

# Introduction

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## Introduction

It is hard to think of any human endeavor more transformative in its effects than science. In the space of a few hundred years, it has generated dramatic improvements in our understanding of the universe and spawned a plethora of new technologies. It pervades almost every aspect of contemporary human life: our education, our daily decisions, our politics, even our sports and pastimes. It lies at the heart of our purest intellectual activities and our unparalleled ability to control the world around us. If one were to list the most distinctive and important of human activities, science would surely be among them.

In view of this significance, it should be unsurprising that science *itself* has become an object of intensive enquiry. Thus, researchers from a broad array of different disciplines—including history, sociology, economics, psychology, and philosophy—have sought to understand various aspects of science. Further, over the past few decades, newly emerging interdisciplinary fields, such as *science and technology studies* (STS), have sought to integrate the deliverances of such research in pursuit of a more complete understanding of science.

Though a detailed discussion of these various fields of research falls well beyond the scope of the present chapter, we do need to say more about the philosophy of science and its potential interconnections with the cognitive and behavioral sciences—especially psychology. Psychologists have long been interested in the sorts of cognitive activities central to science—explanation, reasoning, inductive learning, categorization, and concept formation, for example. Moreover, when psychologists study such phenomena, they typically deploy a standard battery of experimental methods. Similarly, philosophers of science have long been interested in questions about the nature of science, its

practices, and its core concepts. And when philosophers of science address such issues, they too draw on their own battery of familiar methods—including, for example, the construction of arguments and counterexamples, the analysis of concepts, and, on occasion, the use of logics and formal models.

Strikingly—and this is the departure point for the present volume—there is remarkably little systematic interaction between the philosophy of science and the sorts of experimental approaches to be found in psychology. A core assumption of the present volume is that this lack of interaction presents an intriguing opportunity for growth. Philosophical and psychological approaches to the study of science *should* interact in deeper, more systematic ways than they currently do. This volume is thus dedicated to exploring the prospects for an *experimental* philosophy of science—one that uses the empirical methods of psychology in order to help address questions in the philosophy of science.

## Experimental philosophy and philosophy of science

The rarity with which experimental methods from psychology have been applied by philosophers of science is puzzling, given the recent impact of such methods on many other areas of philosophy. Epistemologists, for example, have become increasingly interested in experimentally investigating how such concepts as *knowledge* and *justification* are deployed in people's explicit judgments (see, e.g., Beebe, 2014). Circumstances are similar in the philosophy of action, metaethics, the philosophy of language, the philosophy of mind, and even some parts of metaphysics. In each of these fields, one finds a growing group of philosophers using experimental psychological techniques to help develop and assess accounts of philosophically significant concepts, such as *reference*, *consciousness*, and *intention*. (For recent reviews of such work, see Sytsma and Buckwalter, 2016.) Appropriately enough, the resulting approach has been dubbed *experimental philosophy* (Knobe et al., 2012).

Though there are many reasons for this “experimental turn,” one highly influential consideration, widely associated with the so-called *positive program*, is to aid in what has long been a core philosophical activity—the analysis of philosophically important concepts (Knobe and Nichols, 2008). Ordinarily, when philosophers engage in conceptual analysis, they draw heavily on their own “intuitions” in order to assess proposals regarding the structure and content of the salient concepts. Experimental philosophers maintain that the use of empirical methods—applied to broad, (ideally) representative populations—can

make a substantial contribution to this project. In particular, they maintain that, by adopting this approach,

[t]hey can avoid some of the idiosyncrasies, biases, and performance errors that are likely to confront philosophers who attend only to their own intuitions and the intuitions of a few professional colleagues who read the same journals and who may have prior commitments to theories about the concepts under analysis. (Stich and Tobia, 2016, p. 23)

So construed, experimental philosophy might be viewed as an attempt to replace potentially idiosyncratic judgments with more thorough empirical research. What's novel is that experimental philosophers propose that scientific standards ought to apply to philosophy as well. More specifically, they maintain that, to the extent that philosophical theories incur empirical commitments regarding people's intuitions and other psychological states, philosophers should aspire to the same standards as scientists do.

