

Rival Visions of Parsimony

THEORY NOTE

SEVA GUNITSKY

University of Toronto

“Parsimony” is a vague and divisive concept in political science. I identify three distinct but often conflated conceptions of parsimony. The *aesthetic* conception emphasizes a theory’s elegance and clarity; the *ontological* conception, drawing upon the hard sciences, posits that the world is governed by simple fundamental laws. Neither applies in international relations theory or to social science more broadly. Instead, only the *epistemological* conception—abstracting from reality to highlight recurring patterns and build testable propositions—justifies parsimony. This view is not a naive simplification of the world but a self-conscious capitulation to its complexity. Though both critics and supporters of parsimony often do not distinguish among these three “visions,” doing so has important implications for how we think about evaluating theories.

Parsimony remains a vague, enigmatic, and unusually divisive concept in political science. Proponents see it as essential for theory building, while critics attack it as a naive simplification of reality. As a result, parsimony is either ignored completely or tolerated as an arcane element of social science philosophy. King, Keohane, and Verba (1994, 20) note that parsimony “has been used in so many ways in casual conversation and scholarly writings that the principle has become obscured.”

Despite this confusion, parsimony remains a key concept in international relations theory. It is embedded in ideas like Weber’s ideal types, Lakatos’ hard core, and Kuhn’s normal science (Weber 1949; Kuhn 1962; Lakatos 1970).¹ It plays a crucial role in statistical concepts such as degrees of freedom and model overfitting (Achen 2002, 2005; Schrodt 2014).² And issues related to parsimony surface, often implicitly, in debates about “the end of theory” and the merits of paradigms.

I argue that there are three distinct justifications for parsimony, each with its own assumptions and limitations (see Table 1). The aesthetic justification emphasizes theoretical elegance; the ontological justification sees parsimony as a reflection of reality; and the epistemological justification treats parsimony as a stylized assumption made for the sake of theory. Both critics and supporters of parsimony often fail to separate these three justifications or “visions” of parsimony. Yet distinguishing among them has important implications for how we think about evaluating theories.

Seva Gunitsky is an associate professor of political science at the University of Toronto. He is the author of *Aftershocks: Great Powers and Domestic Reforms in the Twentieth Century* (Princeton University Press, 2017).

Author’s note: For helpful comments I am grateful to Caroline Cardarople, Adam Casey, Simon Frankel-Pratt, Ryan Griffiths, Sean Molloy, Dan Nexon, Gerard Toal, and the anonymous reviewers of *International Studies Quarterly*.

¹As Jackson (2011, 37) notes, Weber’s ideal types are not “a representation or depiction” of reality, but “a deliberate oversimplification of a complex empirical actuality for the purpose of highlighting certain themes or aspects that are never as clear in the actual world.” This view exemplifies the epistemological view of parsimony.

²Parsimony plays a role in both frequentist and Bayesian approaches; MacKay (1992, 416) notes that Ockham’s razor is “automatically embodied” in Bayesian reasoning since complex models “are automatically self-penalizing under Bayes’ rule.” In information theory, the notion of minimum message length also functions as a form of Ockham’s razor: models generating the shortest message length are more likely to be correct (Wallace and Boulton 1968).

The aesthetic conception of parsimony emphasizes the value of a theory’s elegance and clarity. There are two closely linked variants of this justification. The *intrinsic* variant emphasizes beauty as an inherent virtue in a theory, often coupled with the notion of elegance as a marker of truth. The *pragmatic* variant instead emphasizes beauty and clarity as a way to help spread or falsify a theory. In this view, we should favor parsimonious theories because they discourage obscurantism and calculated vagueness. While this variant is more than cosmetic, the aesthetic conception as a whole is neither essential nor necessary in social science.

The ontological justification focuses on simplicity as rooted in the nature of existence itself. In this view, theories should be elegant because the world is designed in an elegant way. As with the aesthetic justification, it also appears in two variants. The largely obsolete but historically important *metaphysical* variant argues that God or Nature is inherently simplicity-seeking. Leibniz ([1686] 1989, 306), for example, speaks of “simplicity of the ways of God” revealing itself in physical phenomena. The *scientific* variant, by contrast, argues that the physical world is built upon laws of symmetry, and parsimonious explanations are thus more likely to reflect reality. While useful in the physical sciences (and theoretical physics in particular), this justification makes little sense in social science except under some extremely stylized and narrow circumstances.

The epistemological justification makes no claims about elegance or the nature of existence and instead uses parsimony as a way to produce generalizable explanations and improve causal inference. Its *cartographic* variant employs theories as stylized “maps” that self-consciously simplify the world in order to understand it. It rests on the idea that explanation requires generalization, and generalization requires abstraction. Theories “lie” in the same ways that maps lie, but they do so for a reason: to highlight the salient features of the world. The *empiricist* variant, by contrast, sees parsimony as a way to improve statistical models and ensure falsifiability. The epistemological variants dominate positivist, explanatory, and “problem-solving” approaches (much of mainstream international-relations theory) but not critical or historicist approaches (Cox 1981; Hollis and Smith 1991; Dunne, Hansen, and Wight 2013; Jackson and Nexon 2013).

Table 1. Three views of parsimony in social science

Type of parsimony	Definition	Sub type	Justification	Use in social science theory
Aesthetic	Parsimony as elegance and clarity	Intrinsic	Beauty as an inherent virtue in a theory	Not justifiable
		Pragmatic	Clarity and simplicity as aides to theory testing and replication	Desirable but not necessary
Ontological	Parsimony as a description of the world	Metaphysical	“God” or “nature” as inherently simplicity-seeking	Not justifiable
		Scientific	Symmetry in physical laws means simpler theories are more likely to reflect reality	
Epistemological	Parsimony as a stylized theoretical assumption	Cartographic	‘Theory as a map’; simplifying assumptions are necessary for useful generalizations	Useful for explanatory or ‘problem-solving’ theory
		Empiricist	Parsimony increases falsifiability, improves model design, cuts off the ‘garden of forking paths’	Useful for causal inference, positivist hypothesis testing

Examining parsimony through this lens has several implications for how we think about evaluating theories. For critics, two caveats are in order. First, dismissing a theory’s parsimony because beauty is impractical misses the mark by attacking only the aesthetic conception. Second, dismissing parsimony by claiming the world is too complex confuses the ontological and epistemological justifications for parsimony. The epistemological conception makes no claims about the “real” world, but uses parsimony as a shaky but sometimes essential guide to inquiry.

At the same time, this argument suggests that parsimony’s virtues are limited. As [Huemmer \(2008, 217\)](#) notes, appeals to parsimony are often made on the basis of intuitive claims, “without discussion of the reasons for favoring simple theories.”³ Nebulous appeals to elegance and beauty focus on only one element of parsimony.

Moreover, proponents of parsimony should be wary of mistaking the artifice of theory for a description of reality. A common pitfall of parsimonious explanations is the reification of stylized assumptions into statements about the world. This is the source, for example, of [Hirschman’s \(1985\)](#) critique of neoclassical economics—economists coming to believe their simplified models are descriptions of human behavior.

The distinction between ontological and epistemological parsimony has been a source of much confusion. These are not just distinct but directly opposed to each other. Ontological parsimony assumes the world is simple, while the epistemological version assumes the world is complex and seeks to mitigate the consequences of that complexity.

Epistemological justifications do not appeal to aesthetic virtues or invoke a fundamental feature of reality, but point out the necessity of abstraction while recognizing its inevitable and self-conscious tradeoffs. Epistemological parsimony is therefore not a naive simplification of the world but a sometimes useful capitulation to its complexity.

