

## Replies to Healey's Comments Regarding van Fraassen's Positions

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### Abstract

Healey (2019a) makes four comments on my (Park, 2019a) objections to van Fraassen's positions. The four comments concern the issues of whether 'disbelief' is appropriate or inappropriate to characterize van Fraassen's position, what the relationship between a theory and models is for van Fraassen, whether he believes or not that a theory is empirically adequate, and whether destructive empiricism is tenable or not. I reply to those comments in this paper.

**Keywords:** Destructive Empiricism, Disbelief, Empiricism, Models

### 1. Introduction

Richard Healey makes four useful comments on my paper (2019a) where I criticized Bas van Fraassen's positions. The four comments concern the issues of whether 'disbelief' is appropriate or inappropriate to characterize van Fraassen's position, what the relationship between a theory and models is for van Fraassen, whether he believes or not that T is empirically adequate, and whether destructive empiricism is tenable or not. I respond to Healey's four comments one by one in this paper. It will become clear that van Fraassen's positions might not be appealing to social cognitive agents, those cognitive agents who interact with one another. This paper will be useful to those who wish to be clear about what van Fraassen's positions are and how they can be criticized.

### 2. Disbelieve

It is a perennial issue what van Fraassen's position is. Does he not believe T? Does he think that it is unreasonable to believe T? I reconstructed his position as follows:

Bas van Fraassen (2017) argues that we are rational to believe and disbelieve T, a scientific theory that best explains phenomena, relying on the English view of rationality. In addition, he thinks that the belief of T is supererogatory. As a result, he disbelieves T. (Park 2019a, 146)

Richard Healey (2019a) raises two objections to this reconstruction of van Fraassen's position. I reply to them one by one in this section.

First, Healey objects, "Disbelief in a proposition  $P$  is neither simple absence of belief in  $P$  nor belief in not- $P$ . For a person  $A$  to disbelieve  $P$ ,  $A$  must hold  $P$  unworthy of belief (at least according to Webster's dictionary)" (Healey 2019a, 43).

I thank Healey for clarifying what it means to disbelieve  $p$ . A negative value judgment is involved in a disbelief of T. Consequently, it would have been better, if I used 'not believe' instead of 'disbelieve' in my reconstruction of van Fraassen's position. The former reflects, but the latter does not, what the English view of rationality (van Fraassen, 1989, 171–172)

implies. It implies that it is rational not to believe T, but it does not imply that T is unworthy of belief.

Consider, however, that van Fraassen does not believe T on the grounds that it is *supererogatory* to do so, which means that it is beyond the requirement of rationality to believe T, and that we are rational even if we do not believe T. Does his behavior of not believing T indicate that he takes T to be unworthy of belief? Motivational internalists and externalists in meta-ethics would answer “Yes” and “No,” respectively. Motivational internalists claim that motivation is internal to a value judgment, so if you take an action to be valuable or moral, you are necessarily motivated to perform it, and if you take an action to be not valuable or not moral, you are necessarily not motivated to perform it. Therefore, motivational internalists would argue that van Fraassen’s behavior of not believing T indicates that he takes T to be unworthy of belief. By contrast, motivational externalists claim that motivation is external to a value judgement, so even if you take an action to be valuable or moral, you might not be motivated to perform it, and even if you take an action to be not valuable or not moral, you might be motivated to perform it. Motivational externalists would be happy to say that van Fraassen takes T to be worthy of belief, even if he does not believe T. Therefore, motivational externalists would recommend, whereas motivational internalists would not, that I replace ‘disbelieve’ with ‘not believe’ in my reconstruction of van Fraassen’s position.

I (2016) defended motivational internalism, but I am happy to replace ‘disbelieve’ with ‘not believe’ in this paper. Let me add, however, that the replacement of ‘disbelieve’ with ‘not believe’ does not affect the main thesis of my two papers (2019a, 2019b) in which I argued that van Fraassen’s position has epistemic and pragmatic disadvantages in a social world. For example, I previously said that if van Fraassen *disbelieves* his epistemic colleagues’ theories, epistemic reciprocalists would in return disbelieve van Fraassen’s theories. In light of Healey’s comment, I now say that if van Fraassen does *not believe* his epistemic colleagues’ theories, epistemic reciprocalists would in return *not believe* his theories. In short, the same objections can be raised *mutatis mutandis* against van Fraassen’s position.

