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The New Empirical Biopolitics

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Abstract

Political science traditionally has either ignored biology in favor of purely environmental explanations for political phenomena or merely ruminated about the likely role of biology, leaving data-based research on biopolitics in dangerously short supply. Currently, attention to the apparent genetic basis for political and social orientations holds the greatest promise of advancing empirical biopolitics. Thus, in this essay, we orient behavior genetics research in the larger framework of biology and politics, confront its normative implications, describe the techniques involved, assess the strengths and weaknesses of commonly employed data and procedures, and describe the next steps in this research stream. Because these next steps involve molecular genetic work, we provide some background genetic information, but we mainly urge political scientists to join interdisciplinary teams so that nature and nurture can both be employed in ongoing efforts to understand the sources of mass-scale human politics.

Gene: a sequence of DNA base pairs that constitutes the basic unit of inheritance

Neurotransmitters: complex proteins that are part of the nervous system and affect behavior

Heritability: the proportion of phenotypic variance among individuals attributable to genetic differences in that population

Introduction

Original empirical research connecting biology to politics is disappointingly rare in political science. We begin this review by discussing work being done in cognate disciplines and by addressing the normative reservations some political scientists seem to harbor concerning biologically informed research. We then provide extensive description of a technique—the classic **twin design**—that has been employed by political scientists of late and that is equipped to serve as an entry point for biology into the research repertoire of political science, just as it has in other disciplines. But the twin design has limitations; therefore, later in the essay, we describe molecular genetic work that can be done in cooperation with geneticists to identify the precise genes and biological systems relevant to politics. We pay particular attention to the application of these techniques to the study of political attitudes, but we conclude with a discussion of the way in which the incorporation of biology can enhance research in virtually every subfield of political science.

Political Science, Psychology, Economics, and Behavior Genetics

A biological approach to political science is hardly new. In fact, biopolitics stretches back nearly as far as behavioral politics; both approaches found their first enthusiastic practitioners in the behavioral revolution of the 1960s. Some might even argue that the pedigree of biopolitics is longer than that of behavioralism, going back to Aristotle's notable claim that "man is by nature a political animal." What is striking is that behavioralism in political science is inextricably bound up with empirical research, whereas biopolitics has remained largely theoretical, descriptive, and speculative (see, e.g., the notable work of Ira Carmen, Bryan Jones, Roger Masters, Steven Peterson, Albert Somit, Joseph Tannenhaus, John Wahlke, and James Q. Wilson). That must change if political scientists are to play any role in the rapidly emerging synthesis of biology and the social sciences.

In terms of biological mechanism, empirical research on the biology of social behavior can be roughly divided into work that is focused on the brain (and associated **neurotransmitters**) and work that is focused on genes. Among the social sciences, psychology is notable for having developed robust research agendas in both physiological realms. Cognitive psychology is the most visible example of a focus on brain physiology, and the extensive research on the **heritability** of social traits typically is associated with the behavior genetics research of psychologists such as Thomas Bouchard and David Lykken. Economics has recently developed a widely publicized research focus on the brain, evidenced by the formation of a Society for Neuroeconomics and an associated well-attended annual meeting for the presentation of neurocognitive economic research (for informative examples, see recent work by Colin Camerer, Ernst Fehr, Read Montague, Tania Singer, and Paul Zak). To date, however, very little research in economics has focused on genetics. In political science there has been very little of either kind of work, despite the longstanding presence of a biopolitics subgroup within the discipline.

The scarcity of empirical work in biopolitics may result from the fact that biopolitics has to a substantial degree followed the lead of evolutionary psychology in focusing on the role of human genetics and brain physiology in establishing broad human behavioral universals, such as hierarchy, war, leadership behavior, and sexual politics. The problem for empirical work that focuses on human universals is that these universals, by definition, leave insufficient variation in central dependent variables. The need for variation is not unique to empirical biopolitics, and the frustrations of relying primarily on stochastic variation for the study of humans are familiar to all behavioral political scientists. One exception exploited by psychologists in studying human universals is the existence of cognitive and behavioral abnormalities associated with selective, naturally occurring physical damage to the brain. This has provided advances in cognitive psychology, but any application to political science is remote. Similarly, studies of universals in animal behavior have recently advanced rapidly through a combination of extensive selective breeding and the use of **gene** knockout and splicing technologies. For obvious ethical reasons, these techniques will continue to be unavailable for human behavioral research; consequently, investigation of human genetic behavioral universals is far less accessible for empirical research and unlikely to yield its answers quickly or easily.

Some empirical work on the biological causes of naturally occurring variation in politically relevant human behavior has been conducted. In 1986, Douglas Madsen published a groundbreaking study of the role of serotonin in dominance behavior. At virtually the same time, a team of researchers led by Lindon Eaves and Nicholas Martin added a short battery of political and social attitude items known as the Wilson-Patterson Inventory to a long set of mental health, personality, and addictive behavior questions that were being presented to >60,000 respondents in a survey of twins and their family members. Using the classic twin design, their analysis of these data (Martin et al. 1986) indicated that a surprisingly large portion of variance in attitudes is traceable to genetic forces. This finding should have sent shock waves through political science, but instead it remained virtually unknown. In the 20 years since, political science has seen almost no published empirical work that followed up on either the clear indication of a physiology of political behavior reported by Madsen (1986) or the clear evidence of a genetic basis for political beliefs reported by Martin et al. (1986).

Twin design: comparing the resemblance of monozygotic and dizygotic twins to estimate genetic and environmental components of variance

In the past few years, this has begun to change. Schrieber's (2005) dissertation utilizing functional magnetic resonance imaging (fMRI) studies of brain activity during political cognition provided evidence that differences between political sophisticates and political novices arise from their use of different neural substrates and won the annual political psychology award for best dissertation. Alford et al. (2005) reanalyzed the twin data gathered by Eaves and Martin, expanding the coverage of ideology to include an analysis of the heritability of party identification. Fowler et al. (2006) conducted a twin study demonstrating the heritability of variations in levels of political turnout. Hatemi et al. (2007c) identified the indirect connection of genetics to vote choice. McDermott and colleagues (Johnson et al. 2006) investigated the effects of neurotransmitter levels on play in simulated games. Orbell et al. (2004) and Axelrod & Hammond (2006) utilized simulations to model the implications of evolution for political variables. And studies informed by a biological conception of political behavior, including notable publications by Ostrom (1998), Marcus (Marcus et al. 2000), and Lodge & Taber (2005), have found an increasingly wide audience.