Examining the distinct meanings of parsimony also sheds light on some debates in international relations theory. Disputes over the merits of “grand” versus “midlevel” theory, for example, are often framed as a tradeoff between parsimony and complexity, in which midlevel theory self-consciously sacrifices parsimony for the sake of descriptive accuracy.⁴ Yet, this is not an inevitable tradeoff. Midlevel theories that trade paradigms for puzzles still retain epistemological parsimony by emphasizing recurring patterns produced by generalizable relationships.

In short, getting parsimony right matters for reasons besides metatheory. I discuss each of the three justifications, then examine the epistemological version in more detail.

Aesthetic Parsimony

The aesthetic dimension of parsimony is the most common and the least useful justification for parsimony in the social sciences. This view emphasizes the virtues of clarity, beauty, and simplicity in theoretical arguments and links to the commonsense notion of parsimony as “doing a lot with a little.” Theories that make few starting assumptions, yet are able to explain diverse phenomena using these assumptions, are said to possess inherent elegance and explanatory power.

Aesthetic parsimony is not merely cosmetic in its appeal to beauty. Simple theories may be easier to test, replicate, or falsify. As [Walt \(1999, 21\)](#) writes, “a theory that is easy to grasp and understand is inherently easier to evaluate than one that is impenetrable or obscure. Accessibility increases the number of potential critics, thereby increasing the number of challenges that a theory is likely to face.”⁵ Simplicity may therefore aid in the propagation and popularity of a theory and in doing so can invite challenges that more efficiently probe and confirm (or discredit) the theory.

³For instance, [Wendt \(2015, 292\)](#) writes that “social scientists are all trained to make their theories as parsimonious as possible, so for my purposes, an intuitive, ‘you-know-it-when-you-see-it’ criterion should suffice here.”

⁴See for example [Sil and Katzenstein \(2010a; 2010b\)](#); [Lake \(2013\)](#).
⁵[Geddes \(1995, 2011\)](#) notes that “the advantage of a clearly stated deductive argument is that others attracted by the idea’s parsimony and innate plausibility may be motivated to devise systematic empirical tests.”

We can thus distinguish between two variants of aesthetic parsimony. The first focuses on the *intrinsic* virtues of beauty and elegance for their own sake. As Kaplan (1964, 318) writes, “[w]hether or not a theory can be beautiful in the same sense as a work of art, there is no doubt that it can provide a comparable intrinsic pleasure in its contemplation.” The second variant highlights the *pragmatic* value of clarity and elegance as an aid to spreading and validating a theory. For example, Dafoe, Oneal, and Russett (2013, 202) note that “[s]imple parsimonious methods are better understood, more transparent, and less likely to rest on subtle, inappropriate assumptions.”

Despite these advantages, the aesthetic justification cannot be a decisive marker of a theory’s value. In some cases, elegance is sacrificed when dealing with social phenomena that possess contingent, nonlinear dynamics and feedback loops. Some theories may rely on interacting or divergent subexplanations or require large amounts of background knowledge. Complex adaptive systems of dense and strategic interaction, which characterize much of the social world, are not conducive to transparent explanations (Jervis 1997; Schmidt 2007, 3, Gunitsky 2013). The fact that a theory lacks elegance does not always make it internally incoherent or externally invalid. While clarity and accessibility are desirable qualities in a social science theory, they cannot be necessary criteria.

The underlying motivation for embracing elegant theory is often connected to the notion that simple theories are more likely to reflect reality. As Michael Polanyi (1958 [2005], 154) puts it, “the intellectual beauty of a theory is a token of its contact with reality.” But this idea, borrowed from the natural sciences, conflates the aesthetic and ontological dimensions of parsimony. As discussed in the next section, in the “hard” sciences parsimonious theories enjoy an advantage because the evolution of physics has progressed by theoretical unification. Over time, complex theories come to be seen as manifestations of broader phenomena resting on simple common principles. (Maxwell’s unification of electricity and magnetism is one such prominent example.)

For that reason, in the physical sciences a theory’s elegance may indeed offer a hint of concordance with reality. Yet, the social sciences have evolved largely through fragmentation rather than unification. While beauty and simplicity may be prized as desirable “luxury goods,” simple theories are not inherently more likely to be valid or to serve as accurate representations of the real world compared to complex or contingent theories.

A long-standing criticism of parsimony has been that elegance is irrelevant because the world is inelegant. As Thomas Huxley ([1870] 1894, 243) noted, the “great tragedy of Science” has been “the slaying of a beautiful hypothesis by an ugly fact.”⁶ Yet this critique reduces parsimony to its most visible and least relevant dimension. Proponents of parsimony cannot justify it on aesthetic grounds alone; yet, neither can skeptics dismiss parsimony as a misguided quest for beauty, as doing so focuses only on the aesthetic justification.

⁶Similarly, Kaplan (1964, 31) writes: “[t]he esthetic norm, however, has little bearing on behavioral science in its present state, which may be characterized . . . as one of almost unrelieved ugliness.” And Levi (1997, 1) argues that the beauty of natural science is one of “logic and parsimony,” while social science is “generally messy and aloof.”

Ontological Parsimony

The ontological justification argues that parsimonious assumptions have a real-world material dimension beyond their aesthetic component. That is, theories should be simple because the underlying phenomena they seek to explain arise from a world that tends toward simplicity. Simple theories are more likely to reflect reality itself.

This argument exists in two variants, the metaphysical and the scientific. The historically earlier, metaphysical variation rests on the assumption that the essence of the universe, incarnated by God or Nature itself, favors simplicity. A prominent example of this approach is found in Isaac Newton (1687): “nature is simple and does not indulge in the luxury of superfluous causes,” he writes. “It is the perfection of God’s works that they are all done with the greatest simplicity” (ibid.). The metaphysical variant of ontological parsimony overlaps in some key respects with the aesthetic justification and is unscientific in the broadest sense of the word; our main concern here is with the scientific variant.

The scientific version of ontological parsimony, most often associated with theoretical physics and mathematics (but sometimes imported into social science), argues that reality itself is governed by parsimonious physical laws. The fundamental physical nature of matter itself, at least at the subatomic level, possesses a symmetry that abets and even demands parsimonious explanations. Parsimonious theories that take advantage of this symmetry are appealing not just because they are elegant, but because they are more likely to be true.

Here, “symmetry” refers not to an aesthetic ideal but to a technical description of invariance under transformation. “Just as a square on a piece of paper looks the same if you rotate it by 90 degrees, the equations that physicist have found to describe nature often do not change when certain operations are performed on them,” writes Kane (2000, xvii). “When that happens, the equations are said to have a symmetry” (ibid.). Such equations not only lend themselves to more elegant mathematical description but to a better description of the state of physical reality.⁷ Maxwell’s eight field equations, which form the basis of classical electrodynamics, are “exceptionally ugly and very opaque” when time and space are treated as distinct entities (Kaku 1994, 86). But when Einstein’s insights are applied to treat time and space as symmetrical in a higher dimension, the eight field equations suddenly “collapse into one trivial-looking equation.”⁸

In the shift from Maxwell to Einstein, the ontological basis for parsimony stems not from metaphysical assumptions but from a physical observation: the symmetry of treating space and time as equivalents. Parsimony becomes a desired attribute because the symmetry of parsimonious theories is not just elegant but signals a closer correspondence to reality. “[S]ymmetry guides physicists to Nature’s inner secrets,” argues Zee (1999, 73, 75), since “as physicists explore Nature at ever-deeper levels, Nature appears to get ever simpler.”⁹

⁷“Nature seems to take advantage of the simple mathematical representations of the symmetry laws,” noted C.N. Yang (1957) in his Nobel acceptance speech. “When one pauses to consider the elegance and the beautiful perfection of the mathematical reasoning involved . . . a deep sense of respect for the power of the symmetry laws never fails to develop.”

