

Chapter 7

Falsifiability

In this chapter, we introduce the notion of *falsifiability*. The issues surrounding falsifiability appear, at first glance, as if they could not be more simple or straightforward. But in fact, the issues surrounding falsifiability, especially when applied to real-life cases, can get quite complex. In this chapter we will begin with a somewhat simplified account of falsifiability, and then move on to consider some of the complicating factors. In later chapters, especially as we examine some cases from the history of science, we will see examples of some of the more complex issues involving this notion.

Basic Ideas

In a sense, falsifiability is perfectly straightforward. It is an attitude toward theories. In particular, it is the attitude one has when one allows for the possibility that a particular theory might be false. For example, suppose Sara is a physicist who believes that the Big Bang theory

of the origin of the universe is probably correct. Suppose that, like most physicists, Sara is not dogmatic in her beliefs. That is, if a sufficient amount of new evidence came to light that provided convincing reasons to think the Big Bang theory was not correct, then Sara would be willing to give up her belief in the Big Bang theory. In short, although Sara believes the Big Bang theory is correct, she is willing to admit that it might be false, and so we say that she treats the theory as *falsifiable*.

In contrast, suppose Joe is a member of the Flat Earth Society. The Flat Earth Society is a well-established group, with a large number of members who sincerely believe the Earth is flat. Suppose Joe believes the theory that the Earth is flat. Moreover, no matter what evidence is presented that suggests this theory is false, Joe finds some way around the evidence. For example, suppose we point out that almost everyone believes the Earth is spherical. Joe replies (perhaps not unreasonably) that popular opinion is no guide to the truth. So we show Joe a photograph of the Earth that was taken during a space shuttle flight. Joe replies that there is good reason to believe that the space program was a complete fraud; that the photos and television coverage have been faked; and he expresses sympathy that we have been suckers for such fraudulent reports. We argue that history books are filled with reports from voyagers who have circumnavigated the globe, and this is only possible if the Earth is a sphere. Joe tells us about an article he recently read suggesting that, on a flat Earth, compass bearings would be skewed as one approached the periphery of the Earth, and what probably happened to explorers such as Magellan was that they sailed in a large circle around the periphery of a flat Earth, and due to the skewed compass bearings, they mistakenly thought they were sailing in a straight line around the circumference of a sphere.

We soon realize that Joe will hold to his theory no matter how much evidence is presented that suggests the theory is false. Unlike Sara, Joe appears unwilling to admit that his

theory might be false, and so it appears that Joe is treating the theory as *unfalsifiable*.

When writing and speaking on falsifiability, authors tend to speak of falsifiability as if it were a characteristic of theories. That is, there is a prevalent but bad habit of speaking of this or that theory as being falsifiable or unfalsifiable. But with a little reflection, it should be clear that this is not the best way of speaking. Generally, falsifiability is an attitude that a person might hold toward a particular theory, rather than being a characteristic of the theory itself. For example, consider again the flat Earth theory. There is nothing about the flat Earth theory that makes the theory inherently unfalsifiable. We can easily imagine two individuals, both believers in the flat Earth theory, yet such that one becomes convinced the theory is wrong while the other (like Joe above) refuses to abandon the theory no matter how much evidence is presented. In each case the theory is the same; what differs is the attitude of the individuals toward the theory. Thus, it is generally not accurate to speak of a theory itself as being unfalsifiable; rather, the crucial factor is one's attitude toward the theory, and it is one's attitude that determines whether one is treating a theory as falsifiable or unfalsifiable.

Complicating Factors

At this point, the notion of falsifiability might seem like a pretty simple notion, and the question of whether someone is treating a theory as falsifiable might seem to be a straightforward question. Some cases, for example, the cases of Sara and Joe discussed above, are indeed fairly straightforward. But in other cases, especially those from the history of science involving substantial changes in theories (for example, the change from the Earth-centered to sun-centered view), it is not at all easy to say when theories are being treated as unfalsifiable. Let's consider a few reasons why this issue is difficult.

