CHAPTER 11

Conclusion

The foundation for this book has been the granular examination of a scientific practice, namely, the interpretation of experimental results. Hodgkin and Huxley's development of their theory of the action potential was the central example here. This science-first methodology draws attention to any number of underappreciated features of scientific practice. First of all, it guides philosophers of science in the direction of greater explanatory pluralism. It illustrates that scientists offer compositional explanations of individuals, their property instances, and their activity instances. It illustrates that scientists offer explanations of the rates of activity instances. Close attention to scientific detail draws attention to enabling explanations of why individuals engage in the activity instances they do in terms of the property instances they bear.

Collectively, these examples also begin to redress inattention in the philosophy of science to a large class of explanations: singular explanations. These are explanations of spatiotemporal particulars. The examples also draw a connection between singular explanations, experimental data, and experimental results. Experimental results and their singular explanation play a foundational role in scientific research.

Once close attention to scientific reasoning reveals these many practices, the historian and philosopher of science will want a theory of them. At least part of the story, for some explanations, is that they are representations of compositional ontological dependencies between things in the world. This account captures many instances of the compositional explanations of individuals, their property instances, and their activity instances. It also serves as a model for enabling explanations, explanations of the activity instances of individuals in terms of the property instances of those individuals, provided one accepts that enabling is a noncausal, noncompositional determination relation between a property instance of an individual and an activity instance of that individual.

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Attention to scientific journal articles reveals that scientists often engage in hypothetical reasoning. Curtis and Cole reasoned that, if the action potential difference recorded between electrode A and electrode B is entirely due to the membrane action potential, then the difference should be the same whether the potential propagates from A to B or from B to A, the difference is the same, so the difference is entirely due to the membrane action potential. Generations of philosophers of science would have interpreted reasoning like this in terms of HD confirmation. The theory of compositional abduction offers an alternative interpretation – an alternative theory – of what scientists are sometimes thinking. The abductive alternative avoids the "tacking problems" that have beset HD confirmation and offers a diagnosis of HD confirmation's susceptibility to the tacking problems.

Scientists often seem to think that the fact that what is mentioned in some hypothesis H explains something mentioned in some evidence E provides some defeasible reason to believe that the hypothesis H is true. Why would scientists think this? The theory of singular compositional abduction provides an answer. The things mentioned in H are among the things that ontologically determine that the things mentioned in E are as they are. The influx of sodium ions makes the initial inward current what it is. The scientific thought is that if the things mentioned in H were not as they are represented, then the things mentioned in E would not be as they are represented. But it is things being as represented in H that makes H true. The connection between H explaining and H being true is clear. Moreover, one can see why scientists so often care about alternative explanations or rival hypotheses. If it is the things mentioned in H*, rather than the things mentioned in H, that explain the things mentioned in E, then this defeats the explanatory value of H. The theory of compositional abduction provides an account of defeasible scientific reasoning.

The theory of singular compositional abduction also complements three nearby projects, namely, the study of Peircean abduction, the study of IBE understood as warranted abduction, and hypothesis confirmation by mutual manipulation. Peirce and Neo-Peirceans have thought that scientists use abduction to introduce hypotheses (as pursuit-worthy), which are then subsequently confirmed using hypothetico-deductivism. Perhaps, as Peirce thought, this captures some scientific thinking. Perhaps one can develop a sophisticated formal logic that characterizes this. Perhaps this paves the way for a unified epistemological model of scientific discovery, diagnostic reasoning, and other kinds of creative reasoning. The theory of

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singular compositional abduction has a different aim, namely, understanding some episodes of the scientific interpretation of experimental results. Scientists may use singular compositional abduction to introduce hypotheses or to make the case that some hypothesis is pursuit-worthy, but they also sometimes use it to confirm hypotheses. Following Peirce, compositional abductive inferences should be distinguished from "deductive" inferences of the consequences of some hypothesis and from the "inductive" inferences that some consequences of a hypothesis are true or false. The theory of singular compositional abduction goes beyond these observations to make the case that Peirce's deductive and inductive inferences may enable subsequent abductive inferences. The deductive inferences may reveal ontological dependencies between things in the world, whereas the inductive inferences may reveal that the ontological consequences in fact obtain. Abductive inferences might then show that ontological dependencies between things in the world enable confirming explanations.

