Chapter 1
Introduction

Abstract The main objective of this book is to provide an introductory overview of a “hot topic” in contemporary philosophy of science, namely, the scientific realism/antirealism debate, which is accessible to students of philosophy as well as students of the sciences who might have an interest in philosophical questions about science. Unlike other books on the scientific realism/antirealism debate in contemporary philosophy of science, this book takes an argumentation approach to the debate. That is to say, rather than devote an entire book to a defense of scientific realism (of some variety or another) or antirealism (of some variety or another), I survey and evaluate what I take to be the key positions and arguments in the scientific realism/antirealism debate in contemporary philosophy of science. Also unlike many books in the contemporary scientific realism/antirealism literature, this book does not include detailed descriptions of a few case studies from the history of science. Instead, this book includes detailed analyses and evaluations of the key arguments these case studies from the history of science are supposed to motivate in the first place. The book concludes with several arguments for my own brand of scientific realism, namely, Relative Realism. I take Relative Realism to be a middle ground position between scientific realism and antirealism.

Keywords Argument · Canonical form (standard form) · Cogent argument · Deductive argumentation · Inductive argumentation · Invalid argument · Non-cogent argument · Sound argument · Strong argument · Unsound argument · Valid argument · Weak argument

When she appeared before the United States House Foreign Affairs Subcommittee on Europe, Eurasia, Energy, and the Environment, the climate activist, Greta Thunberg, said to U.S. lawmakers, “I don’t want you to listen to me. I want you to listen to the scientists.” Greta Thunberg had to urge U.S. lawmakers to “listen to the scientists” and then take action on climate change because climate change is a divisive political issue in the United States. The results of a Gallup poll from March 2019 show that 77% of Democrats believe that global warming is caused by human activities and they are concerned about it, whereas only 16% of Republicans believe that global warming is caused by human activities and they are concerned about it.
Most Republicans (52%) are “cool skeptics,” that is, they do not believe that global warming is caused by human activities and they are not concerned about climate change.

Now, most contemporary philosophers of science would probably agree with Greta Thunberg that we should “listen to the scientists” when they talk about the causes and dangers of climate change. This is because most contemporary philosophers of science either accept scientific realism or lean toward scientific realism. According to the results of the PhilPapers Survey, which is an opinion poll that was conducted by professional philosophers to survey the opinions of academic philosophers on various philosophical topics, 75% of professional philosophers either accept or lean toward scientific realism, whereas 11% accept or lean toward scientific antirealism (Bourget and Chalmers 2014, p. 498). Among academic philosophers who are experts in General Philosophy of Science, in particular, 60% either accept or lean toward scientific realism, whereas 16% accept or lean toward scientific antirealism. This means that most philosophers of science have “a positive epistemic attitude toward the content of our best theories and models, recommending belief in both observable and unobservable aspects of the world described by the sciences” (Chakravartty 2017). Accordingly, if our best climate models show that global warming is occurring due to human activities, we have good reasons to believe that global warming is real and that human activities are in fact a contributing factor.

Despite the fact that most professional philosophers subscribe to or lean toward scientific realism, as the results of the PhilPapers Survey suggest, the scientific realism/antirealism debate rages on as influential articles and books defending either scientific realism (of some variety or another; see, for example, Dicken 2016) or scientific antirealism (of some variety or another; see, for example, Wray 2018) continue to be published regularly. Unlike other books on the scientific realism/antirealism debate in contemporary philosophy of science, however, I would like to take a somewhat different approach to this debate in this book. Instead of devoting an entire book to a defense of scientific realism (of some variety or another) or antirealism (of some variety or another), I survey and evaluate what I take to be the key positions and arguments in the scientific realism/antirealism debate in contemporary philosophy of science. Also unlike many books in the contemporary scientific realism/antirealism literature, this book does not include detailed descriptions of a few case studies from the history of science. Instead, this book includes detailed analyses and evaluations of the key arguments these case studies from the history of science are supposed to motivate in the first place.

---

1 In Mizrahi (2018) and Mizrahi (2020), I discuss the problems with the method of using case studies as evidence for philosophical theses about science in much more detail.
1.1 An Argumentation Approach to the Scientific Realism/Antirealism Debate

The main objective of this book is to provide an introductory overview of a “hot topic” in contemporary philosophy of science, namely, the scientific realism/antirealism debate, which is accessible to students of philosophy as well as students of the sciences who might have an interest in philosophical questions about science. This book is modeled after recent books in philosophy that aim to introduce students to philosophical problems, questions, and debates through argumentation. A few recent examples of books that take an argumentation approach to philosophy include the following:

- *Just the Arguments: 100 of the Most Important Arguments in Western Philosophy*, edited by Michael Bruce and Steven Barbone (Wiley-Blackwell, 2011).
- *What is the Argument? An Introduction to Philosophical Argument and Analysis* by Maralee Harrell (The MIT Press, 2016).
- *For the Sake of Argument: How to Do Philosophy* by Robert M. Martin (Broadview Press, 2017).
- *Bad Arguments: 100 of the Most Important Fallacies in Western Philosophy*, edited by Robert Arp, Steven Barbone, and Michael Bruce (Wiley-Blackwell, 2018).

Like these four books, this book attempts to cut through dense philosophical prose and present just the arguments for and against scientific realism as well as other key positions in the scientific realism/antirealism debate in contemporary philosophy of science. What I take to be key arguments in the contemporary scientific realism/antirealism debate are presented in canonical form, which is also known as standard form, that is, in numbered premises followed by a conclusion, with objections to each argument as well as key quotations that provide references to seminal works in philosophy of science. Accordingly, by “argument” is meant a connected series of statements in which some statements (that is, at least one statement) are supposed to provide evidence for, or reasons to accept, another statement. That last statement is called a conclusion, whereas the statements that are supposed to provide evidence for the conclusion, or reasons to accept it, are called premises.