We are confident that this recent, decidedly empirical variant of biopolitics will flourish as political scientists become increasingly aware that biology does not equate with either universalism or determinism. This is not to say that a more biological turn in political science would come without cost. The first step is merely educating political scientists on modern genetic and biological theory. This re-education process strikes some political scientists as daunting, but this perception must be fought. Previous generations of political scientists have gone outside their discipline to become conversant in first linear algebra and later calculus in order to conduct research in behavioralism and rational choice, respectively. A comparable commitment to the study of biology is adequate to conduct research on genetics and politics. The standard approach in the hard sciences includes large teams of individuals with diverse skills; methodologists,

Phenotype: observed characteristic resulting from the combined effects of genes and environment

Environment: all of the context in which organisms reside

bench geneticists, theorists, data collectors, neuroscientists, and psychophysiologists frequently come together to conduct biologically informed social (but to this point rarely political) science. It is unrealistic and unnecessary to expect political scientists to obtain advanced degrees in biology, but they can learn enough to converse appropriately with the hard scientists on interdisciplinary teams.

Fortunately, some of this research, notably in behavior genetics, utilizes research skills quite familiar to traditional political behavioralists. Paper-and-pencil surveys, correlation analysis, and linear regression were all pioneered by Sir Francis Galton, the founding father of behavior genetics. Even today, most work in behavior genetics, much to the dismay of "wet" geneticists, continues to focus on paper-and-pencil reports and essentially correlational statistical analysis (albeit of a far more advanced variety). Moreover, political scientists can bring to the table fascinating questions, precise descriptions of political phenotypes, detailed understanding of environmental influences, and a willingness to work with scholars in the life sciences toward the goal of producing quality empirical research that integrates genetics and the **environment** to assess the fundamental links running from genes through the brain to behavior.

A critical mass of political scientists possessing a working knowledge of biology is necessary, but not sufficient, since data availability would still be a concern. In contrast to the laudable norm of data sharing in political science—of which the National Election Studies and the vast political science holdings at the Interuniversity Consortium for Political and Social Research (ICPSR) are prime examples—data sets developed within behavior genetics have been almost exclusively viewed as the private property of their initial principal investigators. There is no archive for such data, and we are aware of only a single publicly available twin study data set that contains political or social variables. Empirical social scientists obviously need data to move forward, and data on the relevance of genetics to politics are in short supply. Fortunately, progress is being made on this front. The National Science Foundation recently awarded a grant to a team of political scientists and behavior geneticists (John Hibbing, John Alford, Kevin Smith, Peter Hatemi, Lindon Eaves, Nicholas Martin, Robert Krueger, and Caroline Funk), whose detailed survey of the political attitudes and behaviors of >1000 twins will be available for widespread scholarly use by late 2009. This will be the first time political scientists have unfettered access to twin studies and the first time a twin study asks more than cursory questions about politics (party identification, participation, and selected, dichotomous positions on issues). Additional data sets may well be generated by other collaborative teams. Interactions between political scientists and behavior geneticists are now under way in places as diverse as Virginia, Minnesota, Southern California, Canada, Sweden, and Australia.

While the practical issues discussed above have clearly slowed the growth of empirical biopolitics, an additional constraint has been ideological. Reaction to work in this area frequently betokens a visceral distaste: "Isn't that what eugenics was all about?" or even more directly "Isn't that what leads to Nazi Germany?" Exploring a link between genes and variable human traits raises a sensitive issue, and like the public uneasiness with evolution, it must be faced directly if the social sciences are to make any contribution to the consilience revolution. Science is about facts, and not just the comfortable facts—or, even worse, the dressing up of hopeful fictions as established facts. What was and is wrong about social eugenics and its more extreme expression in selective genocide is that the actions taken were and are morally wrong. Mass killing or sterilization is not wrong because it is mistaken about genetic facts, nor does it become right if it is based on accurate genetic facts.

The argument that establishing a genetic influence on a trait directly enables genocide is also questionable. The science of genetics is new. Genocide appears to be nearly as old as modern hominids. Serving as the latest in a long line of excuses for inhumanity is not the same thing as being a cause of inhumanity. Nor is it the case that science is the final arbiter of what the public construes as facts. A plurality of adults in the United States refuses to believe that humans and chimps share a common ancestor, even though human speciation by natural selection clearly qualifies as a scientific fact and even though the United States is one of the most literate and proscience countries in the world. Although we regret the tendency of many to want to hide from the possibility of a role for genes in explaining human behavioral differences, we are not surprised by either the belief itself or its emotional intensity and tenacity in the face of empirical evidence. We believe that some people are genetically predisposed to cognitive structures that make the biology of human behavior in whatever form discomforting ("after all, biology is what makes animals animals but it is clearly something beyond biology that makes humans humans") whereas others are genetically predisposed to cognitive structures that leave them wondering what all the fuss is about ("after all, we are just slightly less hairy bonobos, are we not?").

An Example of Empirical Biopolitics: The Classic Twin Design

It is important to move beyond mere assessment of the role of genetics to explication of the nature of that role, but, as discussed above, for the near future the most accessible data for the empirical study of biology and politics will come from classic twin studies. As data become more widely accessible and interaction with behavior geneticists increases, political scientists will need at least a rudimentary sense of the design, logic, and pitfalls of the twin design, if only to be reasonably informed consumers. What follows is a brief synopsis—with citations to more in-depth coverage for those who wish to be more than consumers.

Behavior geneticists typically divide influences on an individual trait, whether it is a political attitude or a physical characteristic, into two broad groups—heredity (H) and environment (E). The total variation in a trait can thus be represented as the sum H + E. Heredity is the impact of genetic inheritance on trait variation. In the case of a physical characteristic such as adult height, this would be the proportion of the total variation in height across individuals that is due to the variation across individuals in the multiple genes that control height. For any one individual, the source of this genetic influence is relatively well defined, as on average 50% of our genes come from our mother and 50% come from our father. This leads to the fact that biological children of tall parents are more likely to be tall than are the biological children of short parents, although even for a relatively straightforward additive physical trait such as height, the relationship is far from determinative.