The foundational difference between the theory of singular compositional abduction and IBE typically comes down to a distinction between abduction and warranted abduction. The assumption that an abductive inference is warranted brings with it the idea that alternative explanations or rival hypotheses are somehow eliminated. For some philosophical projects, one will want a theory of warranted abductive inference, rather than mere abductive inference. To support scientific realism, for example, one wants the abductive inference to the existence of an external world to be a warranted inference. For the history and philosophy of science project of understanding how a scientist interprets an experimental result, one does not want to begin with the assumption that in the interpretation of a single experiment, the scientist is warranted in that interpretation. Historians and philosophers of science should be open to the possibility that scientists do not always take the interpretation of a single experimental result to warrant the truth of some hypothesis. A more plausible approach allows that a single abductive inference might be part of a more prolonged scientific investigation that may, or may not, conclude with the scientific acceptance of a hypothesis.

Many versions of IBE propose that scientists choose among rival hypotheses in terms of, among other things, the simplicity and scope of explanations. The theory of singular compositional abduction does not propose that scientists always consider explanatory simplicity, although they sometimes may. More significantly, the theory of singular compositional abduction may complement many versions of IBE by drawing

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greater attention to considerations of scope. Indeed, the theory suggests how one might develop a theory of explanatory scope. The scope of some hypothesis might be the set of experimental results the hypothesis explains; scope might also include the consideration of experimental results that the hypothesis fails to explain, that are abductively disconfirmed.

Finally, the theory of singular compositional abduction complements New Mechanist "manipulability" approaches. Most obviously, the compositional abductive approach provides an account of the scientific use of intralevel experiments to confirm compositional hypotheses. These are cases of scientific reasoning that the manipulability approach has never discussed. In contrast to the attention to intralevel experiments relevant to compositional hypotheses, the manipulability approach has focused exclusively on interlevel experiments. The compositional abductive approach does not apply to the scientific use of interlevel experiments, but it does suggest an abductive approach that does: interlevel abductive inferences. One descriptive advantage of the combination of abductive inferences over the manipulability approach is that the combination of abductive inferences allows that scientists may use both singular compositional abduction and singular interlevel abduction in support of some hypothesis. This is something that the MIE version of manipulationism evidently struggles with, as the conditions of MIE are intended to be jointly sufficient.

I am confident that I have not considered the theory of singular compositional abduction from every angle. Throughout the book I have alluded to any number of "neighboring" inferences for which I have not even attempted to provide an account. There are surely any number of objections that I have not foreseen, especially as many of these proposals so strongly diverge from prevailing approaches. The science-first approach, in fact, highlights a pathway to revision: closely examine more science. This is a strength of the science-first approach. Indeed, I must admit that there are some rather obvious scientific inferences that resist both the compositional and interlevel abduction accounts. Some of these inferences are based on fMRI.

The gist of the problem begins with the observation that, in a typical fMRI study, one presents a participant with, say, some visual stimulus and then measures the change in blood oxygenation level in some region of interest. This is a top-down experiment, so it does not fit the compositional abductive analysis. Further, it is assumed that the level of blood oxygenation in the region of interest does not compositionally ontologically determine a visual experience or visual perception. (One might say that

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the level of blood oxygenation in the region of interest is not constitutively relevant or mechanistically constitutively relevant to the visual perception.) Instead, the level of blood oxygenation in some region is "coupled" to some sort of neural activity that does compositionally ontologically determine a visual perception. What one apparently needs of an abductive theory of the scientific interpretation of the fMRI experiments is some theory of this "coupling." Clearly, the theory of abductive reasoning developed here is far from the final word.

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