In describing Sara above, we said that Sara was willing to give up the Big Bang theory if there was a “sufficient amount” of new evidence providing “convincing reasons” that the theory was wrong. As discussed in Chapter 4, evidence against a theory often comes in the form of predictions that turn out to be incorrect. That is, when a theory is used to make predictions, and those predictions turn out wrong, that poses a problem for the theory. However, also as discussed in Chapter 4, incorrect predictions are often the result of incorrect auxiliary hypotheses rather than an incorrect theory. So when faced with incorrect predictions, it is often more reasonable to reject one or more auxiliary hypotheses than to reject the theory itself.

Since one can (and often should) reject one or more auxiliary hypotheses, an extremely difficult question arises: what counts as a “sufficient amount” of evidence to reject a theory? At what point does one have “convincing reasons” that a theory (rather than one or more auxiliary hypotheses) is wrong?

There are no clear answers to these questions. It is certainly unreasonable to abandon a theory the first time problems arise, but on the other hand, for some theories there comes a time when the evidence against the theory reaches the point where it would be unreasonable to continue to hold the theory.

The cold fusion example from Chapter 4 provides a good illustration of this. Initially, in the late 1980s, there were some interesting experimental results suggesting that fusion was indeed taking place at low temperatures. Moreover, the two scientists reporting these results were by no means oddballs or “fringe” scientists. Rather, these were well respected, well published, well established scientists reporting (although via the press rather than via mainstream scientific journals) quite intriguing experimental results. However, in the ensuing months, problems arose for the cold fusion theory. In particular, one could use cold fusion theory to make certain predictions, and many of these predictions were not observed. Initially, the supporters of

cold fusion handled these problems by rejecting various auxiliary hypotheses—the cold fusion apparatus was set up using incorrect materials, the experimenters did not give the cold fusion apparatus sufficient time to “charge” itself, and so on. As the years went on, disconfirming evidence continued to pile up. In addition, plausible alternative explanations of the initially interesting results were offered. By the end of the 1990s, 10 years after the initial cold fusion announcement, the dwindling number of cold fusion supporters were forced to appeal to increasingly complicated auxiliary hypotheses. Such auxiliary hypotheses included, for example, that the problems for cold fusion were the result of a conspiracy by large oil companies to suppress new energy sources.

The point is that initially, continuing to believe the cold fusion theory by rejecting various auxiliary hypotheses was a reasonable thing to do. But by the time one is appealing to conspiracy theories to save one’s theory, one has crossed the line from reason to unreason. But importantly, the line is not a precise, well-defined line. And as a consequence, it is not a precise matter to say at what point one is treating a theory as unfalsifiable.

These issues become even more difficult when we recall earlier discussions on evidence and worldviews. Consider again my acquaintance Steve, first discussed in the earlier chapter on truth. Steve takes an extremely literal interpretation of certain passages from Vedic scriptures, and as a result of his beliefs about the reliability of these scriptures, he believes that the moon is inhabited with sentient life, that the moon is further from the Earth than is the sun, and that the Apollo moon landings were faked. I and my students have had numerous discussions with Steve on these matters, generally in the form of presenting him with evidence that his beliefs are wrong. Steve rejects all this evidence in favor of evidence from his scriptures. It looks to us, given our way of looking at the world, that Steve’s views on these matters provide a clear case of his treating the views as unfalsifiable. After all, he refuses to change his views in spite of the

overwhelming evidence we provide.

But now, *look at the matter from Steve's perspective*. During our discussions with Steve, he often presents us with what he takes to be convincing evidence that the scriptures in question are accurate. And if his scriptures are correct, then Steve's beliefs are justified and our beliefs are the ones that are incorrect. But notice that we do not accept his evidence, refusing to change our views in spite of what Steve takes to be overwhelming evidence supporting those views. Notably, from Steve's perspective it is *we* who are treating *our* views as unfalsifiable.

Also worth noting is that, from Steve's perspective, he *is* treating his theory as falsifiable. Steve clearly agrees that he would be willing to give up his views if faced with a sufficient amount of evidence. But what Steve takes to be the relevant evidence is very different from what I and most of my acquaintances take to be the relevant evidence. I, and most of my acquaintances, put the most emphasis on what we would consider empirically-based evidence—evidence from physics, astronomy, cosmology, and the like. But for Steve, the most important evidence is evidence from his scriptures. So if given evidence based on his scriptures (perhaps in the form of newly discovered scriptures, or a new and better translation of existing scriptures, or the like), he readily agrees that he would be willing to change his views. Hence, from his perspective, he is indeed willing to give up his views if faced with a sufficient amount of evidence, and so he is, from his perspective, treating his theories as falsifiable.