Environment includes all of the nongenetic external factors that influence trait variation across a population. These influences range broadly from the earliest biological environment of the womb, to the physical environment of a childhood house, to the social environment of the adult workplace. In the case of adult height, some of the obvious environmental factors are prenatal nutrition, the adequacy of childhood and adolescent diet, and exposure to chemical agents that can inhibit growth. Environmental influences can be divided further into two subcategories: the shared environment and the unshared, or unique, environment.

Shared environment is all of the shared external influences that we would typically think of as leading to trait similarity between individuals. Siblings, for example, might share similar childhood environments, including similar parental interactions, a similar physical environment, and similar nutrition. If the siblings happen to be twins, they would also share a more similar prenatal environment. In the case of adult height, a shared environmental factor, such as a regional diet limited in protein and specific nutrients, could lead to similarity in height across the entire

MZ: monozygotic ("identical") twins

DZ: dizygotic ("fraternal") twins

Equal environments assumption: in twin studies, the assumption that environments are equally similar for monozygotic and for dizygotic twins

Allele: the specific version of a gene

population of a region (e.g., North Korea). The unshared environment, in contrast, is composed of all the distinctive external influences that we would typically think of as leading to trait dissimilarity across individuals. Although much of the early childhood environment, for example, is similar across siblings, much is nonetheless variable. Siblings differ in diet, disease exposure, peer influences, and a host of other experiences. With the shift to adult life, the share of unique influences on siblings increases sharply, as peer, workplace, family, and physical settings typically diverge. Thus, the tools of behavior geneticists offer a method for estimating not only the degree of heritability but also the relative contributions of different components of the environment.

The leverage to accomplish these important feats is provided by the existence of two fundamentally different types of twin pairs, one type genetically identical and the other sharing just 50% of their genetic heritage. Twins provide a powerful "natural experiment" by introducing known genetic variation into analyses of the sources of trait variability. Observing the political similarity of parents and children, as is common in political science research, does not offer this same leverage because all nonadopted children share 50% of their genetic heritage with each biological parent. By shifting the focus from the similarity between parents and offspring to the similarity between twins, researchers can take advantage of the fact that twins vary in known ways in the degree of their genetic correlation. This variance in genetic similarity derives from the existence of two distinct types of twins: monozygotic (**MZ**) and dizygotic (**DZ**). MZ (frequently but imprecisely called identical) twins develop from a single egg fertilized by a single sperm, and they share an identical genetic code. DZ (frequently but erroneously called fraternal) twins develop from two separate eggs fertilized by two separate sperm; they are in effect simply two siblings who happen to be born nearly simultaneously. As such, DZ twins share on average 50% of genetic material, the same amount as any other pair of biological siblings.

The classic twin design is built on the assumption that the effect of genetics is measurably distinct for MZ and DZ twins, whereas the effect of the environment is equivalent or at least randomly distributed around equivalence. This crucial **equal-environments assumption** is open to challenge. If, compared to DZ twins, MZ twins not only share more genetic alleles but also share more environmental experiences, attributing the differences between MZ and DZ twins to heritability would overestimate the effects of genetics. Thus, the equal-environments assumption has been subjected to sustained and varied investigation. We do not review this extensive literature here (for more information, see Scarr & Carter-Saltzman 1979; Bouchard et al. 1990; Plomin 1990; Kendler et al. 1993; Plomin et al. 2001; Bouchard & McGue 2003; Horwitz et al. 2003; Richardson & Norgate 2005; Hatemi 2007, ch. 3; Charney 2008), but the central conclusion of empirical research is that violations of the equal-environments assumption are limited and often inconsequential.

Given the genetic differences and environmental similarities of the two types of twins, for any trait that is partly heritable, the tendency for MZ twins to share that characteristic should be stronger than the tendency for DZ twins to share that characteristic. In contrast, characteristics that arise purely from the environment, whether shared by the twins (as would typically be the case for parental socialization) or not shared by the twins (as would be the case for many adult experiences), should not generate any significantly different patterns when we contrast MZ and DZ twins (see Eaves et al. 1989, 1997; Plomin et al. 2001 for thorough discussions of the relevant statistical techniques). This is the basic and powerful concept behind the classic twin design.

Rudimentary assessment of the role of genetics is possible by subtracting the correlation for DZ pairs from the correlation for MZ pairs and then doubling the difference (since the genetic similarity of MZ twins is twice that of DZ twins). Shared environment can be estimated by doubling the correlation for DZ pairs and then subtracting the correlation for MZ pairs. Unshared environment is generally considered to be the remainder (1 – MZ), although it is important to note that this figure actually includes the effect of unshared environment as well as the error term. But the preferred methodology for estimating effects involves structural equation models. State-of-the-art analyses employ Cholesky decomposition techniques, which, unlike the old polychoric correlation procedures, make it possible to provide significance tests, to account for mediating variables, and to engage in model testing and subsequent re-estimation of the relationships once the proper model has been identified (Hatemi 2007, ch. 3). The typical designation in these structural equation models is A for (additive) genetics, C for shared or common environment, and E for unshared environment. Other models add a D term for interactive genetic effects. Still further elaborations on these basic models are possible and increasingly common.

How Can Genes Possibly Influence Lifelong Temperaments?

As mentioned, the classic twin design produces useful indications of a genetic influence on political attitudes but no sense of the processes that produce this connection. In this regard, the work of psychologists on the heritability of personality can serve as a template. In many ways, the concerns of psychology with enduring temperaments mirror those of political science, and both "personality" and "political ideology" (the phrase political scientists apply to a cohesive collection of attitudes on issues) enjoyed early prominence among behavioralists in their respective disciplines. But evidence of a heritable component of personality is more generally acknowledged than is the case for ideology, and research to explicate this relationship in psychology has moved far ahead of research in political science.

The evidence that personality is partly heritable is overwhelming. Taking the means of several estimates of the heritability of the "Big Five" personality traits suggests that extraversion has a heritability coefficient of around 0.53, agreeableness 0.42, conscientiousness 0.46, emotional stability or neuroticism 0.49, and openness or curiosity 0.54 (computed from results collected by Bouchard & McGue 2003, p. 23). The heritability of personality traits has even been observed in animal experiments, a context where environmental controls are possible to a much greater extent than with humans. For example, researchers have found that extraverted bird parents tend to have extraverted offspring even when those offspring have never seen their parents. Moreover, selective breeding over just three or four generations can produce significantly bolder or shyer birds (Drent et al. 2003; for a summary, see Gosling & John 1999). The notion that extraversion is genetic in birds but not in humans, even though many of the same neurotransmitters relevant to extraversion (such as serotonin and dopamine) are present in both birds and humans, stretches credulity.