Second, Healey objects, “for any P, it would be irrational of A to believe and disbelieve P, and hence neither van Fraassen (nor anyone else) could rationally believe and disbelieve a scientific or philosophical theory” (Healey 2019a, 43).

Healey is right on this count. In my view, it is not only irrational for an agent to believe and not believe T but also psychologically impossible to do so. Instead of saying that according to van Fraassen, we are rational to believe and disbelieve T, I should have said that according to van Fraassen, it is rational for an agent to believe T, but it is also rational for *another agent* not to believe T, or that it is rational for an agent to believe T at one time, but it is also rational for the agent not to believe T *at another time*.

Let me turn to a more substantive issue. Realists believe T, whereas van Fraassen does not believe T. Van Fraassen (2017) asserts that it is rational for realists to believe T and for antirealists not to believe T. In my view, there is something wrong with such a formulation of realism and antirealism, viz., there can be no debate between realists and antirealists under such a formulation. If both the belief of T and the nonbelief of T were reasonable, it would be irrational for realists to criticize the nonbelief of T, and it would also be irrational for antirealists to criticize the belief of T. After all, it is irrational to criticize a reasonable position. Consequently, realists and antirealists should go their own ways without interfering with each other’s epistemic life (Park 2019c, 479–480).

Compare van Fraassen’s formulation of realism and antirealism with an alternative according to which realism affirms, whereas antirealism denies, that it is rational to believe T.

Realists and antirealists disagree over whether it is rational or irrational to believe T. Such a disagreement would lead to voluminous debates between realists and antirealists. The voluminous debates would yield rich insights about science, and as a result, contributors to the debates will learn a lot about science. Such a formulation of realism and antirealism is more useful than the formulation of realism and antirealism that cannot generate any debate between realists and antirealists (Park 2019c, 484).

### 3. Theories and Models

I stated, “According to van Fraassen, a theory is a collection of models, and models are abstract entities” (Park 2019a, 147). Healey objects, “Although van Fraassen *associates* a theory with a collection of mathematical models he does not *identify* the two” (Healey 2019a, 43).

Some philosophers, however, take the semantic view as identifying a theory with a set of models. Wade Savage, for example, states that according to the semantic view, “a theory is a collection of nonlinguistic models” (Savage 1990, vii). Rasmus Winther states that according to the semantic view, “the structure of a scientific theory is its class of mathematical models” (Winther 2016). Van Fraassen is reputed to have defended the semantic view in the literature. Savage and Winther, however, would say that if Healey is right, then van Fraassen is not a proponent of the semantic view, but he can be *associated* with the semantic view.

More importantly, Healey’s previous point stands regardless of whether a theory is or is associated with a collection of models. His point was that van Fraassen cannot believe the contextual theory (CT) because doing so “would involve believing in the existence of all the unobservable abstracta that feature in the relevant models” (Healey 2019b, 26). To use an analogy, if you do not believe that Zeus exists, you cannot believe that it rains because Zeus weeps. Similarly, if you do not believe that models are real, you cannot believe that the contextual theory is true because one of the models accurately reflects the world.

### 4. The Empiricist Position

I claimed that “van Fraassen (1985, 294) chooses the belief that T is empirically adequate” (2019b, 92). Healey argues at length that “van Fraassen does not hold Park’s so-called empiricist position” (Healey, 2019b: 28). I replied, “It is a tricky issue whether van Fraassen is committed to the empiricist position or not” (Park 2019a, 149). Healey (2019a) responds to my reply as follows:

Seungbae (2019b) introduced what he called “the empiricist position” that a theory *T* that would best explain some available data is merely empirically adequate. I argued that this is not van Fraassen’s position, and Seungbae (2019a) now acknowledges that van Fraassen is not committed to this position. (Healey 2019a, 43)

Strictly speaking, I did not acknowledge that van Fraassen does not take this position. I (2019a: 149-150) rather pointed out that some writers attribute this position to him while other writers do not. I (2019a, 150) also exposed some problems with not taking this position. For example, if van Fraassen does not take the position, realists would not take the position either, so he cannot say that constructive empiricism “makes better sense of science, and of scientific activity, than realism does and does so without inflationary metaphysics” (van Fraassen 1980, 73).

