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Introduction

The Logic of Social Science introduces principles and methods for set-theoretic social research. Most of the book is focused on describing in some detail how these principles and methods can be substantively applied. However, the book's starting point is the argument that set-theoretic analysis offers a correction to the bias of essentialism as manifested in the social sciences. Let me begin with this problem.

Essentialism is an innate bias in which human beings understand the world as consisting of entities that possess inner essences, which endow the entities with an identity and a certain nature. Social science researchers adopt this orientation when they treat their categories as corresponding to things "out there" in the external world that possess properties and dispositions. This understanding of categories is useful for everyday life; it is how we comprehend and often successfully manipulate the world around us. In fact, all human cultures and civilizations depend on essentialism. Nevertheless, I argue that an essentialist orientation to categories is not appropriate for the *scientific* study of social reality.

I build the case against essentialism on the back of an impressive interdisciplinary literature developed over decades of research. Following this literature, I conclude that essentialism distorts perception and reasoning in profound ways. Our understanding of social science categories as entities that exist in the external world with identities and tendencies derives from our built-in essentialist bias. Our social categories do not actually exist with properties and powers. If we recognize the bias of essentialism, I argue, we find that the goals of contemporary social science need to be adjusted. We cannot hope to derive valid findings about an external social world that exists independently of human beings and of ourselves as researchers.

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This book is driven almost entirely by a positive agenda: it seeks to develop a set of practical tools for pursuing a social science that does not engage in essentialism. Most of the book concerns specific procedures that scholars can put to use directly to build theories and propositions and to evaluate the validity of those theories and propositions. Many of the tools discussed are inspired by what qualitative social scientists are already doing in their research (Goertz and Mahoney 2012). Qualitative researchers routinely assume that social categories are necessarily and deeply infused with their substantive knowledge. For these researchers, this book offers a new set-theoretic foundation and a new set-theoretic toolkit for the pursuit of non-essentialist research.

This book is committed to science as a mode of discovering truths about the world. This commitment makes the book accessible to all scholars who believe that evidence and logic should be the basis for arriving at inferences and conclusions. For social scientists who work under essentialist assumptions, the book seeks to stimulate a new discussion and debate about essentialism and its consequences for the production of knowledge in the social sciences. It asks researchers to temporarily set aside their skepticism (i.e., adjust their "priors") to the point that the book's arguments can receive a fair hearing.

———

Scientific constructivism is the approach that I develop to undergird a non-essentialist social science. A scientific constructivist approach assumes that categories do not stand in an approximate one-to-one correspondence with entities in the natural world; social science categories do not carve nature at its joints (or even approximately at its joints).[1] Instead, the meaning and efficacy of social science categories depend on collective understandings among communities of individuals located in particular places and times. The entities in the natural world to which a given social science category refers are heterogeneous and largely uncomprehended (and perhaps incomprehensible). These entities are regarded as instances of a given category because the human mind constructs them in this way. Scientific constructivism is designed to recognize and accommodate the profoundly mind-dependent nature of social science categories.

Scientific constructivism is fully committed to science as understood in a conventional way. *Science* consists of generalizable and public procedures for using evidence to rationally derive beliefs about the truth of propositions concerning the actual world. The methods discussed in this book provide explicit rules for researchers to follow in order to use evidence to logically assess propositions that could be true or false. These methods can be used to evaluate descriptive, causal, and normative statements about constructed categories that exist by virtue of collective understanding.

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Both constructivism and science have advocates in philosophy going back centuries and continuing today. Yet the two orientations often stand in opposition to one another in the social sciences (Wendt 1999). Advocates of constructivism tend to be skeptical of science when defined in a conventional way and applied to the social world. They believe that the human-constructed nature of categories obviates the possibility of a science of the social world that uses evidence to arrive at valid conclusions about causal regularities and law-like propositions. Constructivists commonly embrace epistemologies that depart radically from the scientific epistemology of the natural sciences.

For their part, advocates of science often reject constructivism as a depiction of reality and as an approach for the social sciences. They view the concerns of constructivism as reflecting a set of philosophical issues about the nature of reality that are largely irrelevant to the actual practice of social science. They assume that social science categories exhibit an approximate correspondence with actually existing entities of the external world at some level of analysis. They believe that the methods used in the natural sciences are, in principle, appropriate for the social sciences because the subject matter of the natural sciences and that of the social sciences are not fundamentally different.

The scientific constructivist approach of this book joins constructivism and science in a harmonious, truth-seeking alliance. Scientific constructivism is committed to the proposition that the categories of the social sciences do not correspond coherently—i.e., in ways that humans can comprehend and represent—to mind-independent substances, properties, and processes. It endorses the view that human categories function despite an often massive referential disconnect with the natural kinds of the world. It embraces the idea that one task of the social sciences must be to understand how and why particular categories are constructed. It welcomes normative inquiries into the effects of socially constructed categories, including effects on the behavior of the individuals to whom these categories may refer.