To illustrate this argumentation approach, here is an example of an argument in canonical or standard form (that is, in numbered premises followed by a conclusion):

(P1) All academic philosophers are scientific realists.
(P2) Nora Berenstain is an academic philosopher.

Therefore,

(C) Nora Berenstain is a scientific realist.

The statements labeled as (P1) and (P2) are the premises of this argument and the statement labeled as (C) is the conclusion of this argument. The premises of an
argument are supposed to provide supporting evidence for the conclusion. To put it another way, the premises of an argument are supposed to give reasons to believe that the conclusion is true. In this case, (P1) and (P2) are supposed to provide supporting evidence for (C). In other words, (C) is supposed to follow logically from (P1) and (P2). This argument is an instance of deductive argumentation. In a deductive argument, the premises purport to provide logically conclusive support for the conclusion. In the aforementioned argument, the premises, namely, (P1) and (P2), do in fact support the conclusion conclusively, such that (C) must be true if (P1) and (P2) are true. A deductive argument in which the premises successfully provide logically conclusive support for the conclusion is said to be a valid argument. If the premises of a deductive argument purport to provide logically conclusive support for the conclusion, but fail to do so, the argument is said to be an invalid argument.

From the results of the PhilPapers Survey, we have some empirical evidence suggesting that only 75% of academic philosophers either accept or lean toward scientific realism, not 100% of academic philosophers (Bourget and Chalmers 2014, p. 498), as (P1) states. Since we have some evidence suggesting that (P1) is false, the aforementioned deductive argument is valid, but it cannot be said to be sound. For a deductive argument to be sound, it must be valid as well as have all true premises. A valid argument with even one false premise is said to be unsound. Given the results of the PhilPapers Survey, the above argument cannot be said to be sound because, although valid, it has a false premise, namely, (P1).

In addition to deductive arguments, some of the key arguments in the scientific realism/antirealism debate in contemporary philosophy of science are supposed to be non-deductive or inductive arguments. In non-deductive or inductive argumentation, the premises purport to provide probable, rather than logically conclusive, support for the conclusion. Here is an example of an inductive argument in canonical (or standard) form:

(P1) 75% of surveyed academic philosophers are scientific realists.
(P2) Nora Berenstain is an academic philosopher (who was not surveyed).

Therefore,

(C) Nora Berenstain is a scientific realist.

In this case, (P1) and (P2) are supposed to provide some supporting evidence for (C), but not logically conclusive evidence as in the previous example of a deductive argument. To put it another way, (P1) and (P2) are supposed to provide strong reasons, but not conclusive reasons, to believe that (C) is true. This kind of inductive argumentation is known as a statistical syllogism or inductive prediction. In inductive argumentation, the premises purport to make the truth of the conclusion more likely or probable, but not absolutely guaranteed. In this case, if it is true that 75% of surveyed academic philosophers are scientific realists, and if it is also true that Nora Berenstain is an academic philosopher, then it is likely also true that Nora Berenstain is a scientific realist. In other words, if the premises (P1) and (P2) are true, (C) is probably true. An inductive argument in which the premises successfully provide probable support for the conclusion is said to be a strong argument. If the
premises of an inductive argument purport to provide probable support for the conclusion, but fail to do so, the argument is said to be a \textit{weak} argument. In inductive prediction, for instance, given that $X$ percent of sampled things, $F$s, have a particular property, $G$, we are entitled to conclude that, with a probability of $X$ percent, a new $F$ that has not been observed or surveyed yet will also have the property, $G$, provided that $X$ is greater than 50\%, and there is no evidence that the new $F$ is unlike previously observed $F$s (Schurz 2019, p. 2). Accordingly, given that 75\% of surveyed academic philosophers are scientific realists, we are justified in concluding, with a probability of 75\%, that Nora Berenstain is a scientific realist, given that she is an academic philosopher, even though she was not surveyed.

From the results of the PhilPapers Survey, we have some empirical evidence suggesting that 75\% of academic philosophers either accept or lean toward scientific realism (Bourget and Chalmers 2014, p. 498), and so we have evidence suggesting that (P1) is true. Assuming that (P2) is true as well, that is, assuming that there really is an academic philosopher out there whose name is Nora Berenstain, the aforementioned inductive argument can be said to be a \textit{cogent} argument.\textsuperscript{2} A cogent argument is a strong argument with all true premises. A strong argument with even one false premise is said to be a \textit{non-cogent} argument. Given the results from the PhilPapers Survey, the above argument can be said to be a cogent argument because it is strong and (P1) and (P2) are in fact true.

Throughout this book, key arguments in the scientific realism/antirealism debate in contemporary philosophy of science are presented in this format (that is, in canonical or standard form) in order to make their logical form and their premises clear to readers. For, in general, any argument can fail in two ways. First, an argument fails when the conclusion does not follow from the premises even if the premises of the argument are true. For example, suppose that what we know about Nora Berenstain is not that she is an academic philosopher, but rather that she is a scientific realist. In that case, the conclusion that Nora Berenstain is an academic philosopher would not follow from our premises. That is to say, the following deductive argument is an invalid argument:

(P1) All academic philosophers are scientific realists.
(P2) Nora Berenstain is a scientific realist.

Therefore,

(C) Nora Berenstain is an academic philosopher.