⁸“In one masterful stroke, the fourth dimension simplifies these equations in a beautiful, transparent fashion. Written in this way, the equations possess a higher symmetry; that is, space and time can turn into each other” (Kaku 1994, 86, original emphasis). As he notes, “this simple equation contains the same physical content” as Maxwell’s eight equations from a century ago (ibid.).

⁹“I may surprise the reader by saying that Einsteinian mechanics, once mastered, intrinsically is simpler than Newtonian mechanics,” Zee (1999, 75) notes.

Thus, a major reason why even proponents of the Standard Model admit its incompleteness is because of its “ugliness”—a particle zoo with arbitrary constants. (Montano 2013, 50). Kaku (1994, 127) argues that “beauty” for a physicist implies two features: a “unifying symmetry” and “the ability to explain vast amounts of experimental data with the most economical mathematical expressions.” The Standard Model, by these standards, fails both tests.

In the physical sciences, therefore, parsimony is a desirable feature of theories not because of their elegance, but because elegance signals that a theory is more likely to be a true description of physical reality.¹⁰ This view is best summarized by Einstein, who noted that “the only physical theories that we are willing to accept are the beautiful ones” (quoted in Farmelo 2002, xii).¹¹ Unlike the social sciences, the physical sciences have progressed by unification, marked today by the quest for a grand unified theory of physics. As a result, the evolution of theory in the physical sciences is characterized by the increasing parsimony of explanations used to explain the nature of reality.

This deep link between parsimony, symmetry, and theoretical development has given rise to the metaphysical notion of a reciprocal relationship between beauty and truth. As Deutsch (2011, 367) argues, in the physical sciences “elegance is a heuristic guide to truth.” This heuristic, however, relies on the ontological assumption that the nature of the physical world is more precisely described by parsimonious theories. In the social sciences, however, this link between beauty and truth is little more than a hopeful metaphor. The crucial connection—symmetry, in the strict naturalistic sense of a system’s preservation after transformation—is absent.

Wendt (1998, 102) has argued that the fundamental difference between natural and social science is not epistemological but ontological, in that “the objects of natural science are not intentional beings.”¹² To this I would add another fundamental ontological difference. Theories of physical sciences are more able to accommodate parsimony as a justifiable requirement, because the world of physics involves an understanding of parsimony as a reflection of symmetry.¹³ As a result, the conflation of the aesthetic and the ontological dimensions of parsimony—the notion that simple theories are also more likely to reflect reality—may be partially justified in the physical sciences but not in the social sciences.¹⁴

“With relativistic invariance [i.e., symmetry], a single equation describes an electromagnetic field changing in spacetime. I find this completely symmetrical equation as easy to remember as the shape of the circle.”

¹⁰ As Yang (1957, 394) put it, “the conceptual simplicity and intrinsic beauty of the symmetries that so evolve from complex experiments are for the physicists great sources of encouragement. One learns to hope that Nature possesses an order that one may aspire to comprehend.”

¹¹ As a result, ontological parsimony has sometimes acted as a guide against pure empiricism in the physical sciences. Here “a theory was adhered to because of its simplicity and symmetry in spite of its disagreement with fact, then later observations and interpretations removed the disagreement” (Kaplan 1964, 319). For a critique, see Cartwright (1983).

¹² See also Hacking (1991, 1995) on the distinction between natural and human kinds.

¹³ The use of parsimony as an ontological principle is thus applicable to theoretical physics rather than to the “natural” sciences as a whole. As an epistemological principle, parsimony is formally applied in several subfields of biology, for instance in the construction of phylogenetic trees or in models of protein interaction networks (Stewart 1993; Souza-Chies, Bittar, Nadot, et al. 1997; O’Leary 1999; Guimarães, Jothi, and Zotenko, et al. 2006).

¹⁴ A possible exception are artificially simplified situations, for example non-crisis interstate bargaining in which stakes are low and rules, norms, and behaviors are highly institutionalized. As Lake (2011, 477) argues, “when social interactions are repeated frequently or within well-structured and stable institutions, nomolog-

Though ill-suited for the social world, theories based on ontological parsimony have been an important element in the evolution of social science. A prominent example is scientific Marxism, which treated historical evolution as a single trajectory with discrete steps. In some ways, Marx was typical of a nineteenth-century style of reasoning that sought to transpose insights from the physical world onto the social one. Elster (1987, 22) argues that his “scientism—the belief that there exist ‘laws of motion’ for society that operate with ‘iron necessity’—rested on a naive extrapolation from the achievements of natural science.”¹⁵

More often, however, ontological justifications seep into social science by mistake. For example, Hill (2012, 920) argues that “many scientists are inspired by the belief that the real world is governed by elegant laws” and urges social scientists to follow suit. Yet, this ontological-scientific basis for parsimony relies on a logic of unification and symmetry absent from the social world. Likewise, Butcher and Griffiths (2017) offer a parsimonious framework of international systems explicitly justified by Waltzian-style epistemological parsimony. Yet, elsewhere they invoke an ontological justification, describing the variations in their framework as “constitut[ing] the DNA of different systems” (Butcher and Griffiths 2017, 334.)

In sum, the ontological justification for parsimony focuses on theoretical simplicity and elegance as a reflection of the world itself. The metaphysical variant emphasizes the intrinsic elegance of the universe (and in that sense overlaps with the aesthetic justification), while the scientific variant offers reasons why parsimonious theories are a more accurate reflection of physical reality. Neither is justified in social science.

Unlike its ontological version, the epistemological dimension of parsimony makes no claim about the makeup of the world; it is to this variant that I now turn.

Epistemological Parsimony

Epistemological parsimony forms a thread across a range of social inquiry, linking the writing of scholars as diverse as Karl Popper, E.H. Carr, Max Weber, and Kenneth Waltz.¹⁶ The epistemological justification is based on two recurring themes in social science, both aimed at self-conscious simplification. The first is the idea of “theory as a map,” an instrumental approach that highlights certain features of the world in order to make sense of it. The second is the notion of parsimony as an element of causal identification, exemplified by the injunction against “kitchen-sink regressions.” These are the *cartographic* and the *empiricist* variations of epistemological parsimony, respectively.

Neither variant implies that sparse explanations are preferable—only that observation and interpretation cannot be neatly separated. Throwing more variables into a theory or more data into a model—what Nancy Fraser (2007, 320) calls “gratuitous pluralism”—prevents us from

ical analysis may offer parsimonious and powerful explanations.” Yet, even here, parsimony functions as a useful heuristic akin to the rational actor model rather than an accurate reflection of reality.

¹⁵ At Marx’s funeral, Engels proclaimed that just as Darwin “discovered the law of evolution in organic nature, so Marx discovered the law of evolution in human history” (quoted in Blackledge 2006, 32.) This trait wasn’t limited to communism; in its cruder forms, modernization theory also embraced a determinist ontology that saw political evolution as a series of discrete and even predictable stages.

¹⁶ In Jackson’s (2011) two-by-two typology of social inquiry, Carr falls into the reflexivist category, Weber and Waltz into the analytic category, and Popper into the neopositivist category. Only the remaining category of critical realism, which emphasizes causal complexity, can decisively reject parsimony.

understanding the phenomenon in question. Limiting the number of explanatory factors is therefore desirable and sometimes necessary for theoretical and methodological reasons.¹⁷ These two visions of parsimony, linked by their focus on simplicity as a constrained but crucial guide to reason, form the only viable justification for parsimony in social science. I examine each below.

