



On the genetic basis of political orientation

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Scholars have long been interested in the underpinnings of political ideology. Over the past fifteen years or so, political scientists, psychologists, sociologists, and economists have started to take seriously the idea that ideology might be influenced by genes. In this article, we review the literature on the genetics of ideology. We begin by describing twin studies and more sophisticated approaches that have now emerged, which consistently show that ideology is about 40% heritable. Next, we examine the state of research on genetic influences on ideology over the life cycle and mechanisms that could link genes and ideology. We conclude by discussing the preliminary genome-wide studies that have been conducted. Existing research has provided important insights into the link between biology and ideology, but additional research is needed in order to provide a more nuanced understanding of the role of biology in the formation of political ideology.

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Introduction

Political scientists and psychologists have long been interested in the underpinnings of political orientations. Scholars have been especially fascinated with political ideology, which is generally thought of as a set of beliefs about proper societal order and how to achieve it [2,54]. Ideology is often viewed as a unidimensional construct—typically measured on a continuum ranging from liberal to conservative—but has also been demonstrated to be multidimensional (e.g., social and economic dimensions) [1]. Political ideology is related to a wide range of outcomes at the individual level and thus it is important to develop an understanding of why people adopt certain ideologies over others. Researchers in

psychology have tended to focus on the influence of personality traits and motivational factors in shaping ideology [2]. Political scientists have looked at a variety of factors that might influence ideology, including family socialization, demographic variables, and more recently personality traits [3–5].

Motivated by behavior genetics research demonstrating the heritability of traits related to ideology, like personality, there has been a recent growing interest among social scientists in the genetic underpinnings of ideology. In fact, there are now several studies showing that political ideology is, at least in part, influenced by genes [6[•],7^{••},8,9[•],10–12,14–19,20[•],21^{••},24,25,26^{••},29,30[•],31–35,36,37[•],38,39,40^{••},41,42] (for additional reviews of research on the genetic basis of political behaviors and attitudes, see Refs. [45–49]). In this article, we examine the state of the literature on the genetic basis of political ideology. We begin by describing the findings that have emerged from studies using the classic twin design and also from more sophisticated approaches. Next, we examine the state of research on genetic influences on ideology over the life cycle and mechanisms that might link genes and ideology. We end by providing an overview of the preliminary genetic association studies (and criticisms of those studies) that have been conducted so far.

Twin studies

The starting point for understanding the genetic basis of ideology is the classical twin design (CTD). The basic idea behind this approach is to compare monozygotic (MZ) twins, who are genetically identical, to dizygotic (DZ) twins, who share half of their genes. Generally, if MZ twins show more similarity on a given trait compared to DZ twins, researchers would take this as evidence that the trait is under genetic influence. In accordance with the CTD, it is possible to estimate the *heritability* of a trait, which is defined as the amount of variation in the trait that can be attributed to genetic variation. It is important to keep in mind that heritability estimates refer to a population rather than individuals. For example, if a study reported a heritability estimate of 0.45 for a particular trait, the correct interpretation would be that 45% of the individual differences in that trait is attributable to genetic variation. In other words, this estimate does not mean that for a specific individual, 45% of the trait is due to their genes and the other 55% is due to their environment.

In the study that sparked interest in the genetics of ideology among political scientists, Alford, Funk, and Hibbing reported a heritability estimate of roughly 40%

for ideology [6**]. Follow-up studies, which have used a wide range of samples and measures and have used data collected across different countries, support this result [7**,8,9*,10–12]. In addition, more fundamental dispositions toward social rules, order, and conduct that inform attitudes about issues of the day [13*] have also been shown to be heritable [14]. Interestingly, this highly influential work was actually predated by several studies by Lindon Eaves, Hans Eysenck, and Nicholas Martin in the 1970s and 80s showing that genes play a role in shaping ideology [15–17].

Although the classical twin design provides a way of learning about the genetic and environmental underpinnings of orientations like ideology, it is important to point out that the CTD relies on several assumptions required to identify the effect of genetic and environmental factors, such as the absence of assortative mating and the so-called equal environments assumption (EEA). Also, a limitation of restricting the analysis to MZ and DZ twins is that the effect of additive and non-additive genetic as well as environmental factors cannot all be estimated in the same model.