Let me elucidate here another interesting consequence of not taking the empiricist position. On the traditional analysis of knowledge, belief is a requirement of knowledge, so if

van Fraassen does not take the empiricist position, he cannot *know* that T is empirically adequate. According to constructive empiricism, “*Science aims to give us theories which are empirically adequate*” (van Fraassen 1980, 12). Since van Fraassen cannot know that T is empirically adequate, he cannot know either whether science has achieved the aim, even if science has achieved it. In other words, van Fraassen cannot know that he has empirically adequate theories in his hands, even if he has them in his hands. This is, however, a minor point.

A major point regards how Healey defends van Fraassen’s position from my (2019a) criticism that not taking the empiricist position comes with epistemic and pragmatic disadvantages. Healey argues that “an epistemically voluntarist constructive empiricist *may* consistently choose to accept T, (thereby believing T is empirically adequate) and also use T to explain events in terms of T (accepting van Fraassen’s contextual theory of explanation (CT) but without commitment to belief in the *truth* either of T or of (CT))” (Healey 2019a, 43). In short, on Healey’s account, van Fraassen does not, but he may, accept T, and hence that he does not, but he may, believe the empirical adequacy of T.

It is not clear on what grounds Healey or van Fraassen could argue that it is rational not to believe the empirical adequacy of T. We ascertain the truth of *some* observational consequences of T, and then infer the truth of *all* observational consequences of T. When we make this inference, we use the rule of inference called *enumerative induction*, which is an inference from some to all. If van Fraassen thinks that enumerative induction is not rationally compelling, he would naturally think that it is rational not to believe the empirical adequacy of T. If enumerative induction is not rationally compelling, however, it is not clear whether or not there is any rationally compelling inductive rule of inference. Antirealists usually do not conjure up Humean skepticism about induction to refute realism because Humean skepticism refutes not only realism but also variants of antirealism, such as instrumentalism (Park 2019d, 143).

According to Healey, van Fraassen does not, but he may, accept T, and hence he does not, but he may, believe the empirical adequacy of T. This interpretation of van Fraassen’s position does not seem to match up with his daily life. Think again about the example of an earthquake (Park 2019a, 150). If seismologists predict that an earthquake will occur in van Fraassen’s place tomorrow, he would immediately evacuate his place. It does not sound plausible to say that he does not, but he may, accept seismology, which indicates that he does not, but he may, believe that the earthquake will occur in his place tomorrow, which in turn indicates that he does not, but he may, evacuate his place.

Moreover, in light of Healey’s interpretation of van Fraassen’s view, I can recast the disadvantages of van Fraassen’s view that I (2019a, 2019b) specified earlier. Think again about the example of the award committee (Park 2019a, 151). I earlier claimed that if van Fraassen does not believe the empirical adequacy of T, the award committee members would also not believe either the empirical adequacy of the CT, van Fraassen’s theory of explanation, and as a result, they would reject van Fraassen’s application for the scholarly award. I can now say that the committee members do not, but they may, believe the empirical adequacy of the CT, which indicates that they do not, but they may, give the scholarly award to van Fraassen. Since the committee members do not believe the empirical adequacy of the CT, however, they would reject van Fraassen’s application for the scholarly award. Of course, they may give the award to van Fraassen, but they do not. So it does not matter whether they may or may not give the award to van Fraassen. Van Fraassen does not get the award. In sum, Healey’s point that van Fraassen does not, but he *may*, accept T does not protect van Fraassen’s position very much from my criticism that not taking the empiricist position comes with epistemic and pragmatic disadvantages.

Let me again state Healey's sentence: "an epistemically voluntarist constructive empiricist *may* consistently choose to accept T, (thereby believing T is empirically adequate) and also use T to explain events in terms of T (accepting van Fraassen's contextual theory of explanation (CT) but without commitment to belief in the *truth* either of T or of (CT))" (Healey 2019a, 43). Note that according to Healey, van Fraassen *may* use T to explain events in terms of T, although he does not believe the empirical adequacy of T. In my view, however, van Fraassen may not do so, even if he believes the empirical adequacy of T, because he does not believe the truth of T. In general, if you do not believe T, you cannot invoke it to explain events due to Moore's paradox.