Progress has been made in the next step of identifying the specific genes that are relevant to variations in personality traits. The best-known work involving human temperament is centered on serotonin, a neurotransmitter long known for its connection to assertiveness on the one hand and certain types of depression on the other. Allelic variation in a gene known as *5-HTT*, which is associated with the reuptake of serotonin from synapses (thus affecting the availability of usable serotonin) has been associated with depressive behavior, especially if allelic variation is interacted with previous environmental experiences such as an abusive childhood (Caspi et al. 2003). In fact, a whole class of selective serotonin reuptake inhibitors (SSRIs), including Prozac, has grown up around the connection of serotonin transport to social behavior. To be sure, some results on the specific genes involved with personality have not been replicated, and confusion is often apparent (van Gestel & van Broeckhoven 2003); but social behavior is amazingly complex, and research in this area is only beginning to gain momentum. It will take time to establish the details, but few if any scientists would insist that neurotransmitters such as serotonin, dopamine, vasopressin, and oxytocin are irrelevant to personality, and equally few would claim that the manufacture, transport, and reception of these neurotransmitters has no basis whatsoever in genetics. What remains is the difficult but exciting work of connecting genes to behavior, a connection that involves the interaction of thousands of genes, not to mention further interactions of those genes with environmental triggers and modifiers.

So the personality traits that play such a crucial role in psychology have been established as partially genetic, and work is well under way in specifying the genes that are relevant and the particular alleles predisposing an individual toward either risk-taking or extreme caution, buoyancy or despondence. Research in this area is an increasingly important part of psychology, and laypeople do not tend to have much difficulty accepting that personal temperament is partially rooted in genetics. Personality traits seem to be relatively permanent and also to directly involve behaviors. Those who are extraverted tend to behave differently at parties than those who are introverted, and they tend to do so at all stages of life. Reactions to personal situations, including fear and empathy, seem spontaneous and emotionally powerful, just as might be expected if their basis is in the chemicals flowing through various components of the limbic system. In short, the intense, immediate reactions to events in people's personal lives make it relatively easy to accept that genes could play an important role in shaping personality, pushing some people toward hair-trigger tempers and others toward diffidence in the face of affronts.

Political temperament is an obvious political parallel to personality, but there are also some important distinctions. After all, it is often asserted that personality involves behavior whereas political and social attitudes are just that—attitudes. They can be characterized as preferences for the manner in which group life should be conducted. At first blush, these preferences seem distinct from the heavily emotive, behavior-inducing features of personality. Compared to personal temperament, political attitudes are more cognitive and less limbic, are they not? They are highly changeable and subject to life's vicissitudes, are they not? They are subscribed to casually and only peripheral to the core of our being, are they not? If these are accurate perceptions of political attitudes, it makes sense to conceptualize and to study them the way political scientists have done for decades: as purely environmentally contingent epiphenomena. Seen from this vantage point, it is unsurprising and even sensible that political scientists would have turned to behavioralism to understand the source of political attitudes.

But this view of political attitudes is built on intuition rather than science. Attitudes may feel as though they are cognitive responses to our experiences and, moreover, we may be more comfortable believing that our political attitudes are the rational consequences of our individualized environment, but feelings and desires are not the crux of the matter. Is there evidence that neurotransmitters, emotions, chemicals, and genetics are irrelevant to political temperament? The answer is no, and upon closer reflection, the basis for positing a major difference between the personal and the political begins to crumble.

Any assertion that politics is devoid of emotion is inconsistent with even casual observation of the political world. Just as some people respond emotively to personal events whereas others are more laconic, similar distinctions are clearly evident in the political world, where the politically intense reside cheek by jowl with political apathetics. Fascinating recent work has been done on the extent to which emotional reactions characterize people's response to political stimuli (Marcus et al. 2000, Lodge & Taber 2005, Schreiber 2005, Westen et al. 2006). Attitudes on individual political issues may vary substantially over the course of a lifetime (see Fiorina 1981), but ideological frameworks are more consistent over time, and there may be even more stability when it comes to positions on bedrock principles concerning the organization of group life (attitudes toward out-groups, toward punishment of norm violators, toward reproductive matters, and toward the nature of the human condition).

Though it is unquestionably true that attitudes toward mass-scale politics are, from an evolutionary point of view, quite recent, this does not mean that a deeper, even genetic basis is impossible. Reading and writing have been practiced by a significant portion of the world's population for only a few generations, yet specific genes have been identified that correlate with reading performance. Quite probably, the cognitively novel processes involved with reading and writing coopted biological systems that originally evolved for other purposes, but this does not obviate the fact that individuals with a particular **allele** on chromosome 6 are more likely to suffer from dyslexia. Genes can matter even when adaptation for the trait of interest is not involved. This is true of reading and it is likely true of politics.

Even so, one reason political scientists have been slow to accept biological evidence may be that they study an evolutionarily recent and uniquely human subject: mass-scale politics. Animal corollaries for all kinds of social behaviors can be found, most obviously among higher-order primates (see de Waal 1982, 1996) but also in the insect world (Wilson 1975, Whitfield et al. 2003, Robinson 2004), and although these social behaviors are sometimes referred to as political—especially when they involve dominance hierarchies and collective decisions—they are quite distinct from mass-scale politics. Nonhuman animals never cease to surprise, but there is no existing evidence that any species other than *Homo sapiens* cares about social norms, rules, and behaviors when the consequences of these norms, rules, and behaviors do not affect the organism's immediate bailiwick. Humans' ability to engage in abstract thought has created an interesting situation, but the fact that a thought is abstract does not mean people have only weak attachment to it.