Theories as Maps

The cartographic-epistemological justification argues that theories, like maps, necessarily distort and simplify in order to be useful. Maps are not accurate representations of reality. They may and in fact must omit crucial elements of the world. They introduce fictional elements like borders and exaggerate the size of key features like streets or rivers. This simplification is not a limitation of the cartographer's skill, but a way of focusing on the salient features of the landscape in order to make the map legible and functional. Maps must be parsimonious because too faithful a representation of reality would render them useless.¹⁸ "By necessity, theories make the world comprehensible by zeroing in on the most important factors," write Mearsheimer and Walt (2013, 431). "Like a theory, a map is an abridged version of reality" (ibid.).¹⁹

Key to the notion of cartographic-epistemological parsimony is the idea that explanations require generalization, and generalization requires abstraction. A theory abstracts from the world in order to make sense of it, not out of a conviction that abstraction is more elegant or more descriptively accurate. And like theories, different maps may focus on different elements of the landscape depending on their purpose. A map of soil types used by agronomists will look different than a map of hiking trails used by tourists even when covering the same small patch of countryside. Thus, a theory of democracy may focus on different factors than a theory of trade policy even when looking at the same country during the same time period.

One of the most well-known applications of this type of parsimony in modern international relations theory is Kenneth Waltz's 1979 *Theory of International Politics*. Although he does not invoke the map metaphor explicitly, Waltz adopts an instrumentalist conception of theory-creation, arguing that the goal of theory is not to reflect reality but to abstract from it in order to understand "a small number of big and important things" (Waltz 1986, 329).²⁰ As he notes, the process of theory construction cannot be led by pure empiricism. Explanatory power "is gained by moving away from 'reality,' not by staying close to it. A full description would

be of least explanatory power; an elegant theory, of most." (Waltz 1979, 7)

As a consequence, Waltz (1979, 10) argues, theories "must be constructed through simplifying." Yet this simplification is not an assumption about the world but an epistemological heuristic pursued for the sake of theory building: "[s]implifications lay bare the essential elements in play and indicate the necessary relations of cause and interdependency—or suggest where to look for them."²¹

The parsimony of a theory introduces obvious limitations, but for many kinds of social inquiry these limitations are necessary for creating useful generalizations. By creating assumptions about the world, theories enable us to make sense of data. A fluttering leaf, Waltz writes, does not negate the law of gravity, since we know that other factors like wind affect the leaf's path, and we can account for (or negate) those factors in a laboratory. Because we cannot control for intervening variables, isolate the effect of one variable upon another, or even know what the variables are, gathering more and more data sometimes leads nowhere. Since social science is a forest of falling leaves, no theory can be obtained through observing their flight. Nonarbitrary assumptions must be made, and this requires a degree of parsimony.

In the physical sciences, laws and theories are tightly connected precisely because laws allow the creation of theories—a repeated observation leads to an attempt to explain it. But because there are no laws in the social sciences, theories can only be generated "creatively," as Waltz puts it, meaning by stating some (nonarbitrary, of course) assumptions and seeing if they hold up through creating testable hypotheses.

As Henri Poincaré (1902) put it, "[s]cience is built up with facts, as a house is with stones. But an accumulation of facts is no more a science than a heap of stones is a house."²² Since we do not know which facts may be important, we cannot use facts to refine theories. Organizing principles are needed to consider the facts, which in turn requires a degree of parsimony and generalization—not as a concession to elegance or to reality, but to complexity itself.²³

In international relations, grand theories or paradigms possess a parsimonious set of axiomatic assumptions, which presents both advantages and drawbacks. As Levine and Barder (2014, 868) put it, these are "enabling assumptions about the world that necessarily elide and simplify so as to allow theorists to say useful things about it." Though Waltz (1979) offers one well-known example of cartographic parsimony, this justification is invoked, implicitly or otherwise, in any theory that seeks generalization through abstraction. Jackson (2011, 151) points out that this approach is widespread in international politics—in explanations of security communities, network analyses, the study of discourses, world-systems theory, and "any approach to the study of world politics that proceeds not by proposing falsifiable hypotheses . . . [but] by postulating an ideal-typical account of a process or setting and then utilizing that

¹⁷ Carr ([1961] 1990, 11), for example, echoes Waltz in critiquing the empiricist separation of fact and theory: "It used to be said that facts speak for themselves. This is, of course, untrue. The facts speak only when the historian calls on them."

¹⁸ This problem is summarized in the Jorge Luis Borges story "On Exactitude in Science," in which a map the size of the empire is made worthless by its accuracy.

¹⁹ Similarly, Clarke and Primo (2007, 42) argue that it "does not make sense to ask whether maps are true or false any more than it makes sense to ask if other physical objects—tea kettles, toy airplanes, or gas grills—are true or false. Maps are partial; they represent some features of the world and not others, and they are of limited accuracy." See also Hesse (1963).

²⁰ As Kurki (2008, 111) argues, for Waltz theories "do not necessarily reflect, or need to assume, the existence of an underlying reality: theory idealizes, abstracts, and isolates a real of empirical phenomena for instrumental purposes." Similarly, Jackson (2011, 113) notes that "Waltz maintains a distinctly instrumental view of theoretical constructs; theory does not reveal real-but-unobservable components of the world, but instead provides a set of more or less helpful idealizations or oversimplifications that can be used to order the complex chaos of empirical reality into more comprehensible and manageable forms."

²¹ In this respect Waltz mirrors Weber's "ideal-typification" approach. "Waltz's international system is neither a descriptive reality nor are his units concrete realities," note Goddard and Nexon (2005, 24).

²² Similarly, Stanley Hoffmann (1959, 348) writes: "Collecting facts is not enough . . . [I]t is not helpful to gather answers when no questions have been asked first."

²³ In the short story "Funes the Memorious," Borges ([1944] 1962, 66) describes a man with an infinitely capacious memory who, despite his gift, "was not very capable of thought. To think is to forget a difference, to generalize, to abstract." Funes had a real-life counterpart in Solomon Shereshevsky (1886–1958), a Soviet journalist and mnemonist-savant with a fantastically precise memory but difficulty with abstract concepts (Luria 1968).

ideal type to organize empirical observations into systematic facts.”

In sum, the cartographic-epistemological conception of parsimony emphasizes the creation of generalizable explanations. Since generalization requires focusing on certain elements while ignoring others, abstraction is a necessary side effect. The knowledge produced by explanatory approaches “achieves political relevance by distancing itself—through theorizing—from the particularities of politics” (Jahn 2017, 64). Despite the loss of information, this abstraction is often required for a theory to move beyond *ad hoc* description.²⁴

Parsimony and Causal Inference

The second epistemological justification for parsimony emphasizes inductive causal inference and hypothesis testing rather than deductive theory building. It stems, however, from the same concern: parsimony is required to sort through the world’s complexity. Namely, parsimony is needed if hypotheses can be properly tested, especially when the data is noisy or incomplete. As Pearl (2000, 46) writes, parsimonious theories “are more constraining and thus more falsifiable; they provide the scientist with less opportunities to overfit the data ‘hindsightedly’ and therefore command greater credibility if a fit is found.”²⁵

In statistical analysis, unparsimonious or “kitchen-sink” regressions employ a long list of possible influences associated with the dependent variable. Schrodtt (2014, 288) describes these as the first “sin” of modern statistical analysis. Parsimonious models, Schrodtt (2014, 288) argues, “have an edge” because they avoid fitting the error and minimize collinearity. As Achen (2002, 2005) notes, in the absence of a theory justifying the inclusion of these variables, such methods can lead to data-mining and spurious correlations.²⁶

The empiricist dimension of epistemological parsimony places limits on the “garden-of-forking-paths” approach criticized by Gelman and Loken (2014). As the number of variables increases, they note, so does the number of potential comparisons, so even researchers not seeking to *p*-hack may stumble into false positives.²⁷ Parsimonious models decrease the risk of these problems.

