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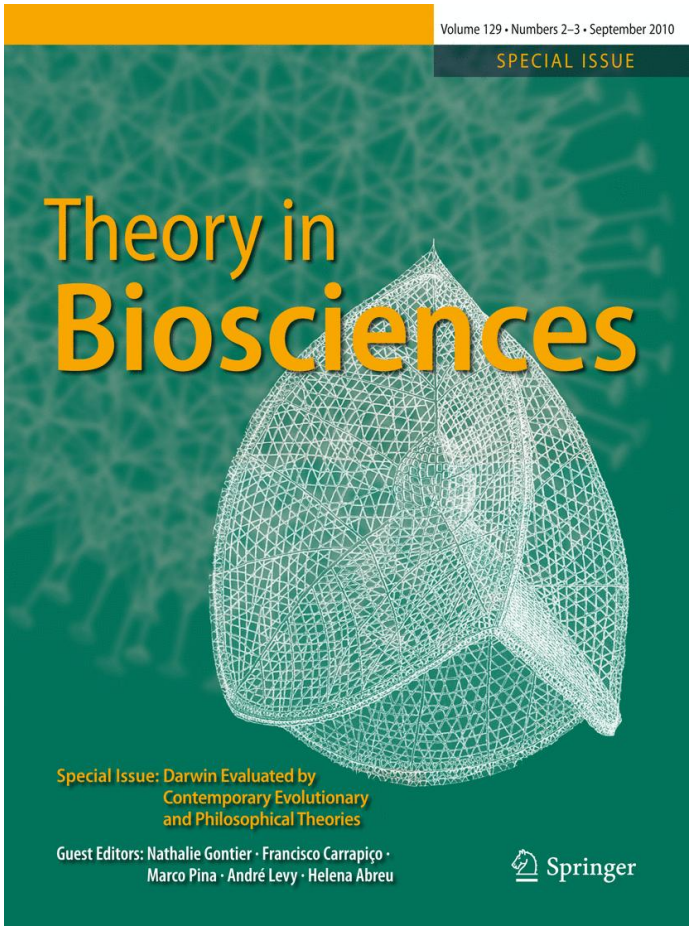

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ORIGINAL PAPER

Taking evolution seriously in political science

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Abstract In this essay, we explore the epistemological and ontological assumptions that have been made to make political science "scientific." We show how political science has generally adopted an ontologically reductionist philosophy of science derived from Newtonian physics and mechanics. This mechanical framework has encountered problems and constraints on its explanatory power, because an emphasis on equilibrium analysis is ill-suited for the study of political change. We outline the primary differences between an evolutionary ontology of social science and the physics-based philosophy commonly employed. Finally, we show how evolutionary thinking adds insight into the study of political phenomena and research questions that are of central importance to the field, such as preference formation.

Keywords Philosophy of science · Evolutionary theory · Complex adaptive systems · Behavioralism · New institutionalisms

Introduction

> *What we lack is a dynamic theory, one that endogenizes the mechanisms of transformation*. Margaret Levi 2006 American Political Science Association: Presidential Address.

In recent years, there has been an explosion of interest in evolutionary theory in wide variety of scientific domains. In fields as diverse as computer science, philosophy, economics, sociology, psychology, biology, and anthropology "evolutionary thinking" (Dennett 1995) has come to the forefront of the disciplines. While some social scientists have long been interested in applying evolutionary theories to social systems,[1] a surprisingly small number of political scientists have examined these theories' implications for political and institutional development.[2] We suggest that the resistance to evolutionary theory is the indirect consequence of basic epistemological commitments made by the founders of political science as a discipline in the mid-twentieth century. This followed a long line of philosophers such as Descartes, Kant, and Kuhn, who all believed that the mathematical reductionism exemplified by Physics represented the most advanced form of science. During their search for scientific foundations in the 20th century, political scientists adopted a similar philosophy which promoted the idea of a collective scientific enterprise to uncover the "laws" of politics.

In this essay, we first explore the epistemological and ontological assumptions made to make political science to be "more scientific." Next, we show how this mechanical framework has encountered problems and constraints on its explanatory power arguing that the emphasis on equilibrium analysis is ill-suited for the study of political change.

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[1] See (Veblen 1898; Schumpeter 1934; Spencer and Peel 1972; Boulding 1981).

[2] There is growing interest in applying evolutionary theories in political science as well. See (Axelrod 1984; Masters 1989; Axelrod 1997; Somit and Peterson 1998; Thayer 2000; Blank and Hines 2001; Alford and Hibbing 2004; McDermott 2004; Alford et al. 2005; Modelski 2007; Fowler et al. 2008; Fowler and Dawes 2008, McDermott et al. 2008).

Third, we outline the primary differences between an evolutionary ontology of social science and the physics-based philosophy commonly employed in political science. Finally, we show how evolutionary thinking adds insight into the study of political phenomena and research questions that are of central importance in political science, such as preference formation.

Physics and philosophy of science in political science

As a discipline, political science has often looked to other fields for insight. Nowhere is this more evident than in the ongoing debates about exactly what kind of "science" political science should be. The debate within the field during the last century has been the outgrowth of broader historical debates on the philosophy of social science. Gilbert and Ahrweiler (2009) characterize this debate as one between "rationalism" and "empiricism." Rationalists emphasized mathematics and the human capacity for deductive reasoning, and generally argued that "starting from axiomatic principles, we can extend our knowledge to yield theoretical systems." (p. 13). In contrast, empiricism argued that only by investigating the particulars of a case and the historical process can one actually gain knowledge.

This ongoing philosophical debate informed the discussion of the scientific foundations of political science in the 20th century. As disciplinary historian James Farr (1995) highlights, behavioralism was the outgrowth of a much broader intellectual movement in the social sciences, the intellectual thrust of which was to "study political behavior according to the canons of scientific methodology." (p. 201). Over time, the kind of study that was considered to be more scientific was ontologically reductionist and deductive in nature. This dominant scientific "paradigm" emerged from debates during the "behavioral revolution" in the 1950s and 1960s. The main pillar of this revolution was "a methodological plea for science." (Farr 1995, p. 202). Like many other disciplines at that time, the study of Thomas Kuhn (1962) was particularly influential. Developing a historical view of science, Kuhn articulated a progressive view of scientific inquiry, whereby "paradigms" provided the baseline assumptions on which further progressive revolutions were developed. Kuhn's study was particularly influential for the behavioral revolutionaries. Gunnell (2004) points out, "During the 1960s, APSA presidential addresses by David Truman (1965) and Gabriel Almond (1966)… began to employ Kuhn's concept of paradigm in speaking broadly about the development of the discipline and the advent of behavioralism" (p. 47).