Moore's paradox arises when we assert a Moorean sentence. It has the structure, "P, but I don't believe p" (Moore 1993, 207–212). Suppose that you are a juror in a courtroom. A witness says, "I saw the accused robbing the bank, but I don't believe I saw the accused robbing the bank." Such a testimony would only puzzle you, and it would not motivate you to vote for the conviction of the accused. Suppose that antirealists say, "John is young because his telomeres are long, but I don't believe John is young because his telomeres are long." The antirealists say, "John is young because his telomeres are long," to explain why John is young. They add, "I don't believe John is young because his telomeres are long" to express antirealism according to which we should be skeptical about the existence of theoretical entities, such as telomeres. The antirealists' assertion of the Moorean sentence, however, would only puzzle you, and you would not be convinced of the antirealists' explanation of why John is young.

Many writers (Dellsén 2016, 11; Dawes, 2013: 68; Winther 2009, 376; van Fraassen 1980, 12) contend that we can explain events in terms of T without believing it. Healey has just joined the camp of these philosophers, which is fair enough. In my view, however, Moore's paradox prohibits nonbelievers of T from using it to explain events (Park 2018, 33–34). It is to try to have the cake and eat it too to explain events in terms of T without believing T. Explanation is a boon available only to realists, those who believe T. I (2014, 280–281; 2017, 383; 2018, 33–34; 2019e, 155) have been advancing this objection to antirealism for the past several years. No one has yet responded to it.

## 5. Destructive Empiricism

Destructive empiricism holds that "Science aims to give us theories some of whose observational consequences are true: and acceptance of a theory involves as belief only that some of its observational consequences are true" (Healey 2019b, 28). I (2019a, 152–153) affirmed, whereas Healey (2019b, 28–28) denied, that destructive empiricism is a promising competitor to constructive empiricism.

Healey (2019a) justifies his position regarding destructive empiricism as follows. Suppose that  $\{O_i\}$  is a set of observational consequences of T that turned out to be true, and that O is a new observational consequence of T, and it is not ascertained yet. Can an agent assert O? Healey answers, "A may *assert* O, but according to destructive empiricism, accepting T gives A no reason to believe that O is true since A's aims have already been achieved by believing  $\{O_i\}$ " (Healey 2019a, 44).

This sentence is somewhat beyond my cognitive capacity. Healey seems to accuse destructive empiricism of having the absurd implication that acceptance of T gives an agent no reason to believe O. In my view, however, acceptance of T is not a kind of mental state in the first place that can constitute the reason to believe O. According to van Fraassen, acceptance of a theory involves a belief and "a commitment to confront any future phenomena by means of the conceptual resources of this theory" (van Fraassen 1980: 12). Suppose that scientific realists, constructive empiricists, and destructive empiricists have

{ $O_i$ }, i.e., they all know that T is successful. As a result, they accept T. In other words, they commit to using T for scientific purposes and believe, respectively, the truth of T, the empirical adequacy of T, and the truth of some observational consequences of T. Now, they all derive O from T and assert O. What would be their reason to believe O? They would all answer that { $O_i$ } is their reason to believe O. They would not say that acceptance of T is their reason to believe O. In other words, they would all argue that O is true not because they accept T but rather because they have { $O_i$ }, i.e., but rather because T has some observational consequences that turned out to be true. It is wrong to accuse scientific realism and constructive empiricism of having the absurd implication that acceptance of T gives an agent no reason to believe O. By the same reasoning, it is also wrong to accuse destructive empiricism of having the absurd implication that acceptance of T gives an agent no reason to believe O.

It is not clear to me why it is legitimate for scientific realists and constructive empiricists to predicate their belief of O on { $O_i$ }, but it is illegitimate for destructive empiricists to predicate their belief of O on { $O_i$ }. Of course, scientific realists and constructive empiricists have not achieved their aims when they have { $O_i$ }. By contrast, destructive empiricists have achieved their aim when they have { $O_i$ }. It does not follow, however, that destructive empiricists cannot pursue O. After all, having the additional true observational consequence is compatible with their aim. It is not the case that they are going above their aim when they pursue O.

Relatedly, there is another aspect of Healey's sentence above that I do not understand. He says, "A may *assert* O, but according to destructive empiricism, accepting T gives A no reason to believe that O is true since A's aims have already been achieved by believing { $O_i$ }" (Healey 2019a, 44). This sentence implies that an agent's acceptance of T gives her the reason or no reason to believe O, depending on what her aim is. In my view, however, an agent's aim has nothing to do with whether her acceptance of T gives her the reason or no reason to believe O. Suppose that acceptance of T gives an agent the reason to believe O, contrary to what I said above. If her acceptance of T gives her the reason to believe O, however, that is independent of what her aim is. In addition, if her acceptance of T gives her no reason to believe O, that is also independent of what her aim is. It is not clear to me why Healey thinks that an agent's aim determines whether her acceptance of T gives her the reason or no reason to believe O.