In short, epistemological-empiricist parsimony is a key component of positivist statistical methodology and as such plays an important role in international relations approaches that focus on hypothesis testing as part of generalizable explanatory theories.

The Uses and Limits of Epistemological Parsimony

The cartographic and empiricist dimensions of epistemological parsimony both focus on stylized assumptions as a guide to the logic of inquiry. Both suggest that social science ought to minimize the number of explanatory assumptions for the sake of theory creation and hypothesis testing. In the latter

case, parsimony is needed to avoid spurious statistical conclusions; in the former, to advance beyond *ad hoc* description into useful generalization. For both approaches, parsimony is a way of dealing with complexity and contingency.

Yet these variants are sufficiently distinct to have caused disagreements among their respective proponents. For example, while both Waltz and Popper embrace epistemological parsimony, they take two very different paths to the same destination. These differences are useful for highlighting the uses of epistemological parsimony.

Popper favors epistemological parsimony for its empirical advantages. “Simple statements,” he writes, “are to be prized more highly than less simple ones *because they tell us more; because their empirical content is greater; and because they are better testable*” (Popper 1959, 142, original emphasis).²⁸ Waltz, however, explicitly rejects Popperian falsificationism (dubbing it “barren”), since theories can only be superseded rather than falsified outright Waltz (1979, 11). If for Popper parsimony is primarily a tool of theory-testing, desirable because parsimonious theories are easier to falsify, for Waltz parsimony is primarily a tool of theory building. And if Popper makes falsification too easy by invoking a single black swan, Waltz makes falsification nearly impossible because no number of black swans can overturn a theory in the absence of a better explanation.

Waltz adopts parsimony because simplifying assumptions are necessary for his “theory-as-a-map” approach to creative theorizing. Popper does so because for him parsimonious theories are more empirically rich and easier to test (and thus to discard). Counterintuitively, both Waltzian and Popperian justifications for parsimony are grounded in epistemological claims, in the sense that they seek self-conscious simplification in order to make sense of the world.

This approach forms a common element of social science theorizing. For Lakatos (1970), for example, the “hard core” of a theory is a set of unfalsifiable axioms that are then used to generate auxiliary hypotheses. For a Lakatosian research program, the validity of these parsimonious assumptions rests on their ability to generate a progressive research program (Moravcsik 2003).

Kuhn (1962) sees “normal science” as a process in which scientists accept certain axiomatic assumptions without seeking to falsify them with every experiment.²⁹ These background assumptions allow gradual progress, but also lead to the entrenchment of stylized assumptions—the mutation of epistemological parsimony into ontological parsimony—which then require scientific revolutions to be overturned. For Kuhn, the parsimony of normal science acts as a type of communal shorthand that permits incremental research and testing, but can also ossify.

Similarly, Weber’s notion of “ideal types” is a clear expression of epistemological-cartographic parsimony. Ideal types, notes Jackson (2017, 82), are “nothing like pictorial representations of objects or processes; they are more like deliberate caricatures or partial sketches.” In that sense, ideal types

²⁴ A theory that “needs to make up a special explanation for each new circumstance,” writes Bueno de Mesquita (2014, 59), “is no explanation at all.”

²⁵ Sober (2015), for example, offers three justifications for parsimony, all of them variants of the empiricist-epistemological variety. He argues that parsimonious theories are sometimes more likely to be true, more likely to be supported by the observations, and can improve a model’s predictive accuracy.

²⁶ Achen (2002, 424) defines such “garbage-can regressions” as “long lists of independent variables” that are “tossed helter-skelter into canned linear regression packages.”

²⁷ Jeffreys (1983, 9) includes parsimony as one of his eight rules of probability, since by minimizing the “number of postulates we thereby minimize the number of acts of apparently arbitrary choice.” See also Mayo (1996).

²⁸ Complicated theories lead to the profusion of *ad hoc* hypotheses that mark them, in Lakatosian terms, as degenerative research programs. Kaplan (1964, 318) characterizes Popper’s stance as: “the more complicated the theory the less it says, for the harder it is to falsify.”

²⁹ While Kuhnian notion of paradigms may be wholly inapplicable to social science (see, e.g., Jackson and Nexon 2009, 97), debates about their uses and merits continue. McCourt (2016, 476) notes that paradigms have a social dimension, “enabling scholars to situate their work, and be situated by others, in the complex epistemic fabric” of international relations. Here the epistemological parsimony of paradigms may act as a common language of scientific discourse, offering a shared basis of communication (though with well-known costs).

are not reflections of the world but a pragmatic and instrumental simplification of it. “Whatever their mode of empirical anchorage,” argues Kaplan (1964, 83), they “do not simply mirror reality, but perform a service in our dealings with it.”

In its instrumental idealization, Waltzian parsimony likewise employs Weberian ideal types to study the world (Jackson (2011, 114; LaRoche and Pratt 2018). These ideal types “cannot be falsified as one would falsify a hypothesis,” argues Jackson (2017, 83, 84), and can only be evaluated “pragmatically,” that is, by whether they tell us something useful about the world.

As a result, the epistemological variant of parsimony—parsimony as a stylized assumption for the sake of theory creation and hypothesis testing—is an important element in modern international relations theory and in political science more broadly. Unlike the aesthetic and ontological variants, epistemological parsimony is an important though far from universal element of social science theory.

Critics of parsimony, however, often fail to separate the three justifications. In their widely read volume on causal inference, King, Keohane, and Verba (1994, 20) argue that parsimony is “a judgment, or even assumption, about the nature of the world: it is assumed to be simple.” As a result, “we should never insist on parsimony as a general principle of designing theories” (ibid.).

But in defining parsimony as an assumption about the world, the authors confuse the ontological and epistemological dimensions of parsimony.³⁰ These two dimensions are not merely distinct but incompatible. If the ontological variant assumes the world is simple, the epistemological variant assumes the world is complex and uses parsimony as a way to deal with this complexity. In fact, theory must be simple *because* the world is complex—induction is rarely sufficient. The epistemological conception of parsimony rejects pure empiricism, since facts alone cannot be a guide to theory, especially when there is an abundance of facts to choose from. As a result, one cannot treat parsimony “as a mysterious law of nature” whose usefulness “is an entirely empirical proposition” (King and Powell 2008, 5).³¹

Competing notions of parsimony are also embedded in debates about the “end of theory” and the merits of paradigms in international relations. Calls to abandon the “big paradigms” often reference the trade-off between parsimony and descriptive accuracy.³² Grand theories are criticized for being excessively parsimonious, and the turn to midrange, puzzle-based research is presented as a necessary rejection of such sterile simplicity.

For example, Bennett (2013, 467) notes that “a loss of parsimony” is “one of the main costs” of a shift from grand paradigms to causal mechanisms. However, “this is a trade-off most IR scholars have proven willing to make. The isms are parsimonious, but as a consequence they are highly indeterminate.” Similarly, making a case for analytic eclecticism, Sil and Katzenstein (2010a, 412) argue that it “gener-

ates complex causal stories that forgo parsimony in order to capture the interactions among different types of causal mechanisms.”

Yet generalization, in the sense of abstraction from particularities, is still the dominant method in midlevel theoretical approaches. Approaches that reject grand theory preserve epistemological parsimony by focusing on recurring causal mechanisms that produce robust explanations. Despite their acceptance of complexity, midlevel theories seek “contingent generalizations” (George and Bennett 2005, 235) that specify under what conditions independent variables “behave in specified conjunctions or configurations to produce effects on specified dependent variables.”