This deductive argument is invalid because, even if the premises of this argument were true, the conclusion would not necessarily follow from those premises. For premise (P1) tells us that all academic philosophers are scientific realists, but it does not tell us that all scientific realists are academic philosophers. So, even if Nora Berenstain is a scientific realist, it does not necessarily follow that she is an

\textsuperscript{2} In a co-authored paper, Nora Berenstain and James Ladyman (2012) defend a version of scientific realism known as Ontic Structural Realism (OSR). On Structural Realism, see Chap. 3 (Sect. 3.5).
academic philosopher because (P1) tells us that all academic philosophers are scientific realists, but not that all scientific realists are academic philosophers.

Inductive arguments can also fail in this way. For example, suppose that the results of our survey show that 25% of academic philosophers are scientific realists. In that case, the conclusion that Nora Berenstain, who is an academic philosopher who was not surveyed, is a scientific realist would not follow from our premises. That is to say, the following inductive argument is a weak argument:

(P1) 25% of surveyed academic philosophers are scientific realists.
(P2) Nora Berenstain is an academic philosopher (who was not surveyed).

Therefore,

(C) Nora Berenstain is a scientific realist.

This inductive argument is a weak argument because, even if the premises of this argument were true, they would not make the conclusion more probable or likely to be true. Given the premises, the probability that Nora Berenstain (or any other academic philosopher chosen at random, for that matter) is a scientific realist is rather low, that is, merely 25%.

Second, an argument can fail when one or more of its premises is not true. In that respect, a deductive argument could be valid insofar as the premises, if true, would provide conclusive support for the conclusion, but one of those premises is in fact false. For example, the following deductive argument is an unsound argument:

(P1) All academic philosophers are scientific realists.
(P2) Nora Berenstain is an academic philosopher.

Therefore,

(C) Nora Berenstain is a scientific realist.

The premises of this deductive argument, if true, would provide conclusive support for the conclusion, so the argument is valid. However, since (P1) is false, as the results of the PhilPapers Survey (Bourget and Chalmers 2014, p. 498) suggest, the argument cannot be said to be a sound argument.

Likewise, an inductive argument could be strong insofar as the premises, if true, would make the conclusion more probable to likely to be true, but one of those premises is in fact false. For example, the following inductive argument is a non-cogent argument:

(P1) 95% of surveyed academic philosophers are scientific realists.
(P2) Nora Berenstain is an academic philosopher (who was not surveyed).

Therefore,

(C) Nora Berenstain is a scientific realist.

The premises of this inductive argument, if true, would make the truth of the conclusion more likely or probable, so the argument is strong. However, since (P1) is false, as the results of the PhilPapers Survey (Bourget and Chalmers 2014, p. 498) suggest, the argument cannot be said to be a cogent argument.
To sum up, we can broadly distinguish between two kinds of arguments: deductive arguments and non-deductive (or inductive) arguments. In deductive argumentation, a premise (or premises) purports to provide logically conclusive support for a conclusion. Deductive arguments in which the premises succeed in providing logically conclusive support for the conclusion are said to be valid arguments; otherwise, they are said to be invalid arguments. A deductive argument that is valid and all of its premises are true is said to be a sound argument; if even a single premise is false, it is said to be an unsound argument. In non-deductive or inductive argumentation, a premise (or premises) purports to provide probable support for a conclusion. Inductive arguments in which the premises succeed in providing probable support for the conclusion are said to be strong arguments; otherwise, they are said to be weak arguments. An inductive argument that is strong and all of its premises are true is said to be a cogent argument; if even a single premise is false, it is said to be a non-cogent argument.

It would be useful to have a generic decision procedure to follow when we have an argument to analyze and evaluate. The following is a generic decision procedure for the analysis and evaluation of arguments in natural language.

1. **Step 1**: Identify the conclusion of the argument and then the evidence or reasons that are supposed to support that conclusion. The evidence or reasons that are supposed to support the conclusion are the premises of the argument.

2. **Step 2**: Write each premise in a numbered line. Following the premises, write the conclusion after the word ‘therefore’. Label each premise consecutively as ‘P1’, ‘P2’, and so on, and the conclusion as ‘C’.

3. **Step 3**: Determine whether the premises are supposed to provide logically conclusive or probable support for the conclusion of the argument. If the former, the argument is deductive, in which case, go to Step 4. If the latter, the argument is inductive, in which case, go to Step 6.

4. **Step 4**: If the argument is deductive, determine whether the premises successfully provide logically conclusive support for the conclusion. If they do, the argument is valid, in which case, go to Step 5. If the premises fail to provide logically conclusive support for the conclusion, the argument is invalid, in which case, stop! It is not a good argument.

5. **Step 5**: If the argument is valid, determine whether all the premises are in fact true. If all the premises are true, the argument is sound, in which case, stop! It is a good argument. If even one premise is false, the argument is unsound, in which case, stop! It is not a good argument.

6. **Step 6**: If the argument is inductive, determine whether the premises successfully provide probable support for the conclusion. If they do, the argument is strong, in which case, go to Step 7. If the premises fail to provide probable support for the conclusion, the argument is weak, in which case, stop! It is not a good argument.

7. **Step 7**: If the argument is strong, determine whether all the premises are in fact true. If all the premises are true, the argument is cogent, in which case, stop! It is 1.1 An Argumentation Approach to the Scientific Realism/Antirealism Debate

To sum up, we can broadly distinguish between two kinds of arguments: deductive arguments and non-deductive (or inductive) arguments. In deductive argumentation, a premise (or premises) purports to provide logically conclusive support for a conclusion. Deductive arguments in which the premises succeed in providing logically conclusive support for the conclusion are said to be valid arguments; otherwise, they are said to be invalid arguments. A deductive argument that is valid and all of its premises are true is said to be a sound argument; if even a single premise is false, it is said to be an unsound argument. In non-deductive or inductive argumentation, a premise (or premises) purports to provide probable support for a conclusion. Inductive arguments in which the premises succeed in providing probable support for the conclusion are said to be strong arguments; otherwise, they are said to be weak arguments. An inductive argument that is strong and all of its premises are true is said to be a cogent argument; if even a single premise is false, it is said to be a non-cogent argument.