Scientific constructivism simultaneously insists that these inquiries follow scientific methodologies that are rooted in logic. The book assumes the validity of transcendental principles, including especially logic, that are requisite in order for researchers to make valid inferences and rationally evaluate the truth of propositions. Scientific constructivist research is focused on contingent propositions whose truth is established on the basis of logical reasoning and constructed evidence from the actual world. Scientific constructivism offers general principles for understanding the social construction of categories, the relationships among these categories, and the consequences of the categories for human beings' experienced reality. At the core of the approach is the encounter between sensory information derived from the natural world, constructed categories in the mind, and methods rooted in logic, whose validity transcends human experience.

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Bringing constructivism and science into an alliance is necessary for the flourishing of a social science focused on the rational discovery of truth. However, building the bridge for this alliance is no easy feat. Simply endorsing or justifying scientific constructivism is not sufficient for the task. Any viable scientific constructivist approach must consist of clear guidelines for conducting non-essentialist social research. It must offer well-developed ideas about the procedures that scholars can use to carry out analyses that recognize the mind-dependent nature of social categories. The approach needs principles for formulating categories and propositions, assessing propositions using evidence, and interpreting and reporting results. The approach must not remain on a philosophical plane; it must consist of practical tools that scholars can put to use in designing and conducting social science research. To develop this kind of approach—one consisting of specific and usable procedures for conducting research that is both constructivist and scientific—is the goal of this book.

———

A scientific constructivist approach responds to two challenges facing the social sciences. The first challenge is to recognize and take fully into consideration the implications of scientific research that suggests an essentialist approach is not appropriate for the social sciences. More than thirty years ago, Lakoff (1987) summarized two decades of research across various disciplines showing that categories do not derive meaning from their correspondence to entities in the natural world. Members of a category share no inherent essences or fundamental properties that make them members of the category. Rather, category meanings are located in cognitive models that structure thought and that reflect both human culture and human sensorimotor constitution. In the last twenty-five years, experimental laboratory research in psychology has shown that essentialism is a built-in human bias that emerges early in life as a non-optional mode of categorizing and comprehending reality (Gelman 2003; Newman and Knobe 2019). Essentialist assumptions bias human reasoning concerning categories ranging from race, gender, and caste to money, education, and democracy. Most recently, work in neuroscience offers additional reasons for rejecting the notion that the mind is anything like a mirror of nature. Sensory input from the natural world is transmitted across ensembles of neurons that vary greatly in the density of their connections. Even if our sensory neurons could directly track natural divisions in the world, the categories of which we are consciously aware reflect a heavily processed summary of this sensory input—a summary that is deeply affected by preexisting brain encodings and our current neural activation state, as well as by the inherent limitations of our brain's neural mechanisms.

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The implication of this research is that our social categories do not map onto the structure of a mind-independent external reality. Social scientists seemingly have no other choice than to embrace some kind of constructivism, at least in the minimal sense of acknowledging an inescapable role for human minds in creating and sustaining social categories. Yet embracing even this minimal constructivism is difficult, because mainstream social science methods depend on the assumed truth of essentialism. These social science methods are not appropriate for the study of categories that require shared beliefs for their existence. Letting go of essentialism involves letting go of both human intuitions and longstanding approaches to social research. It involves acknowledging that our intuitions about categorization are mistaken and that social science research must correct for the illusion of essentialism.

The second challenge is to embrace constructivism while remaining fully committed to the pursuit of science. The most radical constructivists reject science in conjunction with rejecting realism—i.e., they reject the proposition that an actual world consisting of a structured set of entities exists independently of human beings. Other relativists are agnostic about an external reality and argue that the issue is irrelevant because the truth-value of propositions depends entirely on human thought and language. Still other relativists are realists about the external world but argue that logic is not part of the structure of this world; instead, they believe, logic is an artifact of the kind of bodies and brains that human beings happen to possess. In all of these approaches, truth, reason, and objectivity are optional ideas that depend on human beings for their meaning. What is true from one conceptual viewpoint may be false from another; no viewpoint can be privileged as objective. Under this radical constructivism, scientific propositions about the natural world can be both true and false, depending on how you look at them.