An agent's aim does not provide her with a reason to believe O. According to constructive empiricists, for example, empirical adequacy is the aim of science. That aim does not give constructive empiricists the reason to believe O. It is rather { $O_i$ } that gives them the reason to believe O. Similarly, according to destructive empiricists, the truth of some observational consequences is the aim of science. That aim does not give destructive empiricists the reason to believe O. It is rather { $O_i$ } that gives them the reason to believe O.

In general, an agent has the reason or no reason to believe p, not depending on what her aim is but rather depending on what evidence she has for p. Arthur Fine (1986) would agree with me on this count. He interprets constructive empiricism as follows:

..the methodology of science and the reach of evidence only moves us to belief in truths about observables. Accordingly, constructive empiricism sets as the goal of science not truth, but theories that are empirically adequate. (Fine 1986, 158)

To put it more directly, according to constructive empiricists, the evidence for the empirical adequacy of T is obtainable, whereas the evidence for the truth of T is not, so we should set empirical adequacy, but not truth, as the aim of science. Note that on Fine's account, the

epistemic consideration is the basis for the teleological consideration, not the other way around. Thus, the aims of science, whatever they might be, cannot be the reason to believe O.

There is a more fundamental problem with the suggestion that aims of science affect our epistemic life. Ancient scientists, such as Aristotle, held the teleological view of the world according to which the world has an aim or a purpose. Modern scientists, such as Galileo and Newton, banished teleology from science. Teleology, however, found its safe haven in philosophy of science, and it still flourishes in the 21<sup>st</sup> century. The time has come to banish teleology from philosophy of science. Scientific philosophy would not tolerate teleology (Park 2020, Subsection 3.1).

Let me now turn to another argument that Healey presents to establish that destructive empiricism does not allow for an ampliative inference from {Oi} to O:

Even if *A* does come to believe *O* this cannot be because *A* takes the belief in {Oi} to be a reason to believe *O*. If it were, one who accepted *T* should come to believe *O* as well as {Oi}, and so come to believe *more* than what the destructive empiricist takes to be involved in acceptance of *T*. Since *A* will not take the belief in {Oi} to be a reason to believe *O*, even if *A* does come to believe *O* this is not through an ampliative inference from {Oi}. (Healey 2019, 44–45)

The crucial claim in this passage is that to believe O is to believe more than what destructive empiricists take to be involved in acceptance of T. If this claim is true, Healey is right to say that destructive empiricists cannot make the ampliative inference from {Oi} to O. After all, to make the inference would be to give up destructive empiricism. It appears, therefore, that destructive empiricists cannot make the ampliative inference from {Oi} to O.

An interesting issue is whether the foregoing crucial claim is true or false. I think that it is false. Destructive empiricists believe the truth of *some* observational consequences of T, not only when they believe {Oi} but also when they believe O in addition to {Oi}. To believe O in addition to {Oi} is not to believe the truth of *all* observational consequences of T. Destructive empiricists can accept T not only on the basis of only {Oi} but also on the basis of {Oi} and O. In sum, believing O in addition to {Oi} is compatible with destructive empiricism. Consequently, destructive empiricists can make the ampliative inference from {Oi} to O.

As the quoted passage above indicates, Healey claims that destructive empiricists “will not take the belief in {Oi} to be a reason to believe *O*” (Healey 2019, 44–45). This claim raises an interesting question. Under what circumstances would destructive empiricists not take {Oi} to be the reason to believe O? My answer is as follows. Suppose that God is scheduled to radically change the way the world operates at a certain point in time, *t*. All the observational consequences of T turned out to be true prior to *t*. Destructive empiricists have just reached *t*. Under such circumstances, destructive empiricists would refuse to take {Oi} to be the reason to believe O. Other than that, they would happily take {Oi} to be the reason to believe O.

If readers are not yet convinced that destructive empiricism is a viable contender to constructive empiricism, I invite them to consider the position that I call *constructive instrumentalism*. It says that science aims to give us useful theories, and that acceptance of T involves as belief only that it is useful. A theory can be useful, even if it is empirically inadequate. For example, obsolete theories, such as the geocentric theory and Newton’s mechanics, were useful, but ran into anomalies, so they were empirically inadequate. It follows that constructive instrumentalism is distinct from constructive empiricism. If readers think that constructive instrumentalism is a legitimate alternative to constructive empiricism,

they should also think that destructive empiricism is a legitimate alternative to constructive empiricism.