Given the careful attention that philosophers of science have paid to experimental methodology, one might have expected to find them at the forefront of this new development in philosophy. However, for reasons that are not immediately obvious (at least not to us), philosophers of science have been slow to employ experimental methods of any sort.<sup>1</sup> Moreover, what work has been done is isolated and scattered. Thus, the primary goal of this volume is to bring together research that both explores and exemplifies the prospects for an experimental philosophy of science.

## What might experimental philosophy of science be?

As we see it, the core idea behind experimental philosophy of science is to use empirical methods, typically drawn from the psychological sciences, to help investigate questions of the sort associated with the philosophy of science. This conception is, by design, ecumenical in a variety of ways.

First, in our view, experimental philosophy of science is to be characterized in terms of subject matter and methodology and not in terms of *who* is doing the research. To be sure, there are "card-carrying" philosophers who engage in the sorts of research we have in mind. But it is at least as common to find professional scientists applying the methods of psychology to questions associated with the philosophy of science. In our view, these scientists are as much a part of experimental philosophy of science as any philosopher. Indeed, in view of the

extensive experimental training that such scientists possess—training seldom possessed by professional philosophers—there are obvious reasons why, when viable, philosophers engaged in experimental work should collaborate with behavioral scientists. This attitude is very much reflected in the coming chapters, many of which are (co)authored by behavioral scientists as well as self-identified philosophers.

Second, our characterization of experimental philosophy of science imposes no explicit restrictions on which empirical *methods* might be relevant to addressing issues in the philosophy of science. The techniques of psychological science are quite extensive, and we see no *a priori* reason to exclude the possibility that relevant results might come from any of a range of quite different sorts of research, including developmental research, reaction-time studies, patient studies, and functional Magnetic Resonance Imaging (fMRI) research. As a matter of fact, however, most extant research in experimental philosophy—including some of what’s reported in this book—relies on a kind of protocol in which stimuli are presented in written form—as “vignettes”—and responses are elicited via probe questions and recorded on Likert-type scales. Such studies are sometimes disparagingly referred to as “surveys.” But this is unfair. It’s true that they are survey-*like* in that both stimuli and probes are presented linguistically, and explicit judgments are elicited. However, it’s important to keep in mind that, in contrast to surveys—which merely seek to record people’s views—research in experimental philosophy almost invariably involves the control and manipulation of different variables. No doubt that there are interesting methodological issues regarding the scope and limits of such techniques,<sup>2</sup> but they are not as easily disparaged at the “survey” label might suggest. Indeed, these methods are commonplace in many areas of psychology—including the judgment and decision-making literature—and possess some notable pragmatic virtues. Most obviously, they are inexpensive, relatively simple to design and administer, and they deliver results that are relatively easy to analyze.

Third, we are inclined to adopt an ecumenical conception of the sorts of issues that fall within the purview of philosophy of science. This is, in large measure because, philosophers of science *themselves* seem to adopt such a view. To be sure, there’s the list of familiar “canonical” questions that one might seek to cover in a survey of general philosophy of science—for example, questions about the demarcation of science from nonscience and pseudoscience; issues about our concept of explanation; issues about causation and our concepts thereof; issues about what reduction is; issues about theory change in science; and issues about the rationality of science. But there are also issues that are rather less well-

worn—for example, about the role of moral and political values in science, and about the epistemic status of thought experiments. Moreover, when one turns to the various philosophies of specific sciences—of biology, physics, economics, psychology and chemistry, for example—one finds a fascinating array of issues concerning the methods, practices, and concepts of these different scientific fields. In the philosophy of biology, for example, we find issues regarding the notion of *function* and its role in biological science, issues about the concept(s) of a *gene*, and issues about the extent to which explanation in biology is mechanistic. Some of these topics are taken up in the chapters of this volume. But in our view, there are many more issues that might form a focus for experimental philosophy of science. Given the immaturity of the field, we'll have to wait and see.

Finally, we remain largely neutral regarding the precise *extent* to which experimental psychological research might contribute to addressing issues in the philosophy of science. At one extreme, there is a vision of experimental philosophy we've encountered in conversation, which conceives its goal as being the wholesale replacement of traditional philosophical research by a discipline in which questions are almost exclusively addressed by empirical means. This is not a result we find either realistic or desirable. Our goal is rather less colonial. It is simply that experimental techniques should become a commonly used addition to the already expansive range of methods that can be brought to bear on issues in the philosophy of science.