If the recent revolution in neuroscience has taught us anything, it is that activity by the cortex does not override limbic activity but is integrated with it (LeDoux 1996, 2002). Politics, therefore, contrary to the instincts of laypeople and to the untested assumptions of political scientists, is certainly a likely candidate for being shaped in part by limbic activity, which in turn is known to be shaped by genes. Moreover, the notion that the cortex is the only part of human anatomy not subject to the laws of evolution is badly mistaken. Recent research indicates that even the most unemotional of decisions, such as whether two digits should be added or subtracted, sets off distinct brain activation patterns (Haynes et al. 2007). It appears that subtle, nonemotional decisions have biological markers, and if they have biological markers, they may also have genetic correlates. Not all cortices are born equal, and genes are undoubtedly relevant to these variations.

Political scientists' belief that politics is *sui generis* is both right and wrong. It is right in the sense that mass-scale politics is evolutionarily recent and uniquely human, but it is wrong in the sense that politics is generated by essentially the same brain and the same genome that existed prior to the advent of mass-scale social life. Recent evidence indicates that positive genetic selection does not need the hundreds of thousands of years that were once thought to be necessary (Rockman et al. 2005), but the hypothesis that existing machinery has been expropriated for shifting situations over the past 5000–10,000 years remains more likely than that completely original neural/biological machinery evolved during that timespan.

The ability of genes to affect political beliefs is easier to understand with some ap-

Polymorphism: a genetic locus with more than one allele

preciation of modern genetics. When analyzing his sweet peas, Mendel happened to select traits (such as whether the flowers were purple or white and whether the seeds were wrinkled or smooth) that are both monogenic and largely oblivious to common environmental forces. This was fortuitous in terms of establishing the basic building blocks of genetics but unfortunate in that most traits, and certainly most complex behavioral traits, are polygenic and heavily contingent on the environment. If a political scientist's knowledge of genetics ends with Mendel, that scholar will expect all genetic forces to be gross, deterministic, and dichotomous, and it would be impossible to reconcile genetics with the graded, changeable, and environmentally shaped world of political attitudes.

A working knowledge of post-Mendelian genetics helps to reconcile the political and the biological. Important individual genes such as *5-HTT*, which is among the most studied in the entire human genome, at best account for 3%–4% of the variance in depressive tendencies (Caspi et al. 2003). Many, many genes are involved in serotonin production, transport, and reception—and serotonin is just one of many neurotransmitters relevant to depression. The correlation of genes with behavioral traits is much more likely to be detected if genes are permitted to interact with dozens of other genes (Comings et al. 2000). Complex traits tend to be configural rather than additive to the point that many genetically based traits (such as genius) do not even run in families (Lykken 1998). Moreover, all these genes, as well as the configurations of which they are a part, interact with environmental forces to shape phenotypes such as obesity, schizophrenia, conscientiousness, and political attitudes. Geneticists do not use terms such as "determinism" or "a gene for…" because that is not how genetics works.

The individuals most resistant to the role of genetics in social behavior seem to be those with the most misconceptions about genetics. Accepting a role for genetics does not require acceptance of the notion that all people are inherently violent (Ardrey 1961) or, alternatively, that all people are peaceful and only made violent by societal forces (Mead 1928; Rousseau 1946 [1762]). As evolutionary psychologists are quick to point out, within species, evolution often has a homogenizing effect as adaptive alleles drive out nonadaptive ones, but within-species morphs are common, and substantial variation, especially in those traits that are not directly and immediately connected to survival and reproduction, is likely. Important **polymorphism**s are scattered throughout the genome, and, after long ballyhooing the misleading fact that a high percentage of genes are identical across all humans and even across all higher-order primates, recent biological research has now come to emphasize the extent and importance of those portions of the genome that do vary from person to person and from chimp to person (Hinds et al. 2006). Genes vary and people vary. Some people are more prone to violence than others, and this variability does nothing to diminish the role of genetics in explaining human behavior—quite the contrary.

Genes do not demand bimodal distributions in which some people are violent and others peaceful. The more genes that are involved in shaping a **phenotype**, the more continuous and normally distributed that phenotype will be. Contrast eye color and height. Although there are important exceptions (mostly green or gray), most people have either brown or blue eyes. Eye color is influenced by a very small number of genes, and the result is a non-normally distributed phenotype. The same cannot be said for height, a trait that is known to be influenced by an extremely large number of genes. Most people are of middling height, and a much smaller number are either extremely tall or extremely short. Complex social traits, including political attitudes, are polygenic and therefore closer to the continuous world of height than the quasi-digital world of eye color. Subtle variation in political attitudes from one person to another is not a sign that genetics is irrelevant to political attitudes.

Genes work probabilistically. To take one example, the so-called breast cancer gene does not mean every person with a specific allele at that genetic **locus** will get breast cancer—only that the odds of contracting breast cancer are increased by the possession of that allele.

Locus: location in the genome

One important reason for variations in behavior involves "promoter" regions that are just upstream from the protein-coding gene. Identical genes with different promoter regions will yield fundamentally different behavioral patterns because the differential sensitivity of promoter regions will lead the relevant gene to be expressed under different circumstances. Polymorphisms in these promoter regions are crucial to the behavioral variations that interest social scientists. A certain environment, such as a vigorous political discussion, may stimulate one person but leave another nonplussed and a third disgusted, even as other situations could trigger different response patterns. Promoter regions are quite likely involved in this behavioral variation.

Finally, given the important role post-Mendelian genetics grants to the environment, the fact that political attitudes sometimes change over the course of a person's lifetime is not at all inconsistent with a potential role for genetics. Genes leave plenty of room for a shifting environment (or developmental stages) to change phenotypic behavior. The only determinists in the world today are environmental determinists. Geneticists go out of their way to point out that the alleged contrast between nature and nurture is in actuality a chimera. Nature interacts with nurture to make us who we are. Geneticists believe phenotypes—both physical and behavioral—are the result of G × E interactions (genetics interacting with environment). Traditional social scientists, unfortunately, cling to the belief that behavioral phenotypes are the result of E alone, a notion totally without empirical foundation and increasingly anachronistic, even embarrassing.

But the fault does not lie entirely with political scientists. Behavior genetics is a more insular field than it should be, with close alliances primarily to those social scientists working on mental disorders and addictive behavior—not coincidentally, areas that generate substantial support from funding sources. Data sets therefore rarely contain extensive information on political attitudes or behaviors, and they are typically proprietary and not widely disseminated. The few articles presenting evidence of a genetic influence on political and social attitudes tend to be atheoretical, with little in the way of explanation for how and why genes are relevant to politics—explanation that is probably necessary if political scientists are to be persuaded.