The key and difficult issue here is the question of what counts as the relevant evidence. This is a subtle but important point, and a point that comes up again and again in the history and philosophy of science. Given the subtlety of the point, and given that I think it is an under-appreciated point, I want to illustrate the same point with another, albeit similar, example.

Consider the Institute for Creation Research (ICR), whose members (among other beliefs) believe in a young Earth theory. In particular, they believe the Earth is no more than

10,000 years old. This is in sharp contrast to what appears to be overwhelming geological evidence putting the age of the Earth at about 4.5 billion years.

As with Steve, ICR members' beliefs are based on a literal reading of scriptures, in this case Christian scriptures. Notably, to become a member of the ICR, one must sign a statement stating explicitly that one will accept no evidence that runs contrary to a literal reading of the Christian scriptures. Once again we are looking at individuals who not only reject any geological evidence we provide indicating that their young Earth theory is wrong, but they even sign a statement explicitly stating they will reject any such evidence.

Again, the situation is similar to that of Steve. For most of us, the geological evidence trumps the scriptural evidence. But for ICR members, scriptural evidence trumps geological evidence. Both parties—most of us, on the one hand, and ICR members on the other—are willing to give up our theories if faced with sufficient evidence, but we disagree sharply on what counts as the relevant evidence. In other words, the main point of disagreement is *not* whether one party or the other is willing to give up their theories if faced with sufficient evidence; rather, the main point of disagreement is what counts as the relevant evidence.

Importantly, what one takes to be the relevant evidence ties in closely with one's overall jigsaw puzzle of beliefs. Steve's trust in his scriptures is a core piece of his jigsaw puzzle. He could not give up his trust in his scriptures without drastically altering, and really replacing, most of his overall jigsaw puzzle. Likewise, the ICR members' trust in their scriptures is a core piece of their jigsaw puzzle. And if I am honest, my emphasis on what I take to be the appropriate sort of empirically-based evidence is likewise a core piece of my jigsaw puzzle. In other words, our respective systems of beliefs heavily influence what we take to be the relevant evidence, and this in turn heavily influences our views on who is treating his or her theory as unfalsifiable. In short, whether a theory is being treated as unfalsifiable, and if so, who is guilty of doing so, depends

greatly on what evidence is preferred. And what evidence one prefers depends greatly on one's system of beliefs.

Concluding Thoughts

In closing, I want to be careful so as not to be misunderstood. In the discussion above, I am *not* suggesting that some sort of relativism is correct, or that all evidence and worldviews are equally reasonable. For example, I am more than happy to argue that basing evidence on literal readings of scriptures is a bad and outdated idea, and that individuals such as Steve and ICR members are indeed treating their views as unfalsifiable.

But I do want to suggest that whether someone is treating a theory as unfalsifiable, and if so, why, is a much more subtle issue than is often appreciated. As the case of Steve and the ICR illustrate, we cannot merely claim that they refuse to accept our evidence, and hence are treating their theories as unfalsifiable. Again, they can say the exact same thing about us—that we refuse to accept their evidence.

Likewise, it would not be reasonable to merely assert, dogmatically, that our preferred evidence is the correct type of evidence. That is, we cannot claim that Steve and the ICR members are treating their theories as unfalsifiable based on dogmatically assuming that our evidence is the correct type of evidence. To do so would essentially amount to leveling a charge of unfalsifiability against Steve and the ICR members, where that charge of unfalsifiability is based on we ourselves taking an unfalsifiable attitude toward our preferred evidence.

To argue convincingly that someone is treating a theory as unfalsifiable requires considering a number of interrelated and complex issues, including issues such as the proper sort of evidence and the reasonableness of competing worldviews. So as stated at the opening of this

chapter, falsifiability turns out to be a much more subtle and complicated issue than it at first appears to be. Watch for these issues as we explore, in subsequent chapters, some of the major developments from the history of science.