The wide acceptance of indeterministic physical theories, such as the standard interpretation of quantum mechanics, has livened the possibility that our world is not diachronically deterministic; that is, it may well be that the way the world is at one time does not fix what the world is like at other times. Instead, our world might be diachronically indeterministic: the way the world is at one time might be consistent with many different futures and pasts. For example, according to the standard interpretation of quantum mechanics, radioactive decay is an indeterministic process. The fact that there is some atom of radium-226 in the world right now does not settle when, or even whether, that atom will decay in the future. My research is focused on indeterminism’s implications for important philosophical questions about the nature of science.

Much of my research concerns scientific explanations in indeterministic contexts. Our world’s indeterministic character threatens to dash our hope that we can understand why things happen. Understanding the future in terms of the past seems impossible if the past is no way constraints the future. Thankfully, our best indeterministic physical theories seems to suggest that, though the world is indeterministic, there is nevertheless a kind of ligature that connects the future to the past: chance. Various ways the future could unfold (given what has previously occurred) have various chances of coming to pass.

I argue that chances transform what would otherwise be an unintelligible indeterministic world into one that we can understand. In positing chances, we thereby posit an intelligible connection between the past and the future—a loose enough connection to allow for indeterminism but a connection nonetheless. Knowledge of that connection is what allows us to understand our indeterministic world. On my view, whether our radium atom decays in the next ten minutes or in the next ten millennia, our theories of radiometric decay help us to understand either outcome by revealing the precise chance of each.

In a pair of papers called “Two Explanatory Questions” and “Chance Explanation”, I develop and defend my view of chance’s explanatory role in our scientific theorizing. In “Two Explanatory Questions”, I distinguish between two distinct explanatory questions that arise when an event occurs by chance: (1) why did the event occur? and (2) why was the event’s chance of occurring equal to n? I argue that many influential accounts of scientific explanation fail to properly account for scientific explanation in indeterministic worlds by conflating these two questions. Once we distinguish between explanations of events that occur by chance and explanations of an event’s chance of occurring, my own picture of scientific explanation begins to emerge.

On my view, elements of scientific theorizing more traditionally taken to explain the occurrence of chance events—such as the laws of nature or an event’s causes—instead explain an event’s chance of occurring, while the chance that an event occurs explains that event’s occurrence. Scientific theories explain an event’s chance of occurring by uncovering the nomic and causal structure of the world. And, scientific theories explain what occurs by uncovering the precise chances of each occurrence. My essay “Chance Explanation” is devoted to articulating and defending this account of chance’s explanatory role.

My account of chance’s explanatory role grew out of my earlier research into a different but related topic: understanding why we are rationally required to conform our expectations about the future to our beliefs about the chances of future events. “Explaining (One Aspect of) the Principal Principle without (Much) Metaphysics” (Philosophy of Science, 2016) shows that we can derive aspects of this rational requirement from claims about the relationship between explanation and prediction combined with claims about chance’s role in scientific explanations—no further metaphysical assumptions are required.
Many philosophers have assumed that if inference to the best explanation favors the hypothesis that an event is likely over the hypothesis that an event is unlikely, then unlikely occurrences are not as intelligible as likely ones. In “Inference to the Best Theory”, I argue that this foundational assumption is false; despite its name, inference to the best explanation has little to do with explanation. I consider various extra-empirical virtues that guide theory choice, such as simplicity, fruitfulness, and scope, and argue that phenomena which are truly explained by theories that lack these virtues are nevertheless just as well understood as are phenomena that are truly explained by theories that manifest these virtues. The upshot of my argument is that there are no good grounds for maintaing that unlikely events are somehow less explicable than are more likely occurrences.

In addition to my work on explanation, I have also written a variety of articles about the metaphysics of chance. First, my article “Exploring a New Argument for Synchronic Chance” (Philosopher’s Imprint, 2018) develops a coherent metaphysics for worlds in which the microphysical properties of physical systems fail to determine the macrophysical properties of physical systems. I argue that these are worlds in which “synchronic” chances connect microphysical states of affairs at a time to macrophysical state of the world at a time, much as diachronic chances connect the past to the future in diachronically indeterministic worlds. Correcting philosophers’ mistaken impressions that it is metaphysically necessary for the macrophysical to supervene on the microphysical allows us to make sense of, and so treat as live options, interpretations of our best common sense and scientific theories according to which our world is synchronically indeterministic.

Second, my manuscript “Where are the Chances?” addresses questions about whether there could be macrophysical chances that are distinct and autonomous from microphysical chances and about whether there could be macrophysical chances in worlds that are fundamentally deterministic. I argue that we can reduce these somewhat obscure metaphysical questions to questions about whether the macrophysical sciences provide explanations that are on equal footing with the explanations proffered by fundamental physics.

Third, I have recently begun to explore the implications my view of scientific explanation has for debates about whether the correct metaphysics of chance is Humean or Anti-Humean. My manuscript “Scientific Explanation: Still a Headache for Humeans” argues that Anti-Humeans offer a much more natural account of inexplicability than do Humeans. For example, Humeans cannot capture the intuitive thought that events that occur in indeterministic systems that are not governed by chance (such as, e.g., Norton domes) are inexplicable.

Finally, my article “How to Know that Time Travel is Unlikely without Knowing Why” (Pacific Philosophical Quarterly, 2018) considers the features of time travel in indeterministic worlds. Time travelers cannot change the past, since “changing the past” involves some proposition about whether a past event occurred (at a particular time and place) being both true and false. Still, if time travelers have psychologies that are relevantly like our own, they will nevertheless try to bring about past events that they know did not occur; my undergraduate students, for example, report being particularly keen on preventing Adolph Hitler’s rise to power. Such attempts will fail, but I argue that these failed attempts are nevertheless unlikely. It is unlikely, for example, that my undergraduates would fail to prevent Hitler’s rise to power if they had the ability to arrive in Austria in 1899 when Hitler was a ten year old boy. I argue that since these failures are unlikely to occur, we should expect that the attempts will not be made and so expect that there will not be frequent time travel to the local past. The most interesting upshot of my argument is the there are evidential relationships between whether there will be time travel and the psychologies of potential time travelers—an upshot that relies on there being chance occurrences in time travel contexts, such as the low chance of a time traveler’s failure to successfully perform easy tasks.