Proponents of midlevel theory critique the ontological reification of epistemological assumptions embedded in grand theories (see, e.g., Lake 2013), but in doing so they do not abandon parsimony. A midlevel theory that maximized empirical accuracy with a different explanation for each outcome would rightly be dismissed as ad hoc description. For grand theories, axiomatic assumptions act as a stylized and unfalsifiable hard core that allows the formulation of useful questions. By contrast, midlevel theory retains epistemological parsimony by employing the tools of abstraction and generalization to highlight recurrent causal mechanisms (Jackson and Nexon 2013, 549; Reus-Smit 2013).

Despite the advantages of epistemological parsimony, not all approaches demand explanatory generalization. Context-sensitive, historicist approaches explicitly sacrifice parsimony for the sake of detail, contingency, and descriptive richness. More radical post-structural views dispense with the notion of causal theory altogether. Scholars like Ashley and Walker (1990, 268), for example, consciously refuse to be “seduced . . . into abstractly theoretical discussions or self-enclosing simulations of idealized realities.”

Epistemological parsimony is therefore especially suited for problem-solving or explanatory theory that seeks to make generalizable statements about the world (Cox 1981; Hollis and Smith 1991; Dunne, Hansen, and Wight 2013). Yet, having to abstract from reality does not absolve theories from the responsibility of acting as a useful guide to that reality. Even accepting the premise of theories as maps, approaches using epistemological parsimony can still omit salient features of the landscape or misplace important landmarks. Here, however, the debate becomes not about the value of parsimony but about the acceptable range of trade-offs imposed by parsimonious assumptions.³³

In his essay *Against Parsimony*, Albert Hirschman (1985, 7) argued that some widespread parsimonious assumptions—such as the rational actor assumption in classical economics—can be misleading or even dangerous. Besides producing theoretical rigidity, they lead economists to mistake simplified models for reflections of the real world. Repeated often enough, the epistemological assumption takes on the appearance of ontological truth.

Disaggregating the three justifications also highlights the limits of Hirschman’s critique. Seen in this light, his argument is not against parsimony as a whole but against the common and tempting conflation of ontological and epistemological parsimony.

Similarly, critics of grand theories sometimes accuse its practitioners of mistaking the map for the territory. In the case of realism, for example, this means treating analytical constructs like “anarchy” as if they were a descriptive

³⁰ Longino, similarly, criticizes parsimony because “we have no a priori reason to think the universe simple” (1997, 24). As she notes in a later work, “[t]he theoretical virtue of simplicity itself involves substantive assumptions—that is, the assumption that the world is simple” (2002, 185). The conflation also occurs in the natural sciences. For example, an article in *Science* (Oreskes, Schrader-Frechette, and Belitz 1994) calls Ockham’s razor “an entirely metaphysical assumption,” noting “[t]here is scant empirical evidence that the world is actually simple.”

³¹ King, Keohane, and Verba (1994, 20) make a similar mistake in arguing that “theory should be just as complicated as all our evidence suggests.”

³² Here I use Lake’s (2013) term “midlevel theory” as shorthand for a variety of related puzzle-driven approaches that reject grand theory in favor of analytic eclecticism, microfoundations, and causal mechanisms. See also Sil and Katzenstein (2010b); Finnemore and Goldstein (2013, 6).

³³ Hence the critique that neorealism goes too far in its embrace of parsimony, producing a theory too sparse to account for historical change (see for example Buzan and Little 2009; Donnelly 2012).

representation of the world. As Waltz (1979, 153) himself warns, “[t]ransmuting concepts into realities and endowing them with causal force is a habit easily slipped into.”³⁴ Theorists “tend to forget the artificiality of the simplifying assumptions on which their grand theories are predicated,” write Levin and Barder (2014, 869). “Over time, the maps become more than a guide through which a complicated and essentially indeterminate world is disclosed; they come, rather, to be conflated with that world” (ibid.). As with Hirschman, the critique here is not against parsimony as such, but against the blurring of its ontological and epistemological variants.

Conclusion

Hidden assumptions about the meaning of parsimony shape many debates about the construction of theory. Rejecting parsimony by claiming the world is too inelegant or too complex ignores the distinctions embedded in this concept. At the same time, claiming that theories ought to contain a measure of elegance or mistaking a theory’s assumptions for a description of the world are both common errors that stem from an unreflective embrace of parsimony.

The benefits of parsimony are real but limited. In its acknowledgment of inelegance and complexity, epistemological parsimony acts as an informed concession to ignorance. Using stylized assumptions to make sense of the world, it treats simplification as a precarious but sometimes necessary guide to reason.

As a result, for common types of social inquiry—namely, explanatory theory that emphasizes generalization and causal inference—parsimony is a key element of theory building and hypothesis testing.³⁵ But because epistemological parsimony represents the outcome of a painful trade-off, even successful theories are disadvantaged by abstracting from the world they seek to explain.³⁶

From this perspective, parsimony is best seen as a necessary evil rather than an intrinsic virtue. In his key work *Capital, Coercion, and European States*, Charles Tilly strikes an apologetic note for his use of parsimonious simplification. “In the interests of compact presentation,” he writes, “I will likewise resort to metonymy and reification on page after page.”³⁷ Despite the shortcomings of these simplifications, he notes, the argument would not be possible without them; “[w]ithout a simplifying model employing metonymy and reification,” Tilly (1990, 34) writes, “we have no hope of identifying the main connections in the process of European state formation.”

Metonymy, reification, simplification—these are often essential elements of theory. To the extent that theorizing

demands abstraction, judgments about theoretical assumptions are also judgments about the appropriateness of parsimony. For many kinds of theories, complexity for the sake of accuracy is antithetical to the task of theory creation. As Healy (2017, 119) argues, unreflective pursuit of nuance is “fundamentally antitheoretical. It blocks the process of abstraction on which theory depends, and it inhibits the creative process that makes theorizing a useful activity.”

The artifice of theory is both an advantage and a constraint. As Whitehead (1919, 143) argued a century ago, the guiding principle for scientists should be “to seek simplicity and distrust it.” The application of parsimony therefore requires both boldness and humility—the boldness of simplifying assumptions and the humility to recognize them as such.

