seungbae Park (2019a, p. 97) argues, however, skepticism suffers from various epistemic and pragmatic disadvantages, which implies that the closer a position is to skepticism, the more severely it suffers from those disadvantages. For example, if antirealists believe that their colleagues' theories are successful, but not that they are true, their colleagues would in return believe that antirealists' theories are successful, but not that they are true. As a result, antirealists might change their explanation from Wray's explanation to the empiricist explanation, thinking that it is better to believe that theories are empirically adequate than to believe that they are successful.

Let me now compare Wray with biologists. Wray invokes evolutionary theory to explain why theories are successful, just as biologists invoke evolutionary theory to explain why elephants have long noses. However, there is an important difference between Wray and biologists. Biologists offer both mechanical and phylogenic explanations of why elephants have long noses, and they believe that both explanations are true, i.e., they believe that elephants have long noses because they have certain genes and because they went through a rigorous selection process in which long-nosed elephants persisted while short-nosed elephants perished. By contrast, Wray does not provide the mechanical explanation of why theories are successful; he only offers the phylogenic explanation of why theories are successful. Thus, he believes that the phylogenic explanation is true, but not that the mechanical explanation is true.

Wray can be compared to imaginary biologists who accept the phylogenic explanation of why elephants have long noses but reject the mechanical explanation of why elephants have long noses. For the imaginary biologists, it does not matter whether the mechanical explanation is true or false. What matters for them is whether they can explain why elephants have long noses without believing that elephants have certain genes. If you think that the imaginary biologists' double standard toward the mechanical and phylogenic explanations is objectionable, you should also think that Wray's double standard toward the realist and selectionist explanations is objectionable.

Wray and biologists have different aims. When biologists give the phylogenic explanation of why elephants have long noses, their aim is to shed light on the evolutionary history during which elephants were subject to a rigorous selection process. By contrast, when Wray gives the phylogenic explanation of why theories are successful, his aim is to undermine realists' claim that their mechanical explanation is the best of all explanations. Admittedly, Wray's selectionist explanation sheds light on the evolutionary history during which theories were subject to a rigorous selection process. However, this illumination is merely a byproduct of the means that Wray uses to achieve his aim, viz., to undermine the realist explanation. He would be happy to abandon that means, provided that there is a better means to achieve his aim. By contrast, biologists would not be happy to abandon the phylogenic explanation of why elephants have long noses, for the phylogenic explanation *is* their aim.

Just as Wray and biologists have different aims, so realists and biologists have different aims. When biologists give the mechanical explanation of why elephants have long noses, their aim is to shed light on why elephants have long noses from a mechanical point of view. By contrast, when realists give the mechanical explanation of why theories are successful, their aim is to arrive at the realist hypothesis that successful theories are true. Admittedly, the realist explanation sheds light on the mechanism that underlies the success of theories. However, this illumination is merely a byproduct of the means that realists use to achieve their aim, viz., to establish scientific realism. They would be happy to abandon that means, provided that there is a better means to achieve their aim, i.e., provided that there is a better argument to establish scientific realism. By contrast, biologists would not be happy to abandon the mechanical explanation of why elephants have long noses, for the mechanical explanation *is* their aim.

3. Lee's Objection

Why do elephants have long noses? Lee (2021, pp. 7–8) observes that this question can be interpreted as a request for a mechanism that is responsible for long noses or as a request for an evolutionary history during which natural selection worked on elephants. In other words, the question can be interpreted as a request for a mechanical explanation of why elephants have long noses or as a request for a phylogenic explanation of why elephants have long noses. The mechanical explanation holds that elephants have long noses because they have certain genes. The phylogenic explanation holds that elephants have long noses because they went through a

rigorous selection process in which long-nosed elephants persisted while short-nosed elephants perished.

Two things are noteworthy about the mechanical and phylogenic explanations. (i) Both explanations are answers to the same question: why do elephants have long noses? But the question can be interpreted as a request for a mechanical explanation or as a request for a phylogenic explanation, as we noted above. (ii) The two explanations are complementary to each other in that they shed light on different aspects of elephants. The mechanical explanation reveals the genetic aspect of elephants, as it shows that long-nosed elephants have certain genes. By contrast, the phylogenic explanation reveals the historical aspect of elephants, as it shows that long-nosed elephants are the ones that survived a rigorous selection process. Both explanations are necessary for a complete understanding of elephants' long noses.