Kuhn was simply the latest in a long line of philosophers who believed that math was the basis of true scientific inquiry. Descartes viewed mathematics as the discipline most closely associated with scientific ideals (Gilbert and Ahrweiler 2009, p. 13). "Philosophers, from Bacon and Descartes to Locke and Kant, the physical sciences, and in particular mechanics, were the paradigm of science" (Mayr 1988, p. 9). The mathematical foundations of science characterized by early physics, mechanics, and astronomy, created a strong legacy under which all other discussions of science were framed. As Mayr (2004) argues, "it was quite generally ignored in discussions of science in those centuries that there were now also other sciences. Instead, these other sciences were squeezed into the conceptual framework of physics. Mathematics remained the earmark of science" (p. 167). Even after the conceptual framework of physics changed quite fundamentally during the nineteenth and twentieth centuries, "a mechanistic approach continued to dominate the philosophy of science" (Mayr 1988, p. 9).

This general argument impacted the study of politics greatly. Since the behavioral revolution, the mainstream of the discipline has adopted a science of politics rooted in this basic "ontological reductionism" characteristic of mechanistic theories. This fostered the widespread belief that politics could be distilled into fundamental laws. As Kant had argued previously, the rationalist approach allowed scientists to "discover the necessary and universally valid laws that account for the properties of the phenomenal world. Historical claims to knowledge on the other hand are particular and contingent." (Gilbert and Ahrweiler 2009, p. 15). Indeed, the rationalist perspective came to be particularly influential in political science during the behavioral revolution, where "the very aim of science, it was argued, was to discover laws or law-like generalizations that organized and explained the facts" (Farr 1995, p. 203).

This "politics as mechanics" ontology supported two other philosophical principles: reductionism and determinism. Mayr (2004) highlights that "most physicalists were reductionists. They claimed that the problem of explanation of a system was resolved…as soon as the system had been reduced to its smallest components" (p. 27). Second models of Newtonian physics were generally deterministic. It was assumed that complete knowledge of underlying processes would allow one to predict outcomes. Consequently, the search for laws generally had focused on the underlying principles of political phenomena at the micro-level of analysis. This view is often based on the assumption that identifying individual-level processes will explain aggregate outcomes. Lachapelle (2000) characterizes this general perspective as "ontological reductionism," which is defined by two philosophical principles: (1) lower-level explanations are better than higher-level ones, and (2) causation operates in a bottom-up manner (p. 334).

Epistemologically, a commitment to uncovering the "laws" of politics entailed the development of generalizable theory and scientific standards, such as prediction and

falsification. This philosophical emphasis contributed greatly to the growth of rational-choice theory (Levi 1997, p. 20). According to Walt (2000), "formal theory involves the construction of specific mathematical models intended to represent particular real-world situations and the use of mathematics to identify the specific solutions ("equilibria") of the model(s)." He argues that the popularity of these methods has grown significantly in recent years, in part because "advocates of formal rational choice approaches assert that these techniques are *inherently more scientific* than other analytic approaches [emphasis added]" (pp. 1–2). Walt states:

> Social science…relies on theory. The reason is fundamental to the drive to make social science a progressive, cumulative effort. Proving or refuting an isolated proposition has some value. However, without an overarching analytical framework that generates *complexes* of related propositions, determining the empirical validity of a particular proposition is a dead end rather than step toward cumulative knowledge (2000, p. 64).

This form of ontological reductionism can create useful heuristics at times, and its mathematical formulations do meet some of the scientific qualities found in physics, namely parsimony and logical consistency—often considered the most central criterion for scientific theories (Beuno De Mesquita and Morrow 2000). While it has proven utility in explaining certain types of research questions, this research program has not produced comprehensive laws of politics, nor has it integrated the variety of research taking place in political science. Politics has continued to be a domain of emergent novelty, with theorists and practitioners consistently failing to predict critical events, such as the end of WWII and the collapse of the Soviet Union and various economic crises (Blyth 2006). The methodological limitations of frameworks derived from ontological reductionism have become apparent. As researchers have turned to more complex research questions, such as the causes of gradual institutional change, they have found that these ontological assumptions are inadequate for explaining complex macro-level phenomena. The following section outlines these methodological problems more clearly before turning to a discussion of how the alternative scientific philosophies offered by evolutionary theory are a more appropriate scientific framework for studying political change.

Problems with a physics-based philosophy: equilibrium analysis

> [One] factor that makes the study of politics so difficult is that neither the units themselves nor their relationships are static. They change. Robert Dahl et al. (2004, p. 378)

In recent years, political scientists have focused on the problem of explaining gradual institutional change. While it is clear that institutions change all the time, the philosophy of science and methodological tools used by political scientists are better equipped for the study of equilibrium and stasis (Levi 1997). This is because social science has a long-standing bias for thinking about relationships in terms of "equilibrium" punctuated by periods of extraordinary change (Lieberman 2002). In order to create models in political science, which conform to the rigorous mathematic requirements in the hard sciences, one has to make the ontological leap that like atoms, humans follow sets of absolute and invariant laws, independent of time and space. For rationalists this entails assumptions regarding clear and stable agent preferences, yet this form of reductionism means that the theory lacks the tools necessary to explain gradual change. In this view, institutions are "self-reinforcing" and game-theoretic models privilege stability over change. As Hall and Taylor (1996) argue, and Grief and Laitin (2004) reiterate:

> "The 'equilibrium' character of the rational choice approach to institutions embroils such analysts in a contradiction. One implication of this approach is that the starting-point from which institutions are to be created is itself likely to reflect a Nash equilibrium." Endogenous institutional change appears, then, to be a contradiction in terms."[3]

The fundamental issue at stake here is one of foundational assumptions. The assumption that human preferences are fixed, stable and predictable, supports the belief that one can design methods and models that predict human social behavior. The fact that political science has been an abysmal failure in making predictions is generally seen within the field as evidence that the data are incomplete—not that the fundamental assumptions are wrong. This is because without these assumptions, the idea of fully predictive political science is impossible.