Alternatives to the Classic Twin Design

The twin design remains the workhorse of behavior genetics, thanks to known differences between MZ and DZ twins in degree of genetic similarity, but other designs have grown in usage. Adoption studies, for example, make it possible to compare siblings who share 50% of their genetic heritage (nonadoptive siblings) and those who share 0% (adoptive siblings), or to compare children with their adoptive as well as their biological parents. Both techniques have been used to good effect, although information on biological parents is often difficult to acquire. However, adoption studies in the area of political attitudes are virtually nonexistent and thus constitute a fertile area for future research—with the caveat that such studies will be best when they involve adults. Twin research indicates that the heritability of political views does not become apparent until after age 20, when preferences begin to firm up (Bouchard & McGue 2003).

More progress has been made regarding a different approach to adding variation in genetic similarity: the extended-family model. When information is collected not only on twins but also on their parents, siblings, and perhaps other relatives, statistical power is increased and several corrections are possible (see Hatemi et al. 2007a).

Association study: determining if alleles are associated with particular phenotypes

Incorporating data from nontwin siblings and other relatives permits more accurate assessment of the environment (since nontwin siblings presumably have roughly similar environments to their twin siblings once age corrections are applied), so data on the extended family, particularly when analyzed with the sophisticated structural equation modeling techniques now common in behavior genetics, have the potential to extend understanding of the relationship between genetics and political attitudes.

The techniques of behavior genetics, from simple correlations comparing the similarity of MZ and DZ twins to more complex structural equation models, are not completely foreign to those scholars familiar with the statistical techniques commonly used in political science. In this sense, detailed political data on twins constitute a valuable entry gate for political scientists eager to begin to apply the insights of biology to research on politics. No immersion in the details of molecular genetics is required, and with fairly minimal background work, it will be possible for many political scientists to confirm, extend, or modify existing, preliminary findings on the degree to which political attitudes (and behaviors) are influenced by genetic factors as opposed to either shared or unshared environmental forces.

Although this situation makes twin studies incredibly valuable, they have their limits. The real problem with twin studies is not the equal-environments assumption but the fact that they provide no information on the identity of the specific genes or biological systems leading to a given phenotype. It is one thing to know that a given phenotype is roughly 45% heritable; it is quite another to know the specific genes involved, the association of these genes' various alleles with phenotypic manifestations, and the biological explanations for that association of alleles and phenotype. For this reason, research on genetics and politics cannot stop with assessments of heritability of the sort possible with twin studies and related procedures. Instead, DNA samples must be obtained so that information on specific alleles at candidate loci is available. Variation in these alleles is then assessed for correlation with phenotypes of interest in what is usually referred to as an **association study**.

For example, thanks to the availability of DNA samples drawn earlier on thousands of subjects in Australia, we have begun the process of determining if allelic variations in genes known to be involved with standard neurotransmitter systems, including the serotonin transport gene discussed above (*5-HTT*), are associated with variations in political beliefs. Twin studies are still viewed with suspicion by many in the social sciences, but if associations are found between variations in individual genes and political beliefs, it will be much more difficult for environmental determinists to make their case. Although this type of bench genetic work requires more scientific background than twin studies do, the rapidly decreasing cost of genetic analysis and the possibility of teaming up with geneticists make this kind of research feasible for political scientists.

Allelic association studies require a priori, theoretically based knowledge of a locus suspected of being politically relevant. It is the allelic variation at this locus, after all, that is checked for correlation with phenotypic behavior. If, however, politics is genetic but driven by something other than the usual chemical suspects (e.g., serotonin and dopamine), steps must be taken to identify the novel loci. Since large-scale political behavior is not the same as small-scale social behavior, there is good reason to think that political phenotypes may be traceable to loci other than those connected to traditional personal temperaments. In such a situation, linkage analysis is advised. Linkage analysis takes advantage of the rapidly growing knowledge of the human genome. Thousands of marker alleles have been identified throughout the billions of nucleotide base pairs found in the chromosomes in each of our cells. These markers are checked for cosegregation with a trait of interest (e.g., intense political feelings). This is done not because these marker alleles are thought to cause the phenotype (this would be a wild coincidence) but because, owing to patterns of genetic recombination, seemingly unrelated traits may cosegregate simply because genes relevant to those traits are located in close proximity on our DNA. The closer two genes are, the more likely they are to vary together. By analyzing these patterns of cosegregation, it is possible to narrow the likely location of alleles relevant to the phenotype of interest.

In a perfect world, twin studies indicate that a phenotypic trait is indeed partially genetic and that, therefore, additional analysis is advisable; linkage analysis is then employed to narrow the range of possible locations for relevant genes; and finally association studies determine the specific alleles at those targeted locations that seem to be associated with the phenotypic behaviors of interest in the first place. Of course, such an orderly progression rarely comes to pass, but it at least helps to illustrate the divergent strengths of twin studies, linkage analysis, and association studies.

In political science, the ultimate goal is not to engage in some sort of gene therapy in order to push everyone toward a certain political ideology but rather simply to understand the factors that shape political attitudes and behaviors. Identifying the genes and alleles involved is one means toward the end of understanding these larger biological processes. In this sense, locating genes is not much more than a helpful step on the road to understanding the biological explanation for politically relevant predispositions. Accordingly, one goal of our research group, consistent with a larger movement in political psychology, is to understand the psychophysiology of politics. Do liberals and conservatives have different physiological reactions to political stimuli? Do they have different physiological reactions to nonpolitical stimuli? Can the ideological leanings of individuals be predicted merely by measuring (or manipulating) chemicals in the body?