### Why *experimental* philosophy of science?

Philosophy has long been rife with methodological debate, and in recent years, few such debates have been more heated than those regarding the value of experimental philosophy. We don't propose to rehearse these general metaphilosophical issues here. Instead, we make a few quite specific suggestions regarding why, and how, experimental philosophy of science might be a valuable endeavor.

### **Experimental philosophy of science as an extension of STS**

Here's a preliminary consideration: one reason to engage in experimental philosophy of science is as a natural extension of STS more generally. Science is an extremely important human endeavor, as worthy of study as almost any other institution or social arrangement. Many cognitive and behavioral scientists

are interested in various questions pertaining to how science is practiced. Experimental philosophy of science would be quite similar in its aims and methods but would be primarily concerned with, and motivated by, questions more typical of the philosophy of science. For example, philosophers of science are interested in questions regarding the nature of explanation, causation, and understanding, as well as the nature of important scientific constructs, such as theories and models. To the extent that such questions are worthy of pursuit, empirically minded investigations are one important way of doing so. On such a view, then, experimental philosophy of science would simply be one subdomain of STS—a kind of “cusp” point where the psychology and the philosophy of science intersect.

### **Experimental philosophy of science as an extension of the “turn to practice”**

One might, however, wonder about the specific *philosophical* significance of experimental philosophy of science. Why, in particular, should we think it worthwhile, in the first place, to apply experimental methods in addressing philosophical questions about science?

As a rule, we are wary of such questions since they often assume a relatively sharp divide between what’s philosophical and what’s not. In the present context, however, we think there’s a rather more local point to be made—one that’s quite specific to the current state of the philosophy of science and concerns the so-called “turn to practice” (Soler et al., 2014, p. 1).

The story behind the “turn to practice” is a familiar one. By the 1970s, traditional philosophy of science was deemed by many “analysts of science” to be too idealized—“too disconnected from how science actually is performed in laboratories and other research settings” (Soler et al., 2014, p. 1). In particular, ethnographic studies conducted in scientific laboratories showed that science was a complex activity that involved much more than experiments and logical inferences (Soler et al., 2014, p. 1).

As a consequence, both philosophers and social scientists increasingly paid greater “attention to scientific practices in meticulous detail and along multiple dimensions, including the material, tacit, and psycho-social ones” (Soler et al., 2014, p. 1).

We join the consensus in applauding the turn to practice. Not only does it help debunk excessively idealized conceptions of science, but also it imposes a plausible, though defeasible, condition of adequacy on philosophical accounts of

science. Roughly put: All else being equal, a philosophical account of some aspect of science—explanation, reduction, genetics, etc.—ought not to be inconsistent with the extant practices of the relevant group of scientists.

It is worth noting, however, that the methods which originally motivated the turn to practice were largely drawn from the social sciences—especially sociology and anthropology—and not from psychology. But if the turn to practice is concerned with what actual scientists *do*, then it is surely the case that *cognitive* activities—thinking, reasoning, learning, and the like are things that scientists do *qua* scientists. Arguably, they are among the core practices of science. And if this is so, then we seem to have good reason to suppose that the methods of psychology are relevant to the philosophy of science. After all, it is very plausible that they are our best methods for studying cognitive activity.

### **On the potential contributions of experimental philosophy of science**

So far, we have argued that experimental psychological methods ought to be taken seriously when addressing questions in the philosophy of science. Yet, it is one thing to say they should be taken seriously, but quite another to say what they would, in fact, contribute to the philosophy of science. Plausibly, this will depend on the sort of question that's at issue, and there may well be many contributions that experimental methods might make. For the moment, however, we mention just four:

1. *Conceptual diversity.* As noted above, philosophers of science have long sought to characterize concepts that figure prominently in one or other region of the sciences. As Paul Griffiths and Karola Stotz note, however, a tacit assumption of much of this research is that the philosopher is sufficiently well informed about the relevant field to be “in a position to consult his or her intuitions as a scientifically literate sample of one, and thus equivalent for this purpose to a member of the scientific community” (Griffiths and Stotz, 2008, p. 1). (Compare: A linguist might, as competent speaker of their *own* dialect, consult intuitions about the well-formedness of sentences, thereby avoiding the need to consult other speakers.) However, this approach faces obvious difficulties if the “key scientific concepts display substantial heterogeneity between different communities of researchers” (Griffiths and Stotz, 2008, p. 1). Under such circumstances, the intuitions of a single respondent obviously won't reveal conceptual diversity *between* communities, any more than the linguist's intuitions regarding their *own* dialect will reveal variations between different dialects. At the risk of stating

the obvious, experimental methods provide a natural approach to acquiring data about cross-community variation.