As a reaction to the impasse of the traditional institutional approach, a number of political scientists have embraced a less-reductionist ontology (Blyth 1997, Grief and Laitin 2004; McDermott 2004, Thelen 2004, Streeck and Thelen 2005, McDermott et al. 2008). This ontological shift toward greater complexity has followed a pattern of institutional drift—it is a series of ad-hoc theoretical shifts generated in the pursuit of particular research questions. As researchers have asked more complex research questions, they have become aware of the constraints of ontological reductionism.

[3] Quoted in Greif and Laitin (2004), p. 633.

The point here is not that political scientists have failed to grasp the philosophical foundations of their study. Indeed, an increasing number of political scientists have embraced an ontological position more closely aligned with evolutionary biology, and have increasingly embraced methodological tools such as process tracing and agent-based modeling that allow researchers to investigate mechanisms of change. The primary problem has been a failure to explicitly investigate the alternative philosophy of science that exists in the evolutionary sciences. Much of this resistance to the application of "generalized Darwinism" (Hodgson and Knudsen 2006, Hodgson et al. 2008) has been political. Quite understandably, there has been an ongoing aversion to the misconceptions and misappropriation of evolutionary theory as a justification for political atrocities during the 20th century. For example, the holocaust greatly influenced Karl Popper's view when he argued that evolutionary theory was not scientific, but rather a "metaphysical research program." Later on in his life, after coming to a much more nuanced understanding of modern evolutionary theory, Popper recanted his statement, finding that evolutionary theory could indeed produce generalizations and testable hypothesis. Ultimately, it greatly informed his thinking on evolutionary epistemology (Popper 1987). As Alford and Hibbing (2004) point out, many social scientists continue to see Darwinism as a world of predictably selfish individuals. Therefore, neither have a majority of scholars considered the implications of multi-level selection theory for explaining altruism, nor have social scientists explored the debates regarding the evolutionary nature of culture and institutions.

We argue that both modern evolutionary theory and political science have advanced to a point that is opportune for a productive cross fertilization of ideas. Social scientists studying complexity could benefit greatly from a serious consideration of the research agenda of "generalized Darwinism," which focuses on sources of agent variation, mechanisms of selection, and means of replication. Following Hodgson et al. (2008), we contend that the goal of this research agenda "is not to copy slavishly all ideas from the biological to the social domain. It is instead to appreciate the evolving panorama of evolutionary theory in its attempt to explore and understand this complexity" (p. 64).

Key ontological and epistemological assumptions in evolutionary theory

> [A] substantial gap has opened up between the methodologies popular in comparative politics and the ontologies the field embraces (Hall 2003, p. 374).

Political science now requires a less reductionist ontology. We submit that a step toward evolutionary thinking can open this door. At the root of evolutionary theory is the assumption that the objects of analysis—living organisms—are fundamentally different from inanimate matter. As Mayr points out, the development of biology as a science has required an investigation of "additional principles" that apply only to living organisms. He argues, "This required a restructuring of the conceptual world of science that was far more fundamental than anyone had imagined at the time" (Mayr 2004, p. 26). To the extent that social systems—the object of analysis in political science—are characterized by imperfect replication, then one should expect Darwinist, as well as other evolutionary principles to apply.

First, evolutionary theory relies on the concept of *dual causation*, meaning that behavior is a function of both genetic and environmental selection. In human societies, environmental selection has also come to include culture and institutions that shape behavior. The basic idea has been extrapolated to the social domain by Boyd and Richerson (1985, 2005a, b) who argue in favor of "dual inheritance," which posits that both biological and cultural mechanisms are important for understanding human behavior. Lachapelle (2000) highlights that "[Boyd and Richerson's] main theoretical achievement [is] ontological in nature: they have shown that culture is genuinely *evolutionary active*…this second system of inheritance can have the very same causal effect that biological evolution has, namely, to bring about changes in phenotypes" [emphasis in original] (p. 344). Given that dual inheritance acknowledges that bottom–up and top–down causation matter, this ontological foundation could reconcile long-standing conflicts between rationalist and historical institutional scholars regarding the relative importance of agency or structure. As Lachapelle (2000) argues, the "explanatory pluralism" facilitated by this foundation is ultimately "agnostic on the question of whether higher-level or lower-level explanations are better, … [and] whether causation operates in a bottom–up or top–down manner" (p. 352). Consequently, an evolutionary framework fully supports the notion that agents interact and co-evolve with their environment. While we do not address this debate here, the question of the extent to which biological or higher-level cultural and institutional factors influence behavior is an empirical question (Hodgson et al. 2008, p. 52).

Second, evolutionary theory is the study of "complex adaptive systems" (Holland 1992). This concept focuses on the importance of interaction and emergence, and attempts to understand the ways in which interactions of genes, behavior, and environment shape one another in a dynamic process. One cannot completely understand the evolutionary puzzle by reducing it to its constituent components, due

to the fact that a series of unguided interactions at the micro-level creates emergent properties at the higher levels of analysis. Just as genes at the micro-level interact to form a unique individual, individuals within a population interact to replicate institutions. The character of the whole institution is thus distinct from a simple aggregation of the constituent units. Interaction is the key aspect of a complex system, which implies that isolating factors as "independent" variables which has been one of the key rules imported into political science from mid-twentieth century versions of "the scientific method" (Popper 1987) may be an ontological fallacy. This "interactionist paradigm" provides a sound ontological foundation for explaining macro-level political outcomes that are the product of numerous interactions at lower levels of analysis.

Epistemological assumptions

This leads to an important difference in epistemological goals between the physical and biological sciences—*prediction*. Many believe that physicists, operating in a world of constant laws are able to construct fully deterministic models that can accurately predict outcomes once the underlying components are known.[4] In contrast, biologists focus much more on probabilistic assessment. Although biologists create typologies, the greater role ascribed to chance and emergence makes it very difficult to construct a fully deterministic model. Evolutionary theories articulate "mechanisms," by which consistent patterns recur, but they are generally more circumspect about defining scope conditions and probabilities, because it is often assumed that the complex interactive nature of the system may eventually cause mechanisms to change.