## 6. Conclusion

Let me highlight two important points from the discussion above. First, in a social world, not taking the empiricist position has more unpalatable epistemic and pragmatic disadvantages than taking the empiricist position. Second, destructive empiricists can raise the same objections *mutatis mutandis* to constructive empiricism as those that van Fraassen raises to scientific realism. We can clearly see this dialectical terrain thanks to Healey's (2019b) formulation of destructive empiricism.

## References

- Dawes, Gregory. 2013. "Belief is Not the Issue: A Defence of Inference to the Best Explanation", *Ratio: An International Journal of Analytic Philosophy* 26 (1): 62–78.
- Dellsén, Finnur. 2016. "Understanding without Justification or Belief." *Ratio: An International Journal of Analytic Philosophy* DOI: 10.1111/rati.12134.
- Fine, Arthur. 1991. "Piecemeal Realism", *Philosophical Studies* 61 (1–2): 79–96.
- Healey, Richard. 2019a. "Four Points in Response to Seungbae Park", *Social Epistemology Review and Reply Collective* 8 (12): 43–45.
- Healey, Richard. 2019b. "The Aims of Reliable Knowledge: Reply to Seungbae Park." *Social Epistemology Review and Reply Collective* 8 (9): 25–30.
- Moore, George. 1993. "Moore's Paradox", In *G.E. Moore: Selected Writings*. Baldwin, Thomas (ed.), London: Routledge.
- Park, Seungbae. 2014. "The Doxastic Requirement of Scientific Explanation and Understanding." *Prolegomena* 13 (2): 279–290.
- Park, Seungbae. 2016. "Defusing Counterexamples against Motivational Internalism." *Filosofija. Sociologija* 27 (1): 23–30.
- Park, Seungbae. 2017. "Understanding without Justification and Belief?" *Principia: An International Journal of Epistemology* 21(3): 379–389.
- Park, Seungbae. 2018. "Philosophers and Scientists are Social Epistemic Agents." *Social Epistemology Review and Reply Collective* 7 (6): 31–43.
- Park, Seungbae. 2019a. "Constructive Empiricism in a Social World: Reply to Richard Healey." *Social Epistemology Review and Reply Collective* 8 (10): 146–154.
- Park, Seungbae. 2019b. "The Disastrous Implications of the 'English' View of Rationality in a Social World." *Social Epistemology* 33 (1): 88–99.
- Park, Seungbae 2019c. "How to Formulate Scientific Realism and Antirealism", *Journal for General Philosophy of Science* 50 (4): 477–488.



Park, Seungbae. 2019d. “New Objections to the Problem of Unconceived Alternatives.” *Filosofia Unisinos* 20 (2): 138–145.

Park, Seungbae. 2019e. “Should Scientists Embrace Scientific Realism or Antirealism?” *Philosophical Forum* 50 (1): 147–158.

Park, Seungbae. 2020. “Formulational vs. Epistemological Debates Concerning Scientific Realism”, *Dialogue* (to be determined).

Savage, Wade. 1990. “Preface.” in *Scientific Theories. Minnesota Studies in the Philosophy of Science. Volume 14*, Wade Savage (ed.), Minneapolis: University of Minnesota Press, pp. vii–ix.

van Fraassen, Bas. 1980. *The Scientific Image*. Oxford: Oxford University Press.

van Fraassen, Bas. 1989. *Laws and Symmetry*. Oxford: Oxford University Press.

van Fraassen, Bas. 2017. “Misdirection and Misconception in the Scientific Realism Debates.” In *Varieties of Scientific Realism: Objectivity and Truth in Science*, edited by Evandro Agazzi, 95–108. Switzerland: Springer International Publishing.

Winther, Rasmus. 2009. “A Dialogue.” *Metascience* 18: 370–379.

Winther, Rasmus. 2016. “The Structure of Scientific Theories.” *The Stanford Encyclopedia of Philosophy*, Edward N. Zalta (ed.), URL = [<https://plato.stanford.edu/archives/win2016/entries/structure-scientific-theories/>](https://plato.stanford.edu/archives/win2016/entries/structure-scientific-theories/).