It would be useful to have a generic decision procedure to follow when we have an argument to analyze and evaluate. The following is a generic decision procedure for the analysis and evaluation of arguments in natural language.

1. **Step 1**: Identify the conclusion of the argument and then the evidence or reasons that are supposed to support that conclusion. The evidence or reasons that are supposed to support the conclusion are the premises of the argument.

2. **Step 2**: Write each premise in a numbered line. Following the premises, write the conclusion after the word ‘therefore’. Label each premise consecutively as ‘P1’, ‘P2’, and so on, and the conclusion as ‘C’.

3. **Step 3**: Determine whether the premises are supposed to provide logically conclusive or probable support for the conclusion of the argument. If the former, the argument is deductive, in which case, go to Step 4. If the latter, the argument is inductive, in which case, go to Step 6.

4. **Step 4**: If the argument is deductive, determine whether the premises successfully provide logically conclusive support for the conclusion. If they do, the argument is valid, in which case, go to Step 5. If the premises fail to provide logically conclusive support for the conclusion, the argument is invalid, in which case, stop! It is not a good argument.

5. **Step 5**: If the argument is valid, determine whether all the premises are in fact true. If all the premises are true, the argument is sound, in which case, stop! It is a good argument. If even one premise is false, the argument is unsound, in which case, stop! It is not a good argument.

6. **Step 6**: If the argument is inductive, determine whether the premises successfully provide probable support for the conclusion. If they do, the argument is strong, in which case, go to Step 7. If the premises fail to provide probable support for the conclusion, the argument is weak, in which case, stop! It is not a good argument.

7. **Step 7**: If the argument is strong, determine whether all the premises are in fact true. If all the premises are true, the argument is cogent, in which case, stop! It is
a good argument. If even one premise is false, the argument is non-cogent, in which case, stop! It is not a good argument.

Throughout this book, all the analyses and evaluations of key arguments in the scientific realism/antirealism debate in contemporary philosophy of science follow this generic decision procedure, so readers are invited to refer back to it whenever an analysis of a particular argument is at issue. Readers can also find the italicized argumentation terms along with their definitions in the Glossary at the end of this chapter.

Here is an example of how to use this generic decision procedure for analyzing and evaluating arguments in natural language. Take the following passage for example:

Every field of inquiry deals with some subject matter: it studies something rather than nothing or everything. Thus it should be able to tell, at least roughly, what sort of objects it is concerned with and how its objects of study differ from those studied by other disciplines. [...] Evidently, what holds for all fields of inquiry also holds for a particular discipline such as the philosophy of science. Therefore, it belongs to the job description, so to speak, of the philosopher of science to tell us what that “thing” called science is (Mahner 2007, p. 515).

The first step is to figure out whether an argument is being made in this passage. In this passage, is evidence (or reasons) presented in support of a conclusion? The answer is yes. The word ‘therefore’ in the last sentence suggests that the conclusion of the argument in this passage is the following:

(C) Philosophers of science should be able to tell us what science is.

The author does not simply assert (C). Rather, the author provides evidence (or reasons) in support of (C). The reasons, which constitute the premises of this argument, are the following:

(P1) For any discipline or field of inquiry, practitioners in that field should be able to tell us what it is that they study.
(P2) In the discipline or field of inquiry known as philosophy of science, practitioners (namely, philosophers of science) study science.

Now that we have the parts of the argument, namely, the premises and the conclusion, the second step is to write the argument in canonical (or standard) form. When we put the premises and the conclusion together, we have the following argument in canonical (or standard) form:

(P1) For any discipline or field of inquiry, practitioners in that field should be able to tell us what it is that they study.
(P2) In the discipline or field of inquiry known as philosophy of science, practitioners (namely, philosophers of science) study science.

Therefore,

(C) Philosophers of science should be able to tell us what science is.

Now that we have the argument in canonical (or standard) form, the third step is to figure out what type of argument it is supposed to be: deductive or inductive. Are the premises of this argument supposed to provide conclusive or probable support
for the conclusion? In this argument, the premises are supposed to provide conclusive support for the conclusion because they apply a general principle to a particular instance. Of course, what is true in general must be true in a particular instance that falls under the general principle. As the author of the passage puts it, “what holds for all fields of inquiry also holds for a particular discipline such as the philosophy of science” (Mahner 2007, p. 515). So this argument is supposed to be a deductive argument.

Given that this argument is intended to be a deductive argument, it can be either valid or invalid. The fourth step, then, is to figure out whether the argument is valid or invalid. If the premises were true, would they provide logically conclusive support for the conclusion? Again, the answer is yes. That is to say, the conclusion of this argument must be true if the premises are true. Again, what holds for all disciplines or fields of inquiry must hold for philosophy of science as well, given that philosophy of science is a discipline or field of inquiry.