Why are theories successful? Lee (2021, p. 13) argues that this question can also be interpreted as a request for a mechanism that is responsible for the success of theories, or as a request for an evolutionary history during which natural selection worked on theories. The mechanical explanation holds that theories are successful because they are true; this explanation coincides with the realist explanation. By contrast, the phylogenic explanation holds that theories are successful because they underwent a rigorous selection process in which successful theories persist while unsuccessful theories perish; this explanation coincides with the selectionist explanation.

Again, two things are noteworthy about the mechanical and phylogenic explanations. (i) Both explanations are answers to the same question: why are theories successful? But the question can be interpreted as a request for a mechanical explanation or as a request for a phylogenic explanation. (ii) The two explanations are complementary to each other in that they shed light on different aspects of successful theories. The mechanical explanation reveals the semantic aspect of successful theories, as it shows that successful theories possess the semantic property of being true. By contrast, the phylogenic explanation reveals the historical aspect of successful theories, as it shows that successful theories are the ones that survived a rigorous selection process.

Lee argues, contrary to what Wray claims, that the realist and selectionist explanations complement each other because they each contribute to a complete understanding of their explanandum. He says, "the selectionist explanation and the realist explanation are complementary to each other in the sense that a complete understanding of the phenomenon that scientific theories are predictively successful requires us to acquire both explanations" (Lee, 2021, p. 15). The realist explanation sheds light on the mechanism that underlies the success of theories, while the selectionist explanation sheds light on the evolutionary history during which successful theories persisted while unsuccessful theories perished.

In sum, Lee's response to Wray's selectionist explanation is to say that it is a phylogenic explanation revealing the historical aspect of successful theories, while the realist explanation is a mechanical explanation revealing the semantic aspect of successful theories. Therefore, the realist and selectionist explanations are not rivals to each other, and they are in fact complementary to each other. This conclusion is contrary to Wray's view that the selectionist explanation is an antirealist rival to the realist explanation. Lee has made a valuable contribution to the debate between realists and selectionists.

A reviewer objects that I missed an important point regarding Lee's objection to selectionism. Lee writes "not only are realism and selectionism compatible, they are indeed complementary to each other" (Lee, 2021, p. 15). Now, it is clear that the compatibility of realism and selectionism suffices to undermine the selectionist objection to realism, since selectionists advance the selectionist explanation as an *alternative* to the realist explanation.

But if they are compatible, then selectionists such as Wray have failed to propose an antirealist alternative to the realist explanation.

Let me explicitly state here that I agree with Lee that the phylogenic and mechanical explanations are compatible with each other, and that selectionists have failed to propose an antirealist alternative to the realist explanation. I would only add that Wray advances the selectionist explanation for the purpose of meeting the demand to explain the success of theories without being committed to their truth, and that it is unclear whether he has achieved the purpose. The selectionist explanation invokes a scientific theory, and thus it is not clear whether it is a realist explanation or an antirealist one. I flesh out this objection in Section 5 below.

4. My Response to Lee's Objection

In this section, I argue that Lee's contention that the realist and selectionist explanations complement each other presupposes that the realist explanation is true, and thus that it begs the question against selectionists.

Consider the following mythological and atmospheric explanations of lightning. The mythological explanation holds that lightning flashes in the sky because Zeus is angry, while the atmospheric explanation holds that lightning flashes in the sky because warm and cold air masses collide with each other. We believe that the atmospheric explanation is true, and that it sheds light on the atmospheric aspect of lightning. By contrast, we do not believe that the mythological explanation is true, or that it sheds light on the mythological aspect of lightning. Accordingly, we do not say that the two explanations reveal different aspects of lightning and contribute to a complete understanding of lightning. In short, we do not say that they complement each other.