Finally, the important roles ascribed to chance and geographic scope conditions make evolutionary biology a historical science. Evolutionary biologists often research unique phenomena that cannot be explained by making reference to laws, nor can their causes necessarily be discovered by experimentation (Mayr 2004, p. 32). Consequently, the primary method of analysis is that of a *historical narrative* that describes the influence of historical contingency and environmental factors on outcomes. Mayr (1988) defends scientific merit of this approach in the following way:

> When asked whether or not the adaptationist program is a legitimate scientific approach, one must realize that the method of evolutionary biology is in some ways quite different from that of the physical sciences. Although evolutionary phenomena are subject to universal laws, as are most phenomena in the physical sciences, the explanation of a particular evolutionary phenomenon can be given only as a 'historical narrative.' Consequently, when one attempts to explain the features of something that is the product of evolution, one must attempt to reconstruct the evolutionary history of this feature (Mayr 1988).

Instead of accurately predicting the future, the goal of evolutionary theorists is to understand the forces and dynamics that have shaped the world as we know it. Specifically they are interested in understanding how and why species adapt, prosper, and sometimes die out. In other words, why is there variation across time and space? They do this empirically and inductively rather than deductively. Evolutionary biologists do not embrace the goal of predicting future outcomes, not because they do not have enough data, nor because their computer models are too simple, but because evolutionary theory assumes that random variation within complex systems can set development along totally new and unpredictable paths.[5] Moreover, some adaptations that work in one setting can be disastrous in others. For example, marsupials may thrive on one continent but not in another. For these reasons, evolutionary scientists are necessarily engaged in path analysis. They are interested in both explaining adaptations and understanding the consequences of those adaptations.

Consequently, theory construction in evolutionary biology resembles a process of comparative historical analysis, rather than experimentation and falsification. While historical narratives can be problematic, they can be "tested" against the historical record and the probability that any particular theory is correct can constantly be updated against new evidence.

Toward an evolutionary political science

This section outlines how some political scientists have made an implicit ontological shift toward complexity that more closely resembles evolutionary biology, yet can be

[4] The reality of modern physics is substantially more complex than this. The Newtonian–Cartesian vision of the physical world as being as finite set of fixed and stable constants governed by universally applicable laws has been abandoned by physicists since Einstein. The fact that so many economists and political scientist have assumed a model of science no longer used by physical scientists is an ironic story. For an excellent history of how economists took this turn, see (Beinhocker 2006).

[5] There is a huge literature dealing with these puzzles; some interesting examples include: (Futuyma and Slatkin 1983; Mayr 1988, Hoffman and Riley 1999; Holland 1992; Jervis 1997; Pierson 2000; Kerr 2002; Ridley 2003; Zimmer 2001).

further informed by a more explicit investigation. For example, Streeck and Thelen (2005) argue for a definition of institutions as "social regimes" of layered rules, norms and behaviors, and they construct an interactive model of institutional change that operates on multiple levels of analysis, integrating theories of both bottom–up and top–down causation. Similarly Grief and Laitin (2004) argue, "Within any organization, or around any set of rules, there are subsets of coordinated elements that are themselves institutions. Institutions can be identified therefore at different levels of aggregation" (p. 640). In both cases, institutionalists have adopted a more multi-layered and complex ontology. Not only does this more closely resemble an evolutionary ontology, but it is precisely the kind of complex system where generalized Darwinism adds insight, as its theoretical tools were specifically designed to integrate levels of analysis by connecting individuals to populations. As Richerson and Boyd (2005a, b) argue "Darwinian tools help us build linkages between phenomena at different levels as given problems require" (p. 247).

In addition to multi-level explanations, many political scientists have increasingly embraced the fact that institutions are interactive and shaped by environmental context. As Hall (2003) argues, "Comparative politics has moved away from ontologies that assume causal variables with strong, consistent and independent effects across space and time toward one that acknowledge more extensive endogeneity and the ubiquity of complex interaction effects" (p. 387). Evolutionary theory adds insight into why outcomes vary with context, as environmental variety entails different kinds of selection pressures. The interactive, contingent and cumulative effects of these selection pressures are likely to yield unique outcomes in any particular case at the same time that general selection mechanisms may operate similarly across cases.

While the biological sciences are more acceptive of complexity and historical contingency, they do not reject general theory. At its core, evolution is a theory that posits general relationships between mechanisms of variation, selection and replication. The theoretical principles of natural selection have been applied to a wide array of phenomena including human institutions. While many mid-level evolutionary theories are still a matter of debate, there is substantial agreement within biology about the importance of general theoretical principles. Kiser and Welser (unpublished) highlight that Gould, a biologist who is famous for giving great emphasis to contingency and chance, believed in general theory, which he argued operated at higher levels of generalization.

In sum, evolutionary theory has proven to be a meta-theoretical framework capable of integrating theory from multiple levels of analysis and across disciplines. Its ontological complexity means that researchers acknowledge the iterated interactions that lead to population dynamics. Ontological complexity has not prevented evolutionary theories from developing a wide array of mid-level general theory. Increasingly, evolutionary theorists have argued that natural selection operates at multiple levels, and can be employed to explain institutional development and change (Sober and Wilson 1998, Alford and Hibbing 2004, Boyd and Richerson 2005a, b). This section has shown how generalized Darwinism can help one to integrate much of the institutional scholarship in political science under a commonly understood philosophy of science. Indeed, the panorama of evolutionary theory has demonstrated that researchers can investigate a wide array of research questions using a variety of methodological tools, while contributing to the overall research agenda.[6] Instead of espousing unrealistic scientific ideals, this philosophy provides political scientists with a truly scientific understanding of human behavior (Thayer 2000).

Empirical implications: preferences, culture, and institutions

> "The dynamic nature of history implies that the centrality of beliefs—how humans form their beliefs and how they learn—is fundamental to a new social science. This in turn leads us to two inquiries: first, how the mind and brain work to understand their environment; second, how humans learn from one another, for example through culture." (North 2006, p. 1005)
>
> We also need to understand that studying the mind is not like studying the physical sciences—it's all in your head' as they say. This makes all knowledge, at least at the first step subjective (North 2006, p. 1005).