Since this argument is valid, it can be either sound or unsound. The fifth step, then, is to figure out whether the premises of this argument are in fact true. Are (P1) and (P2) actually true? Naturally, this question is more difficult to answer than the questions about the type and logical form of the argument. Indeed, it seems fair to say that many philosophical disagreements are about the truth value of premises rather than the logical form of arguments. As we will see in Chaps. 4 and 5, philosophers of science often disagree about the premises of an argument, although they sometimes disagree about the logical form of arguments as well. In the case of the argument in question, however, there are good reasons to believe that (P1) is false. In particular, there seem to be plenty of counterexamples to (P1). Take psychology, for example. Psychologists study the mind even though it is difficult to say what the mind is exactly. There are philosophical disagreements about the nature of the mind: is it physical or non-physical? Is it identical to the brain? Is it like a computer? And so on. Despite these philosophical disagreements about the nature of the mind, psychologists can proceed with their studies of aspects of the mind, such as cognition, perception, reasoning, memory, and the like. In other words, psychologists study this thing called “the mind” even though they are unable to say what that thing called “the mind” is exactly because no one can, at least for now. Similarly, astronomers study planets even though it is difficult to say what a planet is exactly. There is an ongoing debate about the definition of ‘planet’, which has changed as recently as 2006, leading to the demotion of Pluto from the status of planet to the status of dwarf planet (deGrasse Tyson 2009, p. 119). Despite this debate about what a planet is, astronomers can proceed with their studies of the orbit, composition, and other properties of planets, such as Mars, Jupiter, and the like. In other words, astronomers study those celestial objects called “planets” even though they are unable to say what that thing called “a planet” is exactly because no one can, at least for now. Accordingly, there are disciplines or fields of inquiry, such as psychology and astronomy, in which practitioners are unable to tell us what it is that they study. So, the fact that philosophers of science study science does not necessarily mean that they would be able to tell us what science is exactly. If this is correct, then (P1) may not be true. Given this reason to think that (P1) is false, then, the argument in question, although valid, cannot be said to be a sound argument.
1.2 Just the Arguments

In addition to the pedagogical value of presenting arguments in canonical (or standard) form, so that we could analyze and evaluate them carefully, there is another important reason why there is a need for a book that takes an argumentation approach to the scientific realism/antirealism debate in contemporary philosophy of science, just as this book does. According to Michael Bruce and Steven Barbone (2011, p. 1):

“Show me the argument” is the battle cry for philosophers. [...] When things become serious, one wants just the arguments (emphasis in original).

Given that the scientific realism/antirealism debate is a very serious thing, for it deals with serious questions about science that are of both theoretical and practical significance to all of us, it follows that we want just the arguments as far as this debate is concerned. This argument can be stated in canonical (or standard) form as follows:

(P1) When things become serious, we want just the arguments.
(P2) The scientific realism/antirealism debate is a serious thing.

Therefore,

(C) We want just the arguments in the scientific realism/antirealism debate.

To determine if this is a good argument, let us go through the generic decision procedure for the analysis and evaluation of arguments in natural language outlined above. We already have the parts of this argument, namely, the premises and the conclusion, stated in canonical (or standard) form. So we can skip to Step 3 and ask whether the premises of this argument are supposed to provide logically conclusive or probable support for the conclusion. In this argument, the premises are supposed to provide conclusive support for the conclusion because they apply a general principle to a particular instance. The general principle is that we want just the arguments when things become serious. Of course, what is true in general must be true in a particular instance that falls under the general principle. Accordingly, if we want just the arguments when things are serious, and the scientific realism/antirealism debate is a very serious thing, then it necessarily follows that we want just the arguments of the scientific realism/antirealism debate. Since this argument is supposed to be deductive, we can move on to Step 4 and ask whether it is valid or invalid.

This deductive argument is valid because the premises succeed in providing logically conclusive support for the conclusion. In particular, if we want just the arguments when things are serious, and the scientific realism/antirealism debate is a very serious thing, then it follows logically that we want just the arguments in the scientific realism/antirealism debate. Having determined that this argument is valid, we can move on to Step 5 and ask whether the premises are in fact true. Is this argument sound?

For the sake of argument, let us grant that Bruce and Barbone (2011) are right about (P1); after all, few philosophers, if any, would deny that “philosophers are primarily concerned with arguments” (Harrell 2016, p. 7). Now the question is
whether (P2) is true. I believe that it is, and I have reasons in support of my belief that (P2) is true. As mentioned above, I think that the contemporary scientific realism/antirealism debate is a very serious thing, for it deals with serious questions about science that are of enormous theoretical and practical significance for all of us. As Brad Wray (2018, p. 1) points out, one of the central questions in the scientific realism/antirealism debate is this: “Do we have adequate grounds for believing that our theories are true or approximately true with respect to what they say about unobservable entities and processes?” The “unobservable entities and processes” that Wray is talking about here are the theoretical posits of science, which include theoretical entities, such as neutrinos and genes, as well as theoretical processes, such as natural selection and continental drift. Since science informs many of our decisions nowadays, especially at the social and political levels, whether one takes a realist or an antirealist attitude with respect to the theoretical posits of science will in turn inform or influence one’s decisions about social and political issues that could affect many people, not just oneself. To illustrate, take the public debate concerning the legalization of marijuana for example. One of the arguments made in this debate is that marijuana use should not be legalized because smoking marijuana could have profound effects on brain functions, such as working memory and executive function. This is because the main active ingredient of cannabis, THC, acts as a neurotransmitter throughout the nervous system. More specifically (National Institute on Drug Abuse 2019, p. 17):

*Endogenous cannabinoids* such as anandamide function as neurotransmitters because they send chemical messages between nerve cells (*neurons*) throughout the nervous system. They affect brain areas that influence pleasure, memory, thinking, concentration, movement, coordination, and sensory and time perception. Because of this similarity, THC is able to attach to molecules called *cannabinoid receptors* on neurons in these brain areas and activate them, disrupting various mental and physical functions and causing the effects described earlier. The neural communication network that uses these cannabinoid neurotransmitters, known as the *endocannabinoid system*, plays a critical role in the nervous system’s normal functioning, so interfering with it can have profound effects (emphasis in original).