References

- ACHEN, CHRISTOPHER. 2002. “Toward a New Political Methodology: Micro-foundations and Art.” *Annual Review of Political Science* 5: 423–50.
- . 2005. “Let’s Put Garbage Can Regressions and Garbage Can Probits Where They Belong.” *Conflict Management and Peace Science* 22 (4): 327–39.
- ASHLEY, RICHARD, AND R.B.J. WALKER. 1990. “Introduction: Speaking the Language of Exile.” *International Studies Quarterly* 34 (3): 259–68.
- BENNETT, ANDREW. 2013. “The Mother of All Isms: Causal Mechanisms and Structured Pluralism in International Relations Theory.” *European Journal of International Relations* 19 (3): 459–81.
- BLACKLEDGE, PAUL. 2006. *Reflections on the Marxist Theory of History*. Manchester: Manchester University Press.
- BORGES, JORGE LUIS. (1944) 1962. “Funes the Memorious.” In *Labyrinths: Selected Stories and Other Writings*, edited by Donald Yates and James Irby. 59–66. New York: New Directions Publishing.
- BUENO DE MESQUITA, BRUCE. 2014. *Principles of International Politics*. 5th ed. Thousand Oaks, CA: Sage Press.
- BUTCHER, CHARLES R., AND RYAN D. GRIFFITHS. 2017. “Between Eurocentrism and Babel: A Framework for the Analysis of States, State Systems, and International Orders.” *International Studies Quarterly* 61 (2): 328–36.
- BUZAN, BARRY, AND RICHARD LITTLE. 2009. “Waltz and World History: The Paradox of Parsimony.” *International Relations* 23 (3): 446–63.
- CARR, E.H. (1961) 1990. *What Is History?* 2nd ed. London: Penguin.
- CARTWRIGHT, NANCY. 1983. *How the Laws of Physics Lie*. Oxford: Oxford University Press.
- CLARKE, KEVIN A., AND DAVID PRIMO. 2007. “Modernizing Political Science: A Model-Based Approach.” *Perspectives on Politics* 5 (4): 741–53.
- COX, ROBERT W. 1981. “Social Forces, States and World Orders: Beyond International Relations Theory.” *Millennium* 10 (2): 126–55.
- DAFOE, ALLAN, JOHN R. ONEAL, AND BRUCE RUSSETT. 2013. “The Democratic Peace: Weighing the Evidence and Cautious Inference.” *International Studies Quarterly* 57 (1): 201–14.
- DEUTSCH, DAVID. 2011. *The Beginning of Infinity: Explanations That Transform the World*. New York: Penguin.
- DONNELLY, JACK. 2012. “The Elements of the Structures of International Systems.” *International Organization* 66 (4): 609–43.
- DUNNE, TIM, LENE HANSEN, AND COLIN WIGHT. 2013. “The End of International Relations Theory?” *European Journal of International Relations* 19 (3): 405–25.
- ELSTER, JON. 1987. *An Introduction to Karl Marx*. New York: Cambridge University Press.
- EPSTEIN, CHARLOTTE. 2013. “Who Speaks? Discourse, the Subject and the Study of Identity in International Politics.” *European Journal of International Relations* 17 (2): 327–50.
- FARMELO, GRAHAM. 2002. *It Must Be Beautiful: Great Equations of Modern Science*. London: Granta Books.
- FINNEMORE, MARTHA, AND JUDITH GOLDSTEIN. 2013. “Puzzles about Power.” In *Back to Basics: State Power in a Contemporary World*, edited by Martha Finnemore and Judith Goldstein, 3–17. New York: Oxford University Press.
- FRASER, NANCY. 2007. “Identity, Exclusion, and Critique.” *European Journal of Political Theory* 6 (3): 305–38.
- GEDDES, BARBARA. 1995. “The Politics of Economic Liberalization.” *Latin American Research Review* 30 (2): 195–214.

³⁴ While the “aim of science is to seek the simplest explanation of complex facts,” writes Alfred North (1919, 143), in pursuing this we “are apt to fall into the error of thinking that the facts are simple because simplicity is the goal of our quest.”

³⁵ In the more general sense of avoiding superfluous assumptions, the benefits of parsimony extend beyond explanatory approaches and into many strands of social science theory. Epstein (2013, 327, 345), for example, describes discourse theory as “more theoretically parsimonious” than constructivist or psychological approaches, since it “does not harbor any of the indemonstrable assumptions about these actors’ selves” that have haunted IR theory.”

³⁶ As North and Willard (1983, 340) note, while “a lack of parsimony often yields amorphous theory, an excess of parsimony may produce tautology, explain the obvious, or . . . reduce complex human interactions to rigid, almost mechanical abstractions.”

³⁷ For Tilly (1990, 34), metonymy and reification are examples of parsimonious simplification: “Metonymy, in that cities actually stand for regional networks of production and trade in which the large settlements are focal points. Reification, in that I will time and again impute a unitary interest, rationale, capacity, and action to a state, a ruling class, or the people subject to their joint control.”