In addition to the ontological consilience outlined above, research rooted in evolutionary theory has recently provided important insight into a key question of political inquiry: how do we understand human preferences? This question has been one of the most pressing issues in political science. More than 15 years ago, Peter Katzenstein noted that one of the key differences between rational choice and historical institutionalism is that rationalists assume that humans possess a constant and universal set of basic preferences,[7] whereas historical institutionalists are

[6] It should be noted that evolutionary-based research also does not eschew methodological tools based on mathematics, such as agent-based modeling, which are able to capture the iterative dynamics of complex adaptive systems.

[7] Clearly, sophisticated rationalists have backed off the narrow assumption that human motivations can be reduced to simple *homo*

interested in explaining why preferences vary across time and space (Steinmo et al. 1992). Preferences are foundational, because policy-makers must consider both their own preferences as well as those of the rule-takers when they build institutions. As historical institutionalists have long argued, rules shape agents subsequent preferences (Steinmo 1989, 1995; Hall 1997). However, beyond the basic point that "history" shapes preferences, political scientists have had little to offer in terms of an explanation of human motivations.

Evolutionary theory offers a variety of plausible and testable hypotheses regarding political preference formation. These generally focus on the primary means of preference replication—genetic and institutional. Boyd and Richerson's (1985, 2005a, b) intermediate position of "dual inheritance" provides a starting point for analysis. All social creatures inherit powerful instincts to follow social rules. Whether we speak of ants, bees, elephants, or humans, there is no doubt that specific behavioral patterns and the impulse to follow these patterns is inherited from generation to generation (for the best early statement of this see Wilson 1975).[8] In human societies, these rules can become quite complicated and highly regulated. Some theorists have argued that the human intentionality has led to a process by which cultural evolution is fundamentally rather different than genetic inheritance, operating by very different mechanisms of information transfer (Witt 2004, Nelson 2007). Cordes (2006) points out that, "The human mind can intuitively grasp the meaning of novelty. Combined with the cultural modes of transmission, i.e., various forms of learning, these aspects are the reasons cultural change has outpaced genetic change and cultural change departs from genetic interests" (p. 534). Elsewhere, we have argued that institutions perform the same function in a political system, which genes do in a biological system. Political institutions are complexes of rules that strive to structure and shape behavior. They represent the cumulative decisions and re-adjustments of previous eras. Following Richerson and Boyd (2005a, b), we contend that institutions can be seen as creative adaptations that replicate behavior and political preferences without genetic modification. Institutions are designed to replicate certain behaviors and prohibit others, because doing so provides a presumed fitness advantage to the group.

Humans, more than any other species have evolved complicated mechanisms and institutions to shape behavior and promote group-beneficial cooperative strategies. In order to understand these developments, evolutionary theorists have employed the concept of "group selection" and the theory of "multilevel selection" (Darwin 1874, Sober and Wilson 1998, Alford and Hibbing 2004). This theoretical approach argues that the process of natural selection occurs above the level of the individual. Thus evolutionary history is not just about how single individuals adapt to selection pressures, but also how groups compete with one another. Multilevel selection theory (MLS) answers important puzzles regarding the existence of socially cooperative behaviors, by arguing that selfless actions may be beneficial for the group even if they are not individually beneficial. For example, in *The Descent of Man*, Darwin (1874) invokes the concept of group selection to explain the evolution of morality. He argues, "It must not be forgotten that although a high standard of morality gives but a slight or no advantage to each individual man and his children…advancement in the standard of morality will certainly give an immense advantage to one tribe over another."[9]

Social species have evolved socially cooperative strategies as the best means of avoiding selection pressures and improving reproductive success. As Dawkins (1976) argued quite forcefully, the best way for individuals to pass on their genes is to cooperate with others. Therefore, for an evolutionist, there can be no clear and arbitrary distinction between the desire to protect oneself and the need to protect one's kin, family, or clan.[10] Social creatures do *both*. Seen in this light, the social science battling over whether humans are "individually self-interested and rational" or are really "satisficers" motivated by "norms, rules and culture" is a false dichotomy. Under certain conditions, both sets of motivations are necessary for the survival of the group, although they can be found in different degrees across individuals. This implies that the environmental conditions for cultural and institutional development are central to the proliferation and replication of socially cooperative strategies. For example, in their agent-based model of the evolution of social preferences, Bowles et al. (2003) argue "the evolutionary success of individually costly but group-beneficial behaviors…may have been a consequence of distinctive human capacities in social institution building" (p. 135).

Footnote 7 continued
economicus. See (North 1992; Levi 1997; Elster 1998; Elster 2000; Weingast 2005).

[8] This invites an additional discussion of how individuals will sacrifice their individual self-interest in the interest of their children, family, community. The degree of commitment appears to be closely linked to the closeness of the genetic connection for most social species. See (Alcock 2001).

[9] Quoted in Sober and Wilson 1998, p. 4.

[10] There is a growing body of evidence suggesting that the more complex the brain, the larger the social group that the individual may be willing to protect (Dunbar 1996). Moreover, there is good evidence that individuals are more likely to risk their individual short-term self-interest for those whom they share a genetic bond than for those with whom they do not.

Today, there is very strong empirical support for the propositions that human beings are *both* cooperators and individual-interest maximizers and that there is significant variety in these traits within and between communities. There are growing literatures in evolutionary biology, psychology, anthropology, and economics converging on the argument that the human brain has evolved to advantage cooperation.[11] The human mind is neither a "blank slate" nor a purely strategic calculative computer.[12] This insight answers the rationalist's dilemma—how is it possible that human's ever built social institutions in the first place? Our primate ancestors were already a social species, replete with social rules, norms and behaviors. Indeed, human's likely thrived precisely because their genetic abilities and preferences for cooperation advantaged them over their competitors.[13]

Starting from the more complex ontological position of dual inheritance and multi-level selection theory, we can begin to construct the broad outlines of a more nuanced view of political preference formation. Instead of assuming an essential character to human preferences or arguing that they are purely a product of institutional selection pressures, this interactive model accounts for both bottom–up and top–down processes. This view is expressed by Masters, who contends that "contemporary life sciences reject simple dualities and stand four-square in support of an interactional view of human behavior" (quoted in Blank and Hines 2001, p. 23). Individual agents are central in generating variation and new ideas, but those ideas must repeatedly interact with broader institutional and environmental selection pressures.[14]

Moving away from an essentialist position in the origins of human preferences also helps move us toward solving one of the second major conundrums faced by modern social scientists: how to understand human agency? For a traditional rationalist, human choices are structured by the institutional environment such that they are calculations rather than free choices in the commonsense meaning of the term. For sociologists and culturalists—who see human action defined by social rules and norms of appropriateness—agency is equally problematic: The desire to follow rules and cooperate may explain much human behavior, but this perspective also lacks an explanation for why these scripts change?