Now, for the most part, scientific realists tend to think that we have good reasons to believe what our best scientific theories say about the brain, which is why they believe that theoretical posits, such as molecules, neurons, neurotransmitters, and receptors, have roughly the properties that our best scientific theories about the brain say they do. On the other hand, antirealists tend to think that we do not have good reasons to believe what our best scientific theories say about theoretical posits, which is why they suspend belief about the existence of theoretical posits, such as molecules, neurons, neurotransmitters, and receptors. Clearly, then, whether one takes a realist or an antirealist attitude toward brain science or neuroscience will inform or influence (perhaps even tacitly) one’s decisions about the legalization of marijuana. For if one does not think that we have good reasons to believe in the theoretical posits of neuroscience, such as neurons, neurotransmitters, and receptors, and in what our best theories say about these theoretical posits, then it is difficult to see how one can believe that smoking marijuana could have profound effects
on brain function. After all, neurons, neurotransmitters, and receptors are supposed to be the mechanisms by which cannabis can have an effect on the brain. If one does not believe in the existence of the mechanisms by which cannabis can have an effect on the brain, and in what our best neuroscience says about those mechanisms, it is difficult to see how one can believe that THC can attach to receptors on neurons in the brain and thereby disrupt brain functions.

As another example, take the public debate concerning social distancing measures designed to prevent the spread of the infectious disease known as Coronavirus Disease 2019 (COVID-19), which is believed to be caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). According to the Centers for Disease Control and Prevention (CDC), social distancing is the practice of keeping space or a physical distance of at least 6 ft (or 2 m) between oneself and other people when one leaves one’s home. If we want to prevent the spread of COVID-19, then practicing social distancing makes sense because of how we think the virus spreads. From what we know about the new coronavirus so far, it spreads from one person to another by means of respiratory droplets that are produced when an infected person coughs or sneezes around other people. An infected person’s cough or sneeze produces respiratory droplets that can land in the mouths or noses of people who are nearby. These respiratory droplets can also land on the hands of nearby people who will then touch their own mouths or noses, and thereby provide a way for the virus to enter their bodies. Finally, the virus could also be inhaled into the lungs.

Now, as mentioned above, scientific realists generally think that we have good reasons to believe what our best scientific theories say about infectious, disease-causing agents known as “germs” or “pathogens,” which is why they believe that theoretical posits, such as germs and viruses, have roughly the properties that our best scientific theories say they do. On the other hand, antirealists generally think that we do not have good reasons to believe what our best scientific theories say about theoretical posits, which is why they suspend belief about the existence of theoretical posits, such as germs and viruses. Clearly, then, whether one takes a realist or an antirealist attitude toward epidemiology and virology will inform or influence (perhaps even tacitly) one’s decisions about what measures, if any, should be taken in order to prevent the spread of an infectious disease like COVID-19. For if one does not think that we have good reasons to believe in the theoretical posits of epidemiology and virology, such as viruses and respiratory droplets, and in what our best theories say about these theoretical posits, then it is difficult to see how one can believe that social distancing could have an effect on the spread of viral infections like COVID-19. After all, the virus and respiratory droplets are supposed to be the mechanisms by which the infectious disease can spread from one person to another. If one does not believe in the existence of the mechanisms by which the infectious disease can spread, and in what our best medical science says about those mechanisms, it is difficult to see how one can believe that social distancing can have any effect on the spread of this infectious disease.

---

3 Dana Tulodziecki (2016) discusses the germ theory of disease as a case study for the scientific realism/antirealism debate in contemporary philosophy of science.
The point of these examples is to illustrate the seriousness of the scientific realism/antirealism debate in contemporary philosophy of science. These are just two examples of how science can inform or influence decisions about public policies, but there are many other examples. Take, for example, the public debates over policies to combat climate change, the safety of genetically modified food, and the move to alternative, renewable, or “green” energy sources, to mention just a few. Whether one believes the relevant science or not, then, would surely have some effect on one’s decisions and any public policies one would be willing to endorse. Accordingly, if the scientific realism/antirealism debate in contemporary philosophy of science is a very serious thing, as I have argued, then (P2) is true. Granted that (P1) is true as well, since “argument is the heart of philosophy” (Cohen 2004, p. 117) and argumentation is “the most basic philosophical technique” (Martin 2017, p. IX), the deductive argument sketched above can be said to be sound. This sound argument supports the conclusion that we want just the arguments as far as the scientific realism/antirealism debate in contemporary philosophy of science is concerned, and this book is aimed at satisfying precisely this want.

In my evaluation of the argument for the conclusion that we want just the arguments in the scientific realism/antirealism debate above, I said that few philosophers, if any, would object to (P1), namely, the premise that we want just the arguments when things become serious. This is because “philosophers are primarily concerned with arguments” (Harrell 2016, p. 7). In general, then, the main key to successful argumentation is to argue from premises that one’s interlocutor or audience is likely to accept (or at least can be reasonably expected to accept). For, as Trudy Govier (2010, p. 25) puts it:

When you use an argument, you are trying to rationally persuade others of the claim that is your conclusion. You are trying to convince them, by evidence or reasons stated in your premises, that your conclusion claim is correct and you are offering the premises in an attempt to rationally persuade them. In effect, you are asking your audience to accept your premises and to reason from those premises to your conclusion (emphasis added).