What can we learn from the foregoing discussion of the mythological and atmospheric explanations? Only when we believe that two explanations are true can we say that they complement each other, i.e., that they shed light on different aspects of the matter and contribute to a complete understanding of it. If we do not believe that one of them is true, we do not believe that it reveals any aspect of the matter or contributes to a complete understanding of it. Consequently, we cannot say that they complement each other. Conversely, to say that two explanations complement each other is to assume that both explanations are true.

This point applies to Lee's objection to the selectionist explanation. To say that the realist and selectionist explanations complement each other is to assume that both explanations are true. However, realists and selectionists disagree as to whether the realist explanation is true. Wray does not believe that the realist explanation is true, and hence he would not say that the realist explanation sheds light on the semantic aspect of successful theories, any more than we say that the mythological explanation sheds light on the mythological aspect of lightning. It follows that to say that the realist and selectionist explanations complement each other is to beg the question against selectionists.

There is a tension between what Lee says implicitly and what he says explicitly. On the one hand, he says that the realist and selectionist explanations complement each other. To say so is to implicitly commit to the truth of the realist explanation, as I argued above. On the other hand, he explicitly distances himself from the realist explanation, saying that his "paper does not conclude that the no-miracle argument is sound" (Lee, 2021, p. 17). In my view, he can resolve the tension between his implicit and explicit assertions with the use of the six new arguments for scientific realism introduced in Section 6 below.

5. My Response to the Selectionist Explanation

In this section, I argue that Wray's selectionist explanation invokes a scientific theory, and thus that it is not clear whether it is a realist explanation or an antirealist one.

Wray claims that theories are successful because they have gone through a rigorous selection process in which successful theories persisted while unsuccessful ones perished. He offers the selectionist explanation to argue that "the inference from success to truth is unwarranted" (Wray, 2018, p. 171). Note that the selectionist explanation invokes evolutionary theory. If the selectionist explanation assumed the truth of evolutionary theory, it would not be an antirealist one but rather a realist one. As a result, it could not be called upon to meet the demand to explain the success of theories without being committed to their truth. Even worse, it would be self-defeating for Wray to advance such an explanation. Therefore, selectionists have the burden of showing that the selectionist explanation does not assume the truth of evolutionary theory.

A reviewer objects that the selectionist explanation does not require the truth of evolutionary theory, but only requires the assumption that evolutionary theory has survived a rigorous selection process. My response is to say that this assumption might not be available to Wray, given that he (2013) runs the pessimistic induction against realists. The pessimistic induction implies that since old theories were empirically inadequate, new theories, including evolutionary theory, are also empirically inadequate (Park, 2014, p. 9).

Another reviewer objects that a case can be made that evolutionary theory posits only observables. If it is free of theoretical terms, its truth is identical with its empirical adequacy, and selectionists can consistently believe that it is true. Thus, the selectionist explanation is an antirealist one, and it can be used to meet the demand to explain the success of theories without being committed to their truth.

Let me make two comments about this intriguing objection.[2] (i) To believe that evolutionary theory is empirically adequate is to believe that what it says about observable events, including distant past ones, is true. Consequently, antirealists who believe that evolutionary theory is empirically adequate believe what it says about distant past observable events, although they do not believe what scientific theories say about current unobservable events. In my view, such an epistemic policy does not go hand in hand with the scientific practice of inferring distant past observable events from current unobservable events. For example, biologists learn that current Europeans and Asians share some genes with Neanderthals, and then infer that Homo sapiens interbred with Neanderthals. They also learn that different current species use the same genetic code, and then infer that they have descended from a common ancestor. Such scientific inferences indicate that we can have more evidence for current theoretical events than for past observational events.

(ii) Indeed, it is an open question whether evolutionary theory is free of theoretical terms. On the one hand, Darwin developed evolutionary theory without using the concept of genes. On the other hand, evolutionary theory was combined with molecular biology in the mid-20th century, providing genetic explanations of why variations occur and why offspring resemble their parents, thereby enriching the principle of natural selection. I do not attempt to resolve the dispute over whether the genetic explanations are part of evolutionary theory or not. I do claim, though, that antirealists who believe that evolutionary theory is true and free of theoretical terms cannot believe that elephants have long noses because they inherited certain genes from their ancestors. Such a theoretical explanation is only available to realists.