We submit that agency is in part the product of the contradictions that characterize the evolution of the human mind. Our brains are the products of a complex mix of sometimes contradictory evolutionary forces and selection pressures. Much like our physical beings, the mind is not perfectly efficient. Most of us understand that the human body is the product of previous adaptations to past environments and complex compromises between sub-systems: An individual can be tall, strong, and intelligent while still having poor eyesight and a weak immune system. Equally, our ancestor's brains developed cognitive capacities, such as the ability to think abstractly, calculate alternatives, and plan, as they developed more sophisticated communicative capacities and built more complex social organizations (Dunbar 1996). Since sub-systems do not operate perfectly together and are imperfectly replicated, creative adaptations are inevitable. As Richerson and Boyd observe, "We do know that culture is most un-gene like in many respects…[it] has the principle of inheritance of acquired variation (what one person invents another can imitate). We are not entirely blind victims of chance imitation, but can pick and choose among cultural variants that come to our attention and creatively put our own twist to them" (2000, p. 3). Thus one way for humans to cope with the frictions and inconsistencies inherent in their institutional environment is to adapt by engaging in creative abstract problem solving.

Conclusion: history as an evolutionary process

> I was equally disappointed by the traditional philosophy of science, which was all based on logic, mathematics, and the physical sciences, and had adopted Descartes' conclusion that an organism was nothing but a machine. This Cartesianism left me completely dissatisfied…Where else could I turn? Ernst Mayr (2004, p. 2)

Mainstream political science has adopted a model of science-derived Physics and Mechanics. As Zuckerman (1997) notes, "[Positivists] envision a world composed of

[11] See for example, (Barkow et al. 1992; D'Andrade 1993; D'Andrade and Strauss 1992; Dawkins 1982; Fehr and Fischbacher 2004; Gureck et al. 2006; Hartung 1995; Knoch et al. 2006; Lakoff and Johnson 1999; Nelson 2007; Nelson and Winter 2002; Shore 1996; Ziman et al. 2002).

[12] For an excellent summary of evolutionary psychology and its implications for social science see: (Tooby and Cosmides 2001). Anthropologists have their own debates over the origins of cooperation, individual self-interest and preferences for sociality. See, (Boyd and Richerson 2005a, Boyd and Richerson 2005b; Richerson and Boyd 2005, Sperber and Claidi'ere 2006).

[13] Evolutionary game theory has made significant advances demonstrating how cooperative institutions can develop and why they can prove more efficient even for self-interested individuals. The games become more interesting, though far more complex when they begin with cooperatively inclined individuals. For the classic statement see (Axelrod 1984). See also (Maynard Smith 1982; Axelrod 1997; Gintis 2000).

[14] Interestingly, an iterated prisoner's dilemma game with multiple players who are all purely self-seeking rational cannot be sustained. The existence of just some players who consistently punish defectors – even when it is not in their individual rational "self-interest" – can sustain the game.

linear relationships among variables, parity in the size of cause and effect, recurrent patterns over time, and the fundamental insignificance of chance happenings" (p. 285). This legacy in political science is the outgrowth of a much broader intellectual movement in the social sciences, beginning in the early 20th century. Scientific methodology meant adopting reductionist and deterministic models characterized by Newtonian physics.

There can be no doubt that there are many interesting and important correlations and relationships that can be understood through these methodologies and approaches.[15] Evolutionary biology outlines a scientific framework that is better suited to the study of complex systems. Institutional scholars have been confronted with questions of falsifiability and prediction, implying that lacking clear and quantifiable answers to these questions relegates ones work outside of the realm of "science." These critiques miss the point of historical and case-based analysis precisely because they assume a world that is stable and static—a world in which mechanisms and processes are secondary to the correlations of variables. We suggest that such a world does not exist.

Whereas the laws of Newtonian physics are based on the constancy of the physical world, evolutionary theory assumes contingency, inconstancy, and emergence.[16] The study of politics is in many cases the study of complex systems. Mechanical models based on static and fixed relationships between independent variables cannot capture the realities of the living world driven by the iterative and dynamic relationship between preferences, behavior and outcomes. In contrast, evolutionary theory provides an appropriate framework for understanding many aggregate political outcomes because it offers a dynamic theory of politics. Evolution assumes change, not equilibrium. Moreover, evolution's focus on dual causality offers the chance to account for both micro and macro-level dynamics. Moreover, the ability of Darwinism to integrate levels of analysis holds out the possibility of moving beyond earlier dichotomous debates about the relative importance of agency or structure, by recognizing that both are important mechanisms in the evolutionary process. Finally, research rooted in evolutionary theory has already added considerable insight into the question of human preference formation.

These insights have important implications for what we study and how we study it. For evolutionary theorists and historical institutionalists alike, history is not simply a chain of independent events. History is important because it shapes later outcomes. Taking evolution seriously ultimately means that the scholar is skeptical of the very notion of variable independence. Instead, acknowledging the importance of history suggests an explicit awareness that historical changes have important long-term evolutionary consequences. We argue that historical institutionalists are like the environmental biologist who believes that to understand the specific fate of a particular organism or behavior, one must explicitly examine that organism or behavior in the ecology or context in which it lives. This implies a different scientific ontology than that commonly found in the hard sciences of physics and chemistry. While objects in the physical world often adhere to constant "laws" of nature, biological organisms often defy attempts to reduce them to their essential components because of their complexity. Historical institutionalism is rooted in a similar ontological shift in social science. This of courses does not mean that it is not science—unless one's definition of science excludes biology; instead, it implies that the scientific methods applied should fit the subject being studied.