Integrating Political Science

Political scientists' recent exposure to a possible role of genetics in shaping political attitudes as well as other political traits has yet to significantly alter the basic thrust of their empirical research. To this point, the topic has been treated as a curiosity. This is understandable, but it is important to move to the next step, where serious tests of serious hypotheses are performed by a broad spectrum of scholars. Sets of genes could affect politics in so many different ways. There could be genes pushing individuals toward being intensely political or indifferent to politics. Genes could influence certain individuals to possess views traditionally associated with the political right (i.e., wariness of out-groups and devotion to established, unchanging values) and others to possess views traditionally associated with the political left. Certain suites of genes might encourage some people to rebel against their political environment and others to absorb the precise political timbre of the world around them. Then again, there may be some genes that predispose individuals toward certain sets of beliefs. Maybe those with alleles that yield more usable testosterone are more likely to adopt libertarian beliefs ("I will not be led"), and maybe those with alleles that yield more oxytocin—which has been associated with trusting behavior (Kosfeld et al. 2005)—are more likely to join groups or to support redistributive policies. Maybe only a fraction of the population is genetically predisposed one way or the other and the remainder of the population is shaped exclusively by environmental forces. Maybe only certain types of political variables are influenced by genetics. For example, our earlier research found that party identification was almost completely driven by environmental forces, a finding that has been confirmed by subsequent research (PK Hatemi, LJ Eaves, SE Medland, KL Morley, NG Martin, unpublished manuscript). Other research by Hatemi reveals that vote choice is heritable, but largely indirectly, through attitudes toward issues (Hatemi et al. 2007b). These findings are perfectly consistent with a genetic explanation because the political parties and candidates present in a particular country at a particular time are ephemeral, whereas opinions on matters relating to the organization of group life are relatively timeless.

This budding research agenda in political genetics fits nicely with revived interest in political ideology as something more than political scientists' traditional conception; that is, more than just a set of specific issue-beliefs that fit together or the ability to identify currently employed ideological terms such as liberal or conservative (Converse 1964). Ideology should instead be seen as a set of bedrock predispositions toward group life, regardless of when or where the group exists (Jost 2006). The literature connecting personality and political beliefs is extensive and controversial (Adorno et al. 1950; McClosky 1958; Altemeyer 1981, 1996; Caprara et al. 1999; Jost et al. 2003; Caprara et al. 2006; Block & Block 2005), partially because much of it seems to paint one ideology (conservatism) in a bad light. If personal temperament and political temperament are both partially genetic, the natural question becomes whether they both spring from the same biological systems and ultimately from the same genes. An alternative possibility is that the manner in which people organize and conduct their personal lives is distinct from their preferences for the organization and conduct of mass-scale group life—that is, politics. The larger point is that determining the actual route connecting genes and politics will take a good deal of work and a willingness of additional political scientists to avail themselves of improved methodologies and improved data to identify the ultimate sources of political beliefs (for an outline of such a research agenda, see Carmen 2007).

Much of who we are as human beings is shaped by genetics. Traits such as height and weight, personality, mental health, occupational satisfaction, addictive behaviors, religious beliefs, and political and social attitudes have all been found to be heritable, though of course at different levels. A recent Danish study put the genetic contribution of height at 0.81 for females and 0.69 for males; body fat at 0.59 for females and 0.63 for males; and waist circumference at 0.48 for females and 0.61 for males (Schousboe et al. 2004). Bouchard & McGue's (2003) compilation of several twin studies suggests the heritability of general intelligence to be around 0.50, with some estimates as high as 0.70. They also report that perceptual speed and accuracy seem to be somewhat more heritable (0.64) than verbal ability (0.48) and memory (also 0.48). As alluded to earlier, personality traits such as those constituting the Big Five tend to be heritable in the range of 0.4–0.5. A study by McCourt et al. (1999) finds right-wing authoritarianism to be heritable at approximately the same level as each of the Big Five traits. Similar to party affiliation, religious affiliation yields a heritability coefficient that approaches zero. Affiliation with a group is not genetic but the degree of religiosity (as measured by frequency of church attendance) is strongly heritable, perhaps as much as 0.42 (Maes et al. 1999). Specific religious beliefs, such as Sabbath observance and accepting the Bible as truth, range in heritability from 0.25 to 0.35 (Martin et al. 1986). The extent to which people have interests that are artistic (0.44), social (0.50), enterprising (0.52), conventional (0.54), and realistic (0.58) is also solidly heritable, at least as measured by the traditional Falconer method employing twins reared together (Betsworth et al. 1994). Bachner-Melman et al. (2005) have even found an association between specific alleles (relevant to the vasopressin and serotonin systems) and interest in creative dance, on the one hand, as opposed to more traditional athletics on the other.

The precise figures mentioned above should be treated with caution, but the fact is an extraordinary range of human traits have a basis in genetics. Of most interest to political scientists is that social and political attitudes are included in this range and are about as heritable as most standard personality traits. And the same may be true for social and political behaviors. Recent research (Fowler et al. 2006) indicates that actual voter turnout (not just self-reported turnout) is strongly heritable. Research under way should determine the extent to which other political behaviors, such as discussing politics, working in campaigns, and joining organizations, are heritable. Regarding social as opposed to purely political behavior, self-reported altruism is heritable (see Rushton et al. 1986), and ongoing research should indicate if actual altruism—as well as tendencies toward taking risks, deferring gratification, and engaging in altruistic punishment, as measured by behavior in economic games—is heritable. Given the range of traits that are heritable, it would be surprising if these social and political behaviors are not heritable as well (Baschetti 2007). The real question pertains to the biological basis for this established heritability.

Implications

Specifying the degree to which various political concepts are heritable has important implications for virtually all subfields of political science. Obviously, for those who study individual-level political behavior, understanding the source of behaviors as well as the attitudes on which those behaviors are presumably based will matter a good deal. Attitudes that are heritable have been shown to be more resistant to change, to be held more strongly, and to be more likely a basis for the choices we make (see Tesser 1993). Knowing the types of issues that tend to generate heritable attitudes, therefore, will help to explain variations across those attitudes in the extent to which they are salient or not, intensely held or not, easy or hard (see Carmines & Stimson 1980). It will also broaden perspective on the source of politics. Whereas previously the debate tended to be whether various features were socialized early or acquired late, the issue now becomes whether features are inherited, socialized, or influenced by unique features of the environment. Incorporating genetics will indicate the areas where the socialization efforts of parents are and are not likely to pay off.

These individual-level implications for students of political behavior are fairly obvious. Less obvious but no less noteworthy are the potential implications for students of institutions, rational choice, international relations, and comparative politics. Determination of the degree to which, as well as the manner by which, genetics shapes politics would allow institutionalists a better feel for the conditions under which institutions can shape politics. The creation of institutions is an attempt to alter the environment. Add a constable to chaos and behavior will be modified. Recognizing that genetic predispositions will lead some people to react differently than others in the face of the same institution has the potential to allow institutional designers to fine-tune their work in hopes of achieving a better result—or at least suggests the difficulties of successful institutional design. Given genetic diversity, it is fair to conclude that one size does not fit all.