The reviewer raises a novel objection that there is a sense in which genes are observable. That is, chromosomes (coiled strands of DNA) are visible through a microscope. As such, a case can be made that genetic explanations do not appeal to unobservable entities, and the anti-

[2] Yunus Prasetya (2021) also claims that the truth of van Fraassen's (1980) contextual theory of explanation coincides with its empirical adequacy. See Park (2021) for a critical response.

realist in general might have no problem accepting the truth of evolutionary theory. It follows that the selectionist explanation is an antirealist one.

In my view, the reviewer's suggestion that genes are observable would be rejected by Bas van Fraassen, who says that "X is observable if there are circumstances which are such that, if X is present to us under those circumstances, then we observe it" (van Fraassen, 1980, p. 16). As far as he is concerned, "one only observes something when the observation is *unaided*" (Monton and Mohler, 2021). Moreover, scientists today use electron microscopes to investigate genes. To say that they observe genes through electron microscopes implies that physical theories about how an electron microscope works are true. Accordingly, to say that scientists observe genes through electron microscopes is to embrace scientific realism or a position which is close to it. Such a position conflicts with the purpose of advancing the selectionist explanation, which is to argue that we cannot justifiably believe that successful theories, including physical theories about how an electron microscope works, are true.

The reviewer objects that even if evolutionary theory essentially embeds theoretical terms, it could still be argued that the selectionist explanation is an antirealist one. Consider Jarrett Leplin's example cited by Lee. According to Leplin, "To explain why Wimbledon finalists are so great, it is perfectly appropriate to cite the stringency of the selection procedures for entry into the tournament (Leplin, 1997, p. 9). Leplin is right to say so. Moreover, his explanation is perfectly legitimate even if anti-realism is right; even if scientific theories are not true, his explanation of why Wimbledon finalists are so great is hardly affected. This shows that the legitimacy of the selectionist explanation does not in principle depend on whether or not evolutionary theory embeds the notion of genes.

I feel that this objection is the most forceful of all the objections that this reviewer has raised to this paper. It appears, at least initially, that antirealists can avail themselves of observational claims, such as the claim that elephants went through a rigorous selection process and the claim that Wimbledon finalists went through stringent selection procedures. The selectionist explanation only requires such observational claims; accordingly, it is an antirealist explanation.

In my view, however, the reviewer's defense of the selectionist explanation opens a new debate in which the selectionist explanation is not necessarily better off than the realist explanation. Consider the pessimistic induction against antirealism that since old theories were empirically inadequate, new theories are also empirically inadequate (Park, 2014, p. 9). This pessimistic induction implies that evolutionary theory is empirically inadequate, and thus that we are not justified in believing observational claims such as the claim that elephants went through a rigorous selection process and the claim that Wimbledon finalists went through stringent selection procedures. However, the observational claims are so obvious and intuitive that selectionists would not reject them and would rather reject the philosophical argument against them, viz., the pessimistic induction against antirealism. Selectionists might even think that the pessimistic induction is merely a red herring.

By parity of reasoning, however, we should not reject successful scientific theories, but should reject selectionists' philosophical argument against them, viz., since the selectionist explanation undermines the realist explanation, we cannot justifiably believe successful theories. Scientists are aware of all of the observational evidence for the oxygen theory and the special theory of relativity. The theories are so obvious and intuitive that scientists would not reject them and would rather reject selectionists' philosophical argument against them. They might even think that the selectionist explanation is merely a red herring. In sum, just as the observational claims are more powerful and persuasive than the pessimistic induction against them, so scientists' arguments for successful theories are more powerful and persuasive than selectionists' argument against them.

Some philosophers (Lipton, 2001; Fitzpatrick, 2013; Park, 2019b) contend that the no-miracles argument is not necessary for a defense of scientific theories, and that scientists' arguments for scientific theories are necessary for a defense of scientific theories. They would say that antirealists should refute scientists' arguments for scientific theories instead of advancing the selectionist explanation to argue that we cannot justifiably believe scientific theories. They believe that scientific arguments can increase or decrease the credibility of scientific theories, but that philosophical arguments cannot. Accordingly, they would reject both the realist and selectionist explanations.