We have examined evolutionary theory in the biological sciences to determine its applicability to the study of political institutions. In the end, we believe that evolutionary theory offers more than an interesting metaphor. While we do not suggest that human institutions and history evolve in exactly the same ways as biological evolution, but human social institutions—just like humans themselves—are products of evolutionary forces and processes. Virtually every other discipline in the social sciences today has begun to take evolution seriously. We submit that political scientists, should too.

[15] For a broad and thoughtful critique along similar lines as those suggested here, see (Blyth 2006).

[16] Modern physics has also moved away from these stable assumptions. Not only does quantum physics challenge many of Newton's basic assumptions, but "string theory" also goes even further, arguing that it is theoretically not falsifiable.

References

Alcock J (2001) The triumph of sociobiology. Oxford University Press, Oxford

Alford J, Hibbing J (2004) The origins of politics: an evolutionary theory of political behavior. Perspect Political 2(4):707–723

Alford JR, Funk CL, Hibbing JR (2005) Are political orientations genetically transmitted? Am Political Sci Rev 99(2):153–167

Axelrod RM (1984) The evolution of cooperation. Basic Books, New York

Axelrod RM (1997) The complexity of cooperation agent-based models of competition and collaboration, Princeton studies in complexity. Princeton University Press, Princeton, NJ

Barkow JH, Cosmides L, Tooby J (1992) The Adapted mind: evolutionary psychology and the generation of culture. Oxford University Press, New York

Beinhocker ED (2006) The origin of wealth: evolution, complexity, and the radical remaking of economics. Harvard Business School Press, Boston, MA

Blank R, Hines S (2001) Biology and political science. Routledge, London

Blyth M (1997) Any more bright ideas? The ideational turn in comparative political economy. Comp Politics 29:229–250
Blyth M (2006) Great punctuations: prediction, randomness, and the evolution of comparative political research. Am Political Sci Rev 100(4):493–498
Boulding K (1981) Ecodynamics: a new theory of societal evolution. Sage, Beverly Hills
Bowles S, Choi JK, Hopfensitz A (2003) The co-evolution of individual behaviors and social institutions. J Theor Biol 223:135–147
Boyd R, Richerson P (1985) Culture and the evolutionary process. University of Chicago Press, Chicago
Boyd R, Richerson P (2005a) Solving the puzzle of human cooperation. In: Levinson S (ed) Evolution and culture. MIT Press, Cambridge
Boyd R, Richerson P (2005b) The origin and evolution of cultures, evolution and cognition. Oxford University Press, New York
Beuno de Mesquita B, Morrow JD (2000) Sorting through the wealth of notions. In: Brown ME, Coté OR, Lynn-Jones SM, Miller SE (eds) Rational choice and security studies. MIT Press, Cambridge
Cordes C (2006) Darwinism in economics: from analogy to continuity. J Evol Econ 16:529–541
D′Andrade R (1993) Cultural cognition. In: Posner M (ed) Foundations of cognitive science. MIT Press, Cambridge
D′Andrade R, Strauss C (eds) (1992) Human motives and cultural models. Cambridge University Press, Cambridge
Dahl RA (2004) What have we learned? In: Shapiro I, Smith RM, Masoud TE (eds) Problems and methods in the study of politics. Cambridge University Press, Cambridge, pp 377–394
Darwin C (1874) The descent of man in relation to sex. John Murray, London
Dawkins R (1976) The selfish gene. Oxford University Press, New York
Dawkins R (1982) The extended phenotype: the gene as the unit of selection. Oxford University Press, Oxford
Dennett DC (1995) Darwin's dangerous idea. Simon and Schuster, New York
Dunbar R (1996) Grooming, gossip and the evolution of language. Harvard University Press, Cambridge
Elster J (1998) Emotions and economic theory. J Econ Lit 36(1): 47–74
Elster J (2000) Rational choice history: a case of excessive ambition. Am Political Sci Rev 94(3):685–695
Farr J (1995) Remembering the revolution: behavioralism in American political science. In: Farr J, Dryzek JS, Leonard ST (eds) Political science in history. Cambridge University Press, Cambridge
Fehr E, Fischbacher U (2004) Third-party punishment and social norms. Evol Soc Behav 25:63–87
Fowler JH, Dawes CT (2008) Two genes predict voter turnout. J Politics 70(3):579–594
Fowler JH, Baker LA, Dawes CT (2008) Genetic variation in political participation. Am Political Sci Rev 102(2):233–248
Futuyma DJ, Slatkin M (1983) Coevolution. Sinauer Associates, Sunderland, MA
Gilbert N, Ahrweiler P (2009) The epistemologies of social simulation research. In: Squazzoni F (ed) Epistemological aspects of computer simulation in the social sciences. Springer Berlin Heidelberg, New York
Gintis H (2000) Game theory evolving: a problem-centered introduction to modeling strategic behavior. Princeton University Press, Princeton, NJ
Gould SJ (2002a) I have landed: the end of a beginning in natural history, 1st edn. Harmony Books, New York
Gould SJ (2002b) The structure of evolutionary theory. Belknap Press of Harvard University Press, Cambridge, MA
Greif A, Laitin D (2004) A theory of endogenous institutional change. Am Political Sci Rev 98(4):633–652
Gunnell JG (2004) The real revolution in political science. PS: Political Sci Politics 37:47–50 (January)
Gureck O, Irlenbusch B, Rockenbach B (2006) The competitive advantage of sanctioning institutions. Science 312:108–111 (April 7)
Hall P (1997) The role of interests, institutions and ideas in comparative political economy of the industrialized nations. In: Lichbach M, Zuckerman A (eds) Comparative politics: rationality, culture and structure. Cambridge University Press, New York
Hall P (2003) Aligning ontology and methodology in comparative research. In: Mahoney J, Rueschmeyer D (eds) Comparative historical analysis in the social sciences. Cambridge University Press, Cambridge
Hall PA, Taylor RCR (1996) The potential of historical institutionalism: a response to Hay and Wincott. Political Stud 46:958–962
Hartung J (1995) Love thy neighbor: the evolution of in-group morality. Skeptic 3:86–99
Hodgson G (2002) Darwinism in economics: from analogy to ontology. J Evol Econ 12:259–273
Hodgson G, Knudsen T (2006) Why we need generalized Darwinism, and why generalized Darwinism is not enough. J Econ Behav Org 61:1–19
Hodgson G, Knudsen T (2008) In search of evolutionary principles: why Darwinism is too important to be left to biologists. J Bioecon 10:51–69
Hoffman M, Riley J (1999) The science of political science: linearity or complexity in designing social inquiry. Washington University, St. Louis
Holland J (1992) Complex adaptive systems. Daedelus 121:17–30 (winter)
Jervis R (1997) System effects. Princeton University Press, Princeton
Kerr P (2002) Saved from extinction: evolutionary theorising, politics and the state. Br J Politics Inter Relat 4(2):330–358
Knoch D, Pascual-Leone A, Meyer K, Fehr E (2006) Diminishing reciprocal fairness by disrupting the right frontal cortex. Science 314:829–832
Kuhn T (1962) The structure of scientific revolutions. Chicago University Press, Chicago
Lachapelle J (2000) Cultural evolution, reductionism in the social sciences, and explanatory pluralism. Phil Soc Sci 30:331–361
Lakoff G, Johnson M (1999) Philosophy of the flesh. Basic Books, New York
Levi M (1997) A model, a method and a map: rational choice in comparative and historical analysis. In: Lichbach M, Zuckerman A (eds) Comparative politics: rationality, culture and structure. Cambridge University Press, New York
Levi M (2006) Why we need a new theory of government. Perspect Politics 4(1):5–19
Lieberman RC (2002) Ideas, institutions and political order: explaining political change. Am Political Sci Rev 96:4
Masters RD (1989) The nature of politics. Yale University Press, New Haven
Maynard Smith J (1982) Evolution and the theory of games. Cambridge University Press, New York
Mayr E (1988) Toward a new philosophy of biology: observations of an evolutionist. Belknap Press of Harvard University Press, Cambridge, MA
Mayr E (2004) What makes biology unique?. Cambridge University Press, Cambridge
McDermott R (2004) The feeling of rationality: the meaning of neuroscientific advances for political science. Perspect Politics 2(04):691–706
McDermott R, Fowler JH, Smirnov O (2008) On the evolutionary origin of prospect theory preferences. J Politics 70(2):335–350