Rational choice scholars know that individuals have different preferences for avoiding risks, for experiencing new things, for trying to persuade others to change their preferences, and perhaps for substantive matters such as a deep suspicion of out-groups or the promotion of unchanging traditional values. The assumption that preferences are merely a rational reflection of the individual's situation is highly questionable, and the assumption that preferences can be inferred from behavior leads in an endless circle. With the recognition of genetics as a source of preferences, both of those assumptions become unnecessary.

With regard to international relations, conflict can be seen as arising not just because of environmental factors but also from varying innate predispositions on the part of the potential combatants. Adopting a biological orientation does not require adopting the belief that all humans are inherently violent or, conversely, inherently peaceful (for explication, see Sapolsky 2006); such claims are badly misguided. Traits such as a proclivity toward violence vary dramatically from person to person, from context to context, and from gene pool to gene pool. Some people are more violent than others. This is true of their tendency toward violence in their personal lives (e.g., getting involved in a bar fight) as well as of their tendency to advocate collective violence against an out-group (e.g., starting or supporting a war fought by others). Interestingly, the correlation between these two different orientations to violence may be quite weak.

Comparative politics could be greatly assisted by recognition of the fact that groups of people are genetically distinct from other groups of people. To provide a concrete illustration, we reference diversity of an important gene in the dopaminergic system. Imbalances in the neurotransmitter dopamine have been implicated in Parkinson's disease as well as in several behaviors including novelty-seeking. The relevant gene is called *DRD4* because it is instrumental in laying down the D4 class of dopamine receptors. An insufficient supply of these receptors would minimize the effect of any dopamine that is present, since all the dopamine in the world will not matter to a biological system incapable of receiving that dopamine. Previous work has found evidence that, compared to those with short alleles, individuals with one or two long alleles of *DRD4* are more likely to exhibit risk-taking behavior, display behavior, and perhaps attention deficit disorder (Chen et al. 1999, Harpending & Cochran 2002, Ding et al. 2002). There is substantial variation from group to group in the presence of these long alleles (defined here as at least seven repeats of a key 48-nucleotide base-pair sequence in exon III). Data on the frequency of long alleles have been reported for 39 different groups (Chen et al. 1999) and range from a high of 78% for the Ticuna and Guahibo peoples of Colombia to a low of 4% for the Atayal of Taiwan, followed closely by the Han (China) and Samoans, both at just 5%. Continent-by-continent breakdowns reveal interesting patterns. African and European groups are on average quite similar, with the four African groups in the sample (the Biaka, the Mbuti, the San, and the Bantu) averaging 21% long alleles and the five European groups (Sardinians, Danes, Swedes, Spaniards, and a mixed European sample from the United States) averaging 15%. Some African groups, such as the San, have fewer long alleles (9%) than some European groups, such as the Swedes (19%). But the biggest variations can be seen between the East Asian groups, with a mean of 9% (just 6% if the Malay are excluded), and the South American groups, with a mean of 69%.

These allelic differences across groups are immense and we can say with confidence that they are not coincidental. Certain groups are genetically different from other groups. Although such a statement may elicit gasps in some quarters, it is far from surprising; any time breeding populations are kept separate for numerous generations, differences will be evident. The obvious question of interest is whether this undeniable genetic variation across groups has any influence at all on group behavior. Given that research in this area is normatively charged, we should state clearly that we are not claiming that the Ticuna and Atayal people behave differently because of genetic differences. Genes are expressed differently in different environmental contexts, so once contextual factors are introduced, these sizable genetic differences may very well be completely irrelevant to behavior. But they may also be relevant, and to deny this possibility simply because we do not want it to be true alters the status of our inquiry from science to wishful thinking or perhaps even religion. The most startling revelation of all may be that social scientists have not conducted any tests to determine if these sizable genetic variations from group to group have any behavioral implications.

Conclusion

If understanding of politics is to advance, the grip of environmental determinism must be loosened, and appreciation of the role of biology must extend beyond think pieces and "calls to arms." Serious empirical research on the interaction of biological and environmental independent variables needs to become the order of the day. Recent work in cognitive psychology, neuroscience, experimental economics, and behavior genetics serves as a valuable guide for the manner in which empirical biopolitics should be conducted. This article has given the most attention to behavior genetics because momentum is building in this area and because its data and research methodologies are of a sort that is familiar to many political scientists.

The implications of a possible role for genetics in accounting for variance in political attitudes and behaviors across individuals and groups may seem disquieting, but acknowledging a role for genetics does not equate with intolerance. In fact, admitting that behavioral traits are partially genetic may lead to a more tolerant world. Those who accept the growing evidence that sexual orientation is influenced by both genetics and prenatal environment are generally more accepting of homosexuality than those who are convinced sexual orientation is entirely determined by postnatal environmental forces (and therefore can be reprogrammed in boot camps). The same can be said for politics. Accepting that those who differ from us politically are not being willfully bullheaded but may have a genetic predisposition toward beliefs contrary to ours may take the edge off of the overheated political debate that characterizes conflicts between the left and the right. People understandably may not want to give up hope that their political opponents can someday be turned from the dark side, but it still might be useful to recognize that certain individuals are genetically predisposed toward certain political orientations.

Summary Points

1. Twin studies offer a way to assess the extent to which genes are relevant to a trait.
2. Personal temperament is shaped by both genetic and environmental forces.
3. Political temperament is shaped by both genetic and environmental forces.
4. Political temperament may be a function of personal temperament but it also seems to have unique components.
5. Political scientists tend to know little about modern genetics and to ignore the genetic basis of political attitudes.
6. It is possible and desirable for political scientists to work with geneticists and to learn their techniques.
7. Incorporating genetics into the study of social behavior is the wave of the future for the social sciences.

Future Directions

1. Twin studies with better data on political variables.
2. Twin studies of social behavior such as decisions in economic games.
3. Adoption studies involving political variables and adult adoptees.
4. Association studies in which specific genetic alleles are checked for association with particular political traits.
5. Comparing and contrasting personal and political temperaments.
6. Identifying the biological/neural systems relevant to political thinking.

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