By contrast, this book rejects both skepticism about reality and relativism about truth; it fully embraces realism and objective truth. More extreme relativists fail because they cannot account for the fact that scientific categories predict and shape the sensory input we receive from the external world. Extreme relativism provides no insight into our ability to use categories to successfully manipulate and control the natural world and to predictably and meaningfully interact with one another in the social world. Scientific theories are useful precisely because they capture approximate truths about reality. Other forms of relativism fail to appreciate the indispensability of so-called Western thought for understanding the world. Although scholars may assert that logic is an optional and dispensable tool, their words and reasoning betray them. In order to advance arguments, marshal evidence, and reach conclusions, they, like all of us, must accept transcendental notions of logic, truth, and objectivity. Meanwhile, they leave as a mystery the issue of why logic works so well for understanding and controlling the world if it is unrelated to the world.

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I propose that set-theoretic analysis offers a way out of essentialist social science without falling into relativism or anti-realism. Set-theoretic analysis for the social sciences is well suited for constructivist research because it requires the analyst to engage in an ongoing exchange between ideas in the mind and evidence from the world (Ragin 1987, 2000, 2008; Schneider and Wagemann 2012; see also Lamont and Molnár 2002). The categories of set-theoretic analysis are infused with substantive knowledge; they explicitly embody the beliefs of the researcher, who calibrates the boundaries of the categories included in the analysis. Set-theoretic researchers do not measure categories by neutrally describing features of an ontologically objective reality that already exists with an identifiable structure. Instead, they *construct* and *calibrate* categories on the basis of shared understandings concerning the meanings of the categories. If these shared understandings change, the calibrations of the categories also change. In set-theoretic analysis, one's understanding of the meaning of a category establishes the basis for how one reports about the structure of the social world. Categories *literally* help construct the content of the social world.

Although set-theoretic analysis is well suited for constructivist research, a commitment to constructivism is not requisite for the use of set-theoretic analysis. Set-theoretic analysts who embrace essentialism can work under the assumption that a set is simply a group of entities that all share one or more essential properties. These analysts can employ some of the tools developed in this book. However, I show that set-theoretic tools fit most naturally within a constructivist approach in which the mind-dependence of categories is explicitly recognized. I develop the tools of set-theoretic analysis under constructivist assumptions, for social scientists who seek to pursue scientific constructivist research.

To reconfigure set-theoretic analysis for constructivist research, I conceptualize the "sets" of set-theoretic analysis as mental phenomena that are ontologically prior to the entities they categorize. Briefly, I argue that set-theoretic analysts can avoid essentialism by conceiving of sets as actually existing bounded spaces in the mind's representational system that human beings use to understand and classify sensory input from the natural world. Sets are created from and instantiated by an interaction between the mind and the natural world; sets are entities that *exist* as conceptual spaces in the cognitive machinery of the mind. When sets are understood in this way, the toolkit of set-theoretic analysis encompasses a nearly comprehensive methodology for conducting scientific constructivist research.

Under this set-theoretic methodology, social categories refer to particular entanglements of human understandings and aspects of objective reality. They are interactions between conceptual spaces in human minds and entities from

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the natural world. The social categories of interest to social scientists cannot be reduced to the natural kind constituents of their individual referents. A category such as *capitalist country* refers to complex and heterogeneous entities in the natural world. Knowledge of the various natural kinds that compose each instance of a capitalist country is irrelevant to understanding what it is that all instances of capitalist countries have in common. The ultimate commonality shared by all the instances is their membership in the conceptual space for *capitalist country* within human minds. This conceptual space reflects the meanings of the category for the individuals who use and understand the category. The existence and utility of *capitalist country* depend on shared knowledge and shared understandings of its meaning among communities of individuals. With constructivist research, social categories such as *capitalist country* are not imagined to be ultimately composed of instances with *shared* mind-independent properties. Instead, social categories are treated as conceptual spaces embedded in the cognitive machinery of individuals that are used to comprehend heterogeneous natural entities as meaningful and homogeneous social entities.

This book develops practical and ready-for-use set-theoretic tools under this constructivist understanding of categories, as well as developing a full-blown set-theoretic approach for scientific constructivist research in the social sciences.

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The pursuit of a set-theoretic social science involves some significant departures from business as usual. Analyzing all categories as sets is a far-reaching transformation for social research. We almost unavoidably view social reality as composed of variables for which individual cases possess particular values. Our language almost forces us to speak as if social categories are natural kind entities existing in external reality, with identities and dispositions. To think about and discuss categories as sets located in the mind that construct heterogeneous natural entities as instances of a given kind requires a deliberate effort, and it takes some practice to do it consistently and do it well. The good news is that many qualitative researchers already think about categories as sets in an informal way (Goertz and Mahoney 2012). These analysts are familiar with the kinds of research questions, theories, and methods that are possible and appropriate within set-theoretic analysis. This book is an invitation for qualitative researchers to embrace the basic premise of scientific constructivism: that social categories do not have a coherent relationship with entities in the natural world or stand in any kind of approximate one-to-one correspondence with natural kinds. It is an invitation for them to conduct constructivist set-theoretic analysis explicitly, rigorously, and imaginatively.