If your interlocutors do not accept your premises, they will not reason from your premises to your conclusion, and thus your attempt to convince them, by evidence or reasons stated in your premises, that your conclusion is correct will end in failure. If you want your attempts to convince others, by evidence or reasons stated in your premises, that your conclusion is correct, to be successful, you need to argue from premises that your interlocutors are likely to accept (or can be reasonably expected to accept). As we will see in subsequent chapters, scientific realists often argue from premises that antirealists do not (or are unlikely to) accept, whereas antirealists argue from premises that realists do not (or are unlikely to) accept. This fact about the scientific realism/antirealism debate in contemporary philosophy of science has given some philosophers of science the impression that the debate is intractable. For example, Allison Wylie (1986) argues that the scientific realism/antirealism debate “persists because the most sophisticated positions in either side now incorporate self-justifying conceptions of the aim of philosophy and of the standards of adequacy appropriate for judging philosophical theories of science” (emphasis added). In other words, scientific realists are arguing from meta-philosophical premises (that is, premises about what counts as a good philosophical theory of science) that
antirealists cannot accept, whereas antirealists are arguing from meta-philosophical premises (that is, premises about what counts as a good philosophical theory of science) that scientific realists cannot accept. If Wylie is right about this, then it is no wonder that the scientific realism/antirealism debate seems to be intractable.4

I think that taking an argumentation approach might help us break through this apparent impasse in the scientific realism/antirealism debate. Keeping in mind that the main key to successful argumentation, that is, the giving of reasons (or evidence) that manage to rationally persuade an audience of the conclusion of an argument, is to argue from premises that one’s interlocutors are likely to accept (or can be reasonably expected to accept), I will analyze and evaluate what I take to be key arguments in the scientific realism/antirealism debate in such a way that both the acceptable and the unacceptable premises to either scientific realists or antirealists are clear to the reader. Subsequently, I will attempt to give arguments for my own position in the scientific realism/antirealism debate, namely, Relative Realism, that proceed from premises that both scientific realists and antirealists can accept, or so I would argue.

Before we get to that, however, I will introduce the contemporary scientific realism/antirealism debate in more detail in the next chapter (Chap. 2), and I will further explain what is at stake in this debate. In Chap. 3, I will survey what I take to be key positions in the scientific realism/antirealism debate in contemporary philosophy of science. Some of these positions are realist positions, broadly speaking, whereas others are antirealist positions, broadly speaking. In Chap. 4, I will analyze and evaluate what I take to be key arguments for scientific realism using the argumentation approach described above. In Chap. 5, I will analyze and evaluate what I take to be key arguments against scientific realism (or for antirealism) using the argumentation approach described above. Finally, in Chap. 6, I will discuss my own brand of scientific realism, namely, Relative Realism. I take Relative Realism to be a middle ground position between scientific realism and antirealism. I have proposed this view for the first time in a paper published in International Studies in the Philosophy of Science in 2013. But I will develop this position in much more detail, as well as advance novel arguments for it, in Chap. 6 of this book.

1.3 Summary

The scientific realism/antirealism debate in contemporary philosophy of science is a very serious thing, which is why we need just the arguments as far as this debate is concerned. When it comes to arguments, we can broadly distinguish between two kinds: deductive arguments and non-deductive (or inductive) arguments. In deductive argumentation, a premise (or premises) purports to provide logically conclusive 

---

4Paul Dicken (2016, Ch. 3) provides an extensive discussion of the apparent intractability of the scientific realism/antirealism debate, starting with Arthur Fine’s (1984).
support for a conclusion. Deductive arguments in which the premises succeed in
providing logically conclusive support for the conclusion are said to be *valid*
arguments; otherwise, they are said to be *invalid* arguments. A deductive argument that
is valid and all of its premises are true is said to be a *sound* argument; if even a single
premise is false, it is said to be an *unsound* argument. In non-deductive or inductive
argumentation, a premise (or premises) purports to provide probable support for a
conclusion. Inductive arguments in which the premises succeed in providing prob-
able support for the conclusion are said to be *strong* arguments; otherwise, they are
said to be *weak* arguments. An inductive argument that is strong and all of its prem-
ises are true is said to be a *cogent* argument; if even a single premise is false, it is
said to be a *non-cogent* argument. The main key to successful argumentation is to
argue from premises that one’s interlocutor or audience is likely to accept (or at least
can be reasonably expected to accept).

**Glossary**

**Antirealism** An agnostic or skeptical attitude toward the theoretical posits (that is,
unobservables) of scientific theories. Antirealism comes in different varieties,
such as Constructive Empiricism (see Chap. 3, Sect. 3.3) and Instrumentalism
(see Chap. 3, Sect. 3.2).

**Approximate truth** Closeness to the truth or truthlikeness. To say that a theory is
approximately true is to say that it is close to the truth. According to some sci-
entific realists, approximate truth is the aim of science. (See Chap. 2, Sect. 2.1.)

**Argument** A set of statements in which some (at least one statement called a prem-
ise) purport to provide logical support (either deductive or inductive) for another
statement (namely, the conclusion). (See Chap. 1, Sect. 1.1.)

**Canonical form** A method of representing arguments where each premise is writ-
ten on a separate, numbered line, followed by the conclusion (also known as
“standard form”). (See Chap. 1, Sect. 1.1.)

**Cogent argument** A strong argument with all true premises. (See Chap. 1,
Sect. 1.1.)

**Conclusion** The statement in an argument that the premises purport to support.
(See Chap. 1, Sect. 1.1.)

**Deduction** A form of argumentation in which the premises purport to provide logi-
cally conclusive support for the conclusion. (See Chap. 1, Sect. 1.1.)

**Fallacious argument** An argument whose premises fail to provide either conclusive or probable support for its conclusion (see also *invalid argument* and *weak argument*). (See Chap. 2, Sect. 2.2.)