2. *Conceptual uniformity.* The use of experimental methods in philosophy of science is not merely motivated by an interest in conceptual diversity; it may also be motivated by its converse: the search for general philosophical proposals that apply generally across both scientific and nonscientific contexts. Consider the case of explanation. As Woodward (2017) observes, there is a widespread tendency in the recent philosophical literature “to assume that there is a substantial continuity between the sorts of explanations found in science and at least some forms of explanation found in more ordinary nonscientific contexts.” Though the motivations for this assumption are not entirely obvious, there are two *prima facie* reasons that readily come to mind. First, in contrast to such concepts as a *Higgs boson* or *lateral geniculate nucleus*, which are products of science and make little sense independently of this context, the concept of explanation really seems to have led a life outside the lab. Second, in view of this, the assumption of substantial continuity seems like the reasonable default position to adopt. All else being equal, more unified accounts are preferable to less unified ones. Yet if we seek such unity, then we have a good reason to empirically study the explanatory practices and judgments of different populations, both within and outside of science. For, by doing so, we can identify those features of explanation that are highly conserved across disparate populations, and also assess the assumption of continuity which motivates the endeavor in the first place.

3. *Modeling scientists’ effective concepts.* A third reason to deploy experimental methods in the philosophy of science is that it promises to provide us with a deeper grasp of the concepts that scientists use. When philosophers attempt to explicate scientific concepts, they often rely on textbooks or the writings of important scientists in the relevant disciplines. But as Eduoard Machery has pointed out, it is quite possible that the *explicit* concepts found in textbooks or influential writings differ from scientists’ *operative* concepts—the ones they in fact deploy in their daily, professional activities. Among other things, this might be so because scientists may be unusually reflective in such writings or because concept use in textbooks or influential writings may lag behind concept use in the research front (Machery, 2016, p. 476).

In view of this, if one seeks to characterize the operative concepts that scientists deploy in actual practice, then the sorts of experimental methods found in psychology would, once more, appear relevant.

4. *Cognitive foundations.* A final, related role for experimental philosophy concerns its potential to contribute to an understanding of the cognitive



foundations of science. Philosophers of science have long had interests in questions concerning those cognitive processes most distinctive of science—for example, conceptual change, theory formation, inductive learning, and causal inference (Hempel, 1952). Until recently, however, there has been a widespread tendency to “depsychologize” such topics, either by treating them as normative ones, or else by adopting a level of idealization which abstracts from almost any empirical content regarding how human beings in fact engage in such activities. Yet if one seeks to capture actual scientific practice, more realistic models are required; and once again, this provides clear motivation for deploying the methods of psychology, and cognitive science more broadly (Carruthers, Stich and Siegal, 2002; Nersessian, 2008; Knobe and Samuels, 2013).

### Forthcoming attractions

Though the chapters in this volume illustrate a wide array of different concerns, we start with one of the most central and enduring topics in the philosophy of science. At least since Hempel and Oppenheim (1948), philosophers of science have been acutely aware of the need for an account of explanation in order to understand scientific practice. However, only relatively recently has there been any serious effort to empirically examine the role that explaining plays in our cognitive lives. In Chapter 2, Elizabeth Kon and Tania Lombrozo explore this issue by focusing on the way that efforts at explanation influence people’s ability to identify generalizations. In particular, they focus on the differing roles played by principled, as opposed to seemingly arbitrary, exceptions to generalizations.

Continuing the work on explanation, in Chapter 3, Frank Keil addresses one of the mysteries surrounding children’s and adults’ preference for mechanistic explanations. The mystery is that people seem to be rather bad at *remembering* how mechanisms operate (Rozenblit and Keil, 2002; Mills and Keil, 2004.) But if people tend to forget how mechanisms operate, then why do both children and adults prefer mechanistic explanations to the alternatives? In response to this puzzle, Keil argues that while individuals forget the details of mechanistic explanations, exposure to such explanations provides access to higher-order causal patterns that prove invaluable for various other purposes. Indeed, he suggests that access to such patterns explains another mystery: why both children and adults fail to recognize the deficits in their own mechanistic understanding.