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The idea that a set-theoretic social science is a departure from a variable-oriented social science is not controversial. However, methodologists do debate the extent to which set-theoretic methods have value added when compared to other methods, such as regression analysis (see Thomann and Maggetti 2020 for a literature review). Critics of set-theoretic analysis operate under the essentialist assumption that the purpose of a methodology is to report about the objective features of a mind-independent world. From the perspective of this book, however, the question is not whether set-theoretic analysis is a worthy approach in the pursuit of essentialist social science. Instead of arguing about the value added by set-theoretic analysis under essentialist assumptions, this book proposes that the more important and prior questions are (1) whether we need a non-essentialist methodology that accommodates the mind-dependence of social categories and, if so, (2) whether set-theoretic analysis can be that methodology. I argue that the answer is yes to both of these questions.

The focus of this book concerns how to use set-theoretic analysis in the study of categories that depend on shared human beliefs and understandings for their existence. These mind-dependent categories include most of the important categories in the disciplines of sociology (excluding parts of demography), political science, cultural anthropology, and economics. Scholars in these disciplines work almost exclusively with categories that fall into the mind-dependent camp. A few of the categories that are important in these disciplines—such as age, sex, morbidity, and death—exist in large part independently of human minds (some scholars, though not all, would exclude race and intelligence from this camp). In psychology, researchers in subfields such as neuropsychology and behavioral genetics work with largely mind-independent categories. By contrast, psychologists in subfields such as social psychology and educational psychology work with mostly mind-dependent categories. In still other subfields, such as abnormal psychology and developmental psychology, the mind-independent status of categories may vary or be the topic of debate. Insofar as researchers do study mind-independent categories, I view them as engaging in natural science research, for which essentialism is the appropriate point of departure. By contrast, I view scholars who work with mind-dependent categories as engaging in social science, for which constructivism is the appropriate point of departure. This book is directed at the latter group of scholars.

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The scope of this book is restricted in two important ways. First, it focuses mainly on macroscopic research in the social sciences. The examples tend to be studies of large-scale processes and events, such as revolutions, democratization, development, and war. The main categories and units of analysis

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are aggregate groups, such as social movements, organizations, socioeconomic classes, states, and political systems. This macropolitical and macrosocial orientation reflects my own substantive areas of research and expertise. The focus is consequential because it means that the categories analyzed here are clear-cut examples of human-constructed, mind-dependent categories. If this book were more concentrated on the micro level—such as on individuals and their biological and physiological properties—it would need to say much more about the analysis of natural kinds. As it stands, the book offers principles and methods for research that falls squarely into the social sciences, defined as the study of mind-dependent categories.

Second, the book concerns mainly tools for case-study and small-N research—i.e., research that develops and evaluates propositions about a single case or a small number of cases. I do not focus on questions related to the evaluation of propositions concerning trends or tendencies that apply to large samples or large populations of cases. The focus on case-study and small-N research reflects, again, my own areas of interest and expertise. Fortunately, a scientific constructivist approach can be readily developed by starting with small-N research. The individual case is a convenient point of departure, because set-theoretic analysis for the social sciences is fundamentally rooted in a case-based logic. Trends or averages in populations exist only because of the features of the individual cases. A focus on individual cases also permits direct engagement with important philosophical literatures concerned with the mind, logic, cognitive models, categories, causality, normative beliefs, possible worlds, counterfactual analysis, certitude, and scientific truth. Although I do not address medium- and large-N set-theoretic methods in this book, these tools are well developed in the literature (e.g., Ragin 2008; Rihoux and Ragin 2009; Schneider and Wagemann 2012; Oana, Schneider, and Thomann forthcoming) and could be recast for constructivist rather than essentialist research.

This book is divided into three parts. Part I (chapters 1–2) concerns ontology and epistemology, introducing both scientific constructivism and set-theoretic analysis. This part establishes the conceptual foundations for the rest of the book. Part II (chapters 3–7) introduces and discusses specific methodological tools for evaluating propositions in the social sciences. Individual chapters in this part focus on tools for analyzing categories and causality, developing and using set-theoretic tests, carrying out counterfactual analysis, using sequence analysis for causal assessment, and employing Bayesian inference with evidence from case studies. Part III (chapters 8–11) discusses how set-theoretic analysis can be used in conjunction with a range of theoretical tools—what Stinchcombe (1968) calls tools for "inventing explanations." Individual chapters in this part concern theory frames and normative orientations, theory-building categories, critical event analysis, and path dependence. The book concludes by considering some of the implications of scientific constructivism for what it means to be an individual living in a society.

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