**Induction** A form of argumentation in which the premises purport to provide prob-
able support for the conclusion. (See Chap. 1, Sect. 1.1.)

**Invalid argument** A deductive argument in which the premises purport but fail to
provide logically conclusive support for the conclusion. (See Chap. 1, Sect. 1.1.)
Modus ponens  A form of argument with a conditional premise, a premise that asserts the antecedent of the conditional premise, and a conclusion that asserts the consequent of the conditional premise. That is, “if $A$, then $B$; $A$; therefore, $B$.” where $A$ and $B$ stand for statements. *Modus ponens* is a valid form of inference, and so an argument in natural language that takes this logical form is valid. On the other hand, the following logical form is invalid: “if $A$, then $B$, $B$; therefore, $A$.” It is known as the fallacy of affirming the consequent. (See Chap. 4, Sect. 4.1.)

Modus tollens  A form of argument with a conditional premise, a premise that denies the consequent of the conditional premise, and a conclusion that denies the antecedent of the conditional premise. That is, “if $A$, then $B$, not $B$; therefore, not $A$,” where $A$ and $B$ stand for statements. *Modus tollens* is a valid form of inference, and so an argument in natural language that takes this logical form is valid. On the other hand, the following logical form is invalid: “if $A$, then $B$, not $A$; therefore, not $B$.” It is known as the fallacy of denying the antecedent. (See Chap. 5, Sect. 5.1.)

Scientific realism  An epistemically positive attitude toward those aspects of scientific theories that are worthy of belief. Scientific realism comes in different varieties, such as Explanationist Realism (see Chap. 3, Sect. 3.1), Entity Realism (see Chap. 3, Sect. 3.4), Structural Realism (see Chap. 3, Sect. 3.5), and Relative Realism (see Chap. 6, Sect. 6.1).

Sound argument  A valid argument with all true premises. (See Chap. 1, Sect. 1.1.)

Strong argument  A non-deductive (or inductive) argument in which the premises successfully provide probable support for the conclusion. (See Chap. 1, Sect. 1.1.)

Premise  A statement in an argument that purports to support the conclusion of that argument. (See Chap. 1, Sect. 1.1.)

Valid argument  A deductive argument in which the premises successfully provide logically conclusive support for the conclusion. (See Chap. 1, Sect. 1.1.)

Weak argument  A non-deductive (or inductive) argument in which the premises purport but fail to provide probable support for the conclusion. (See Chap. 1, Sect. 1.1.)

References and Further Readings

Berenstain, N., & Ladyman, J. (2012). Ontic structural realism and modality. In E. Landry & D. Rickles (Eds.), *Structural realism: Structure, object, and causality* (pp. 149–168). Dordrecht: Springer.

Bourget, D., & Chalmers, D. J. (2014). What do philosophers believe? *Philosophical Studies, 170*(3), 465–500.

Bruce, M., & Barbone, S. (2011). Introduction: Show me the argument. In M. Bruce & S. Barbone (Eds.), *Just the arguments: 100 of the most important arguments in western philosophy* (pp. 1–6). Oxford: Blackwell.

Chakravartty, A. (2017). Scientific realism. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosophy*. Summer 2017 Edition. https://plato.stanford.edu/archives/sum2017/entries/scientific-realism/.
References and Further Readings

Cohen, D. (2004). Arguments and metaphors in philosophy. New York: University Press of America.

deGrasse Tyson, N. (2009). The Pluto files: The rise and fall of America's favorite planet. New York: W. W. Norton & Co.

Dicken, P. (2016). A critical introduction to scientific realism. London: Bloomsbury.

Fine, A. (1984). In S. Realism & e. J. Leplin (Eds.), The natural ontological attitude (pp. 83–107). Berkeley: University of California Press.

Govier, T. (2010). A practical study of argument (7th ed.). Belmont, CA: Wadsworth.

Harrell, M. (2016). What is the argument? An introduction to philosophical argument and analysis. Cambridge, MA: The MIT Press.

Mahner, M. (2007). Demarcating science from nonscience. In T. A. F. Kuipers (Ed.), General philosophy of science: Focal issues (pp. 515–576). Amsterdam: Elsevier.

Martin, R. M. (2017). For the sake of argument: How to do philosophy. Peterborough, Ontario: Broadview Press.

Mizrahi, M. (2018). Introduction. In M. Mizrahi (Ed.), The Kuhnian image of science: Time for a decisive transformation? (pp. 1–22). London: Rowman & Littlefield.

Mizrahi, M. (2020). The case study method in philosophy of science: An empirical study. Perspectives on Science, 28(1), 63–88.

National Institute on Drug Abuse. (2019). Marijuana research report series. In J. J. Gonzalez III & M. P. McGee (Eds.), Legal Marijuana: Perspectives on public benefits, risks and policy approaches (pp. 15–19). Jefferson, NC: McFarland and Co.

Psillos, S. (1999). Scientific realism: How science tracks truth. London: Routledge.

Sankey, H. (2008). Scientific realism and the rationality of science. Hampshire: Ashgate.

Schurz, G. (2019). Hume’s problem solved: The optimality of meta-induction. Cambridge, MA: The MIT Press.

Tulodziecki, D. (2016). From zymes to germs: discarding the realist/anti-realist framework. In R. Scholl & T. Sauer (Eds.), The philosophy of historical case studies (pp. 265–284). Basel: Springer.

Wray, B. K. (2018). Resisting scientific realism. Cambridge: Cambridge University Press.

Wylie, A. (1986). Arguments for scientific realism: The ascending spiral. American Philosophical Quarterly, 23(3), 287–297.