Another longstanding issue in philosophy of science concerns how people go about changing their minds in light of new evidence. Traditionally, most philosophers 70+ years ago would have had it that people change their minds in light of new evidence. However, Thomas Kuhn (1962/2012) famously argued that at least in some circumstances, theory change was not based on rational considerations. In a more modern variant, Kahan et al. (2012) have argued that, at least with respect to some domains, people exhibit a remarkable degree of insensitivity to new scientific information. In particular, they argue that people's attitudes toward politically charged scientific questions, such as the existence and importance of anthropogenic climate change, remain almost entirely impervious to new information. Fighting against this tide, Ranney et al. (e.g., Ranney & Clark 2016) have argued that, even on such matters, people's attitudes are in fact far more sensitive to relevant information than Kahan et al. would have us believe. In Chapter 4, Michael Ranney, Matthew Shonman, Kyle Fricke, Lee Nevo Lamprey, and Paras Kumar investigate a surprising new way to change people's minds about scientific truths—artificially inflating or decreasing their nationalism. This suggestion has immediate practical implications regarding how to increase science literacy. However, whether the overall moral is a positive one (people have coherent worldviews that are sensitive to evidence) or a negative one (people can be manipulated in all sorts of indirect ways) remains something of an open question.

Addressing another topic regarding theory change, philosophers have questioned what prevents people from developing and accepting new and better theories. Scientists often have difficulties producing and understanding new theories, as of course do students. One might have thought that these difficulties were congruent—the same conceptual barriers to scientists' developing and accepting new theories also impede the progress of students. In Chapter 5, Andrew Shtulman investigates the data on what sorts of mistakes students are likely to make in order to argue that they are frequently stymied by very different sorts of problems from those that slowed down the development of science itself. This has implications for both science education and the study of theory change.

Focusing on knowledge acquisition in children, in Chapter 6, Mark Fedyk, Tamar Kushnir, and Fei Xu argue that the only way to make sense of the barrage of data imposed on us by the world is to already have certain intuitive concepts that allow children to find the properties relevant to accurate belief formation. More specifically, they argue that by the age of four, children have a *theory of evidence* that enables them to make sense of the world in a manner conducive to accurate belief formation.

Turning from general questions in philosophy of science to issues more particular to individual sciences, in Chapter 7, Michiru Nagatsu takes a broad look at the potential of experimental philosophy to address issues in the philosophy of economics. Specifically, he looks at different notions of “choice,” “preferences,” and “nudges”—examining both how such constructs are understood in economics and among the public, and how experimental philosophy can provide novel insight.

In the philosophy of biology, scientists have recently begun worrying that the concept of *innateness* is an amalgam of different ideas (fixity, typicality, and functionality) which—if taken seriously—seem to license invalid inferences from the presence of one of these features to the others. While one might not worry about the folkbiological use of innateness, its continued usage by scientists is somewhat puzzling. In Chapter 8, Edouard Machery, Paul Griffiths, Stefan Linquist, and Karola Stotz explore the question of whether scientists are really using the term to pick out a new and better-behaved concept, or whether in practice they are falling back on the old and seemingly broken version. They find evidence for the latter hypothesis, indicating that the folkbiological notion of innateness is alive and well among the behavior of practicing scientists.

Finally, in Chapter 9, we explore a view of the relevance of experimental results for the philosophy of causation. James Woodward argues that philosophy of science is at its best a normative enterprise, and so some uses of empirical data regarding how a concept like causation *is* used leave open the more pressing question of how it *should* be used. While this could be taken as a pessimistic interpretation of the role of experimental philosophy generally, it also suggests a path forward for how experimental philosophy can be deployed in a way that provides genuine guidance regarding key issues in philosophy of science. This seems a fitting note on which to end, for suggesting future avenues of exploration is in large measure the goal of the present volume.

## Notes

- 1 This is so despite early persuasive advocacy by Griffiths and Stotz (2008).
- 2 For more extensive discussion, see Chapter 9 of this volume.

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