- GELMAN, ANDREW, AND ERIC LOKEN. 2014. "The Garden of Forking Paths." Unpublished manuscript.
- GEORGE, ALEXANDER, AND ANDREW BENNETT. 2005. *Case Studies and Theory Development in the Social Sciences*. Cambridge, MA: MIT Press.
- GODDARD, STACIE, AND DANIEL NEXON. 2005. "Paradigm Lost? Reassessing Theory of International Politics." *European Journal of International Relations* 9 (1): 9–61.
- GUIMARÃES, KATIA, RAJA JOTHI, ELENA ZOTENKO, AND TERESA PRZYTYCKA. 2006. "Predicting Domain-Domain Interactions Using a Parsimony Approach." *Genome Biology* 7 (11):R104.
- GUNITSKY, SEVA. 2013. "Complexity and Theories of Change in International Politics." *International Theory* 5 (1): 35–63.
- HACKING, IAN. 1991. "A Tradition of Natural Kinds." *Philosophical Studies* 61 (1/2): 109–26.
- . 1995. *Rewriting the Soul*. Princeton, NJ: Princeton University Press.
- HEALY, KIERAN. 2017. "Fuck Nuance." *Sociological Theory* 35 (2): 118–27.
- HESSE, MARY. 1963. *Models and Analogies in Science*. London: Sheed and Ward.
- HILL, KIM QUAILL. 2012. "In Search of General Theory." *Journal of Politics* 74 (4): 917–31.
- HIRSCHMAN, ALBERT O. 1985. "Against Parsimony: Three Easy Ways of Complicating Some Categories of Economic Discourse." *Economics and Philosophy* 1 (1): 7–25.
- HOFFMANN, STANLEY H. 1959. "International Relations: The Long Road to Theory." *World Politics* 11 (3): 346–77.
- HOLLIS, MARTIN, AND STEVE SMITH. 1991. *Explaining and Understanding International Relations*. New York: Oxford University Press.
- HUEMER, MICHAEL. 2008. "When Is Parsimony a Virtue?" *Philosophical Quarterly* 59 (235): 216–36.
- HUXLEY, THOMAS. (1870) 1894. "Presidential Address At the British Association, 'Biogenesis and Abiogenesis.' Republished." In *Collected Essays*, Vol. 8. <http://aleph0.clarku.edu/huxley/CE8/>.
- JACKSON, PATRICK THADDEUS. 2011. *The Conduct of Inquiry in International Relations*. New York: Routledge.
- . 2017. "The Production of Facts: Ideal-Typification and the Preservation of Politics." In *Max Weber and International Relations*, edited by Richard Ned Lebow, 79–96. New York: Cambridge University Press.
- JACKSON, PATRICK THADDEUS, AND DANIEL H. NEXON. 2009. "Paradigmatic Faults in International-Relations Theory." *International Studies Quarterly* 53 (4): 907–30.
- . 2013. "International Theory in a Post-Paradigmatic Era: From Substantive Wagers to Scientific Ontologies." *European Journal of International Relations* 19 (3): 543–65.
- JAHN, BEATE. 2017. "Theorizing the Political Relevance of International Relations Theory." *International Studies Quarterly* 61 (1): 64–77.
- JEFFREYS, R.C. 1983. *The Logic of Decision*. 2nd ed. Chicago: University of Chicago Press.
- JERVIS, ROBERT. 1997. *System Effects: Complexity in Political and Social Life*. Princeton, NJ: Princeton University Press.
- KAKU, MICHIO. 1994. *Hyperspace: A Scientific Odyssey Through Parallel Universes, Time Warps, and the Tenth Dimension*. New York: Anchor Books.
- KANE, GORDON. 2000. *Supersymmetry*. Cambridge, MA: Perseus Publishing.
- KAPLAN, ABRAHAM. 1964. *The Conduct of Inquiry: Methodology for Behavioral Science*. San Francisco, CA: Chandler.
- KING, GARY, AND ELEANOR NEFF POWELL. 2008. "How Not to Lie Without Statistics." Unpublished manuscript.
- KING, GARY, ROBERT KEOHANE, AND SIDNEY VERBA. 1994. *Designing Social Inquiry: Scientific Inference in Qualitative Reasoning*. Princeton, NJ: Princeton University Press.
- KUHN, THOMAS. 1962. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
- KURKI, MIJLA. 2008. *Causation in International Relations: Reclaiming Causal Analysis*. New York: Cambridge University Press.
- LAKATOS, IMRE. 1970. "The Methodology of Scientific Research Programmes." In *Criticism and the Growth of Knowledge*, edited by Imre Lakatos and Alan Musgrave, 91–196. Cambridge: Cambridge University Press.
- LAKE, DAVID A. 2011. "Why 'isms' Are Evil: Theory, Epistemology, and Academic Sects As Impediments to Understanding and Progress." *International Studies Quarterly* 55 (2): 465–80.
- . 2013. "Theory is Dead, Long Live Theory: The End of the Great Debates and the Rise of Eclecticism in International Relations." *European Journal of International Relations* 19 (3): 567–87.
- LA ROCHE, CHRISTOPHER, AND SIMON PRATT. 2018. "Kenneth Waltz is Not a Realist (and Why that Matters)." *European Journal of International Relations* 24 (1): 153–76.
- LEIBNIZ, G.W. (1686) 1989. "Discourse on Metaphysics." In *Philosophical Papers and Letters: A Selection*, edited by Leroy Loemker. Dordrecht, Netherlands: Kluwer Academic Publishers.
- LEVI, MARGARET. 1997. *Consent, Dissent, Patriotism*. New York: Cambridge University Press.
- LEVINE, DANIEL J., AND ALEXANDER D. BARDER. 2014. "The Closing of the American Mind: 'American School' International Relations and the State of Grand Theory." *European Journal of International Relations* 20 (4): 863–88.
- LONGINO, HELEN. 1997. "Feminist Epistemology as a Local Epistemology." *Proceedings of the Aristotelian Society, Supplementary Volumes* 71: 19–54.
- . 2002. *The Fate of Knowledge*. Princeton, NJ: Princeton University Press.
- LURIA, ALEKSANDR. 1968. *The Mind of a Mnemonist*. Cambridge, MA: Harvard University Press.
- MAC KAY, DAVID. 1992. "Bayesian Interpolation." *Neural Computation* 4 (3): 415–47.
- MAYO, DEBORAH. 1996. *Error and the Growth of Experimental Knowledge*. Chicago: University of Chicago Press.
- MCCOURT, DAVID. 2016. "Practice Theory and Relationism as the New Constructivism." *International Studies Quarterly* 60 (3): 475–85.
- MEARSHEIMER, JOHN, AND STEPHEN WALT. 2013. "Leaving Theory Behind: Why Simplistic Hypothesis Testing is Bad for International Relations." *European Journal of International Relations* 19 (3): 427–57.
- MONTANO, ULIANOV. 2013. *Explaining Beauty in Mathematics: An Aesthetic Theory of Mathematics*. New York: Springer.
- MORAVCSIK, ANDREW. 2003. "Liberal International Relations Theory: A Scientific Assessment." In *Progress in International Relations Theory: Appraising the Field*, edited by Colin Elman and Miriam Fendius Elman, 159–204. Cambridge: MIT Press.
- NEWTON, ISAAC. 1687. *Mathematical Principles of Natural Philosophy*. Accessed March 8, 2109, <https://archive.org/details/newtonspmathema00newtrich>.
- NORTH, ROBERT, AND MATTHEW WILLARD. 1983. "The Convergence Effect: Challenge to Parsimony." *International Organization* 37 (2): 339–58.
- O'LEARY, MAUREEN. 1999. "Parsimony Analysis of Total Evidence from Extinct and Extant Taxa and the Cetacean-Artiodactyl Question." *Cladistics* 15 (3): 315–30.
- ORESKE, NAOMI, KRISTIN SCHRADER-FRECHETTE, AND KENNETH BELITZ. 1994. "Verification, Validation, and Confirmation of Numerical Models in the Earth Sciences." *Science* 263 (5147): 641–46.
- PEARL, JUDEA. 2000. *Causality: Models, Reasoning, and Inference*. New York: Cambridge University Press.
- POINCARÉ, HENRI. 1902. *Hypothesis and Science*. Accessed March 8, 2109, <https://www.gutenberg.org/files/37157/37157-pdf.pdf>.
- POLANYI, MICHAEL. 1958 (2005). *Personal Knowledge: Toward a Post-Critical Philosophy*. London: Routledge.
- POPPE, KARL. 1959. *The Logic of Scientific Discovery*. London: Hutchinson.
- REUS-SMITH, CHRISTIAN. 2013. "Beyond Metatheory?" *European Journal of International Relations* 19 (3): 589–608.
- SCHMIDT, VIVIEN. 2007. "Bringing the State Back into the Varieties of Capitalism and Discourse Back into the Explanation of Change." Center for European Studies Working Paper Series 152.
- SCHRODT, PHIL. 2014. "Seven Deadly Sins of Contemporary Quantitative Political Analysis." *Journal of Peace Research* 51 (2): 287–300.
- SIL, RUDRA, AND PETER J. KATZENSTEIN. 2010a. "Analytic Eclecticism in the Study of World Politics." *Perspectives on Politics* 8 (2): 411–31.
- . 2010b. *Beyond Paradigms: Analytic Eclecticism in Study of World Politics*. Basingstoke: Palgrave Macmillan.
- SOBER, ELIOT. 2015. *Ockham's Razors: A User's Manual*. New York: Cambridge University Press.
- SOUZA-CHIES, TATIANA, GABRIEL BITTAR, SOPHIE NADOT, LEIGH CARTER, EVELYNE BESIN, AND BERNARD LEJEUNE. 1997. "Phylogenetic Analysis Ofiridaceae with Parsimony and Distance Methods Using the Plastid Genes." *Plant Systematics and Evolution* 204 (1/2): 109–23.

- STEWART, CARO-BETH. 1993. "The Powers and Pitfalls of Parsimony." *Nature* 361 (6413): 603.
- TILLY, CHARLES. 1990. *Coercion, Capital, and European States, AD 990–1992*. New York: Basic Blackwell.
- WALLACE, C.S., AND D.M. BOULTON. 1968. "An Information Measure for Classification." *Computer Journal* 11 (2): 185–94.
- WALT, STEPHEN. 1999. "Rigor or Rigor Mortis? Rational Choice and Security Studies." *International Security* 23 (4): 5–48.
- WALTZ, KENNETH. 1979. *Theory of International Politics*. Boston, MA: McGraw-Hill.
- . 1986. "Reflections on Theory of International Politics: A Response to My Critics." In *Neorealism and Its Critics*, edited by Robert O. Keohane, 322–45. New York: Columbia University Press.
- WEBER, MAX. 1949. *The Methodology of the Social Sciences*, edited by Edward A. Shils and Henry A. Finch. New York: Free Press.
- WENDT, ALEXANDER. 1998. "On Constitution and Causation in International Relations." *Review of International Studies* 24 (5): 101–17.
- . 2015. *Quantum Mind and Social Science: Unifying Physical and Social Ontology*. New York: Cambridge University Press.
- WHITEHEAD, ALFRED NORTH. 1919. *The Concept of Nature*, Accessed March 8, 2109, <http://www.gutenberg.org/files/18835/18835-h/18835-h.htm>.
- YANG, C.N. 1957. *The Law of Parity Conservation and Other Symmetry Laws of Physics*, Accessed March 8, 2109, <https://www.nobelprize.org/uploads/2018/06/yang-lecture.pdf>.
- ZEE, ANTHONY. 1999. *Fearful Symmetry: The Search for Beauty in Modern Physics*. Princeton, NJ: Princeton University Press.