An interesting debate can unfold between the aforementioned philosophers and the advocates of both the realist and selectionist explanations. In that debate, the advocates of the selectionist explanation would not have the upper hand over the advocates of the realist explanation. After all, both believe that philosophical arguments can increase or decrease the credibility of scientific theories, and their common belief would be rejected by the philosophers. Unfortunately, it goes beyond the range of this paper to pursue the debate between them.

6. Other Philosophers' Positions

In this section, I step back and compare Wray's and Lee's positions with other philosophers' positions in the literature regarding evolutionary theory and scientific realism.

Wray's (2018) position is similar to those of Thomas Kuhn (1962/1970, pp. 172–173), van Fraassen (1980, p. 39–40), Wray (2011, p. 8), and Christophe de Ray (2022). These philosophers rely on evolutionary theory to argue against scientific realism, and thus they run the risk of exposing themselves to the charge that their positions are self-defeating. For example, Kuhn claims that successive paradigms do not move toward truths any more than organisms evolve toward goals. If he is right about successive paradigms, evolutionary theory is no closer to the truth than its predecessor, and hence it is false. Therefore, Kuhn's philosophical account of science, which appeals to a false scientific theory, is false (Park, 2017).

Lee's (2021) position is similar to those of Stathis Psillos (1999, pp. 96–97), Alexander Bird (2000, pp. 211–113), and Emma Ruttkamp-Bloem (2013, pp. 207–209). In the debate with antirealists, these philosophers rely on evolutionary theory to argue for scientific realism, and thus they run the risk of opening themselves to the charge that their positions are circular. For example, Psillos claims that theories are successful because they are true, just as elephants have long noses because they have certain genes. He assumes the truth of evolutionary theory, which embeds the notion of genes in order to establish the truth of successful theories, including evolutionary theory (Park, 2017).

Let me now compare Wray's and Lee's positions with each other. There is a difference between them: Wray's position affirms, while Lee's position denies, that the selectionist explanation is an antirealist rival to the realist one. However, there is a similarity between them: they both operate within evolutionary theory. A third party might stake out a position that does not rely on any scientific theory. They might construct a new argument for or against scientific realism that does not appeal to any scientific theory. That position would be different from both Wray's and Lee's positions.

There is such a position in the literature. Park (2022, pp. 67–85) introduces six new arguments for scientific realism, all of which are different from the no-miracles argument. None of them invokes a scientific theory, and thus none of them is vulnerable to the charge that it begs the question against antirealists. Yet all the six arguments complement the no-miracles argument. For example, the argument from hidden evidence holds that since currently successful theories have been supported by previously hidden evidence, they will indefinitely be supported by presently hidden evidence (Park, 2018, p. 57). This argument does not appeal to any scientific theory, nor does it presuppose that the realist explanation is true, yet it

concludes, as does the realist explanation, that successful theories are true. Moreover, it sheds light on the evidential aspect of successful theories in a way that the no-miracles argument does not, thereby contributing to a complete understanding of successful theories.

Critics might attempt to refute the argument from hidden evidence, thinking that a refuted argument cannot complement the no-miracles argument. My response to this possible attempt is to point out that it presupposes that if an argument is refuted, it cannot complement another argument. This presupposition goes hand in hand with my previous contention in Section 4 above that only those who believe that two explanations are true can say that they complement each other, and thus that to say that the mechanical and phylogenic explanations complement each other is to beg the question against selectionists.

7. Conclusion

Evolutionary theory seems to be useful to both realists and antirealists. It has been utilized by realists to defend scientific realism and by antirealists to attack scientific realism, thereby enriching the debate regarding scientific realism. In my view, however, their appeals to evolutionary theory create burdens for realists to show that their position is not circular and for antirealists to show that their position is not self-defeating. In any event, the more philosophers help themselves to scientific claims for their philosophical theorizing about science, the farther their position will be from scientific antirealism, and the closer their position will be to scientific realism.

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