Modelski G (2007) Evolutionary world politics homepage. Seattle, Modelski
Nelson R (2007) Universal Darwinism and evolutionary social science. Biol Phil 22:73–94
Nelson R, Winter S (2002) Evolutionary theorizing in economics. J Econ Perspect 16(2):23–46
North D (1992) Institutions, ideology, and economic performance. Cato J 11(3):477–488
North D (2006) What is missing from political economy. In: Weingast B, Wiltman D (eds) The Oxford handbook on political economy. Oxford, Oxford University Press
Pierson P (2000) Increasing returns, path dependence and the study of politics. Am Political Sci Rev 94(2):251–268
Popper KR (1987) Natural selection and the emergence of the mind. In: Radnitzky G, Bartley WW (eds) Evolutionary epistemology, rationality and the sociology of knowledge. Open Court, La Salle
Richerson PJ, Boyd R (2005) Not by genes alone: how culture transformed human evolution. University of Chicago Press, Chicago
Ridley M (2003) The cooperative gene: how Mendel's demon explains the evolution of complex beings. Harper Collins, New York
Schumpeter J (1934) The theory of economic development. Harvard University Press, Cambridge
Shore B (1996) Culture in mind: cognition, culture, and the problem of meaning. Oxford University Press, New York
Sober E, Wilson DS (1998) Unto others. Harvard University Press, Cambridge
Somit A, Peterson SA (1998) Review article: biopolitics after three decades–a balance sheet. Br J Political Sci 28:559–571
Spencer H, Peel JDY (1972) Herbert Spencer on social evolution; selected writings. The University of Chicago Press, Chicago
Sperber D, Claidi'ere N (2006) Why modeling cultural evolution is still such a challenge. Biol Theor 1(1):20–22
Steinmo S (1989) Political institutions and tax policy in the United States, Sweden and Britain. World Politics XLI(4):500–535
Steinmo S (1995) Why is government so small in America? Governance 8(3):303–334
Steinmo S, Thelen KA, Longstreth F (1992) Structuring politics: historical institutionalism in comparative analysis. Cambridge University Press, New York
Streeck W, Thelen K (2005) Introduction: institutional change in advanced political economies. In: Streeck W, Thelen K (eds) Beyond continuity. Oxford University Press, Oxford
Thayer B (2000) Bringing in Darwin: evolutionary theory, realism and international politics. Int Secur 25(2):124–151
Thelen K (2004) How institutions evolve: the political economy of skills in Germany, Britain, the United States and Japan. Cambridge University Press, New York
Tooby J, Cosmides L (2001) Evolutionary psychology: a primer. Center for Evolutionary Psychology, University of California, Santa Barbara. http://www.psych.ucsb.edu/research/cep/primer.html14/12/02
Veblen T (1898) Why is economics not an evolutionary science? J Econ 12:373–393
Walt SM (2000) Rigor or rigor mortis? In: Brown ME, Coté OR, Lynn-Jones SM, Miller SE (eds) Rational choice and security studies. MIT Press, Cambridge
Weingast B (2005) Persuasion, preference change, and critical junctures: the microfoundations of a macroscopic concept. In: Weingast B, Katznelson I (eds) Preferences and situations. Cambridge University Press, New York
Wilson EO (1975) Sociobiology: the new synthesis. Harvard University Press, Cambridge
Witt U (2004) On the proper interpretation of 'evolution' in economics and its implications for production theory. J Econ Methodol 11(2):125–146
Ziman J, Boden MA, Wheeler M (2002) The evolution of cultural entities, proceedings of the British academy, vol 112. Published for the British Academy by Oxford University Press, Oxford
Zimmer C (2001) Evolution: the triumph of an idea. Harper Collins, New York
Zuckerman AS (1997) Reformulating explanatory standards and advancing theory in comparative politics. In: Lichbach M, Zuckerman A (eds) Comparative politics: rationality, culture and structure. Cambridge University Press, New York