As a result, follow-up work on the genetic basis of ideology has used more sophisticated designs utilizing information from parents to test for assortative mating and non-twin siblings to estimate additive and non-additive genetic factors [18,19,20*,21**]. These models also enable a better understanding of the role of environment shared by children and parents as well as among twin siblings compared to that of non-twin siblings. Generally, the results from research using additional family members confirm the previous finding that individual differences in political ideology can be explained, at least in part, by genetic factors. Interestingly, researchers who use these approaches often report that genes account for an even greater proportion of the variance in ideology than what is reported in studies using the CTD [21**]. Thus, results from studies using the CTD may actually underestimate the extent to which ideology is heritable.

The assumption of the CTD as well as more sophisticated designs that typically is the source of strong criticism [22,23] is the EEA (equal environments assumption). In order to conclude that difference in similarity between MZ and DZ twin pairs for a particular trait is due to genetic factors, it is necessary to assume that the shared environmental influences on the trait studied are the same for both MZ and DZ twins. If this is not the case, the effect of shared environmental and genetic factors is confounded. While this assumption cannot be directly tested in the CTD (or models using additional family members), studies utilizing measures of self-reported environmental similarities among twins have failed to find evidence that a violation of the EEA leads to inflated heritability estimates of ideology [24,25].

Ideology over the life cycle

In addition to the use of additional family members and more sophisticated models, scholars interested in the biological basis of ideology have examined how genetic influences on ideology change over the life cycle and how experiences during the life course can interact with genetic factors to influence ideology [19,26**]. To date, there have only been a few studies in this area, likely due to the fact that fairly complex datasets are necessary in order to answer questions about ideology over time (e.g., longitudinal surveys with data on twins). The existing studies provide an interesting picture of the development of ideology, and indicate that this is a fruitful area for future research. For example, scholars have found that genetic influences on ideology are typically absent before people reach young adulthood. During childhood and adolescence, ideology seems to be driven mostly by unique and shared environmental influences (an example of the latter being family socialization), but when individuals reach early adulthood (and leave home), genetic influences on political attitudes become as prominent as environmental influences and end up persisting throughout most of adulthood [26**].

Mechanisms linking genes and ideology

Interesting research is also developing on the possible psychological mechanisms that might connect genes to political ideology. Although the research outlined above provides solid evidence that there is a genetic basis to ideology, genes do not directly influence ideology. Thus, it makes sense to examine how genes have an indirect influence on ideology. Indeed, Jost has suggested that “the heritability of basic cognitive, motivational, and personality orientations could account for the heritability of political attitudes” [55]. To date, numerous studies have examined whether genetic influences on ideology work through psychological traits or dispositions that have been demonstrated by social scientists to be related to ideology, such as the Big Five personality traits [2–5], cognitive ability [27], cognitive style [2], and religiosity [28]. Given that many psychological traits are heritable, it makes sense to examine whether they are possible mechanisms that account for some of the heritable variation in political ideology. A number of recent studies have found that there is indeed genetic overlap between political orientation and psychological traits, including cognitive ability [9*], social fear [29], the Big Five personality traits [12,16], need for cognition and need for cognitive closure [30*], need to evaluate [31], religiosity [32,33], social dominance orientation [34], and right-wing authoritarianism [35].

It is necessary to point out, though, that there is debate about what the genetic overlap between psychological traits and ideology means. For instance, the relationship could be causal in nature. Genes may influence psychological traits that in turn influence ideology. On the other

hand, the reverse could be true. Genes could influence attitudes that in turn influence psychological traits. Additionally, genetic overlap between ideology and psychological traits could indicate reciprocal causation, where psychological traits influence ideology but ideology also influences psychological traits. Lastly, it is possible that the same set of genes influences political ideology and psychological traits independently—a relationship known as pleiotropy. Numerous recent studies focusing on personality traits and ideology have reported that the relationship between personality and political ideology is correlational (and not causal) and is driven by common genetic influences [36,37,38,39]. Interestingly, though, there is some evidence that cognitive ability, which is not generally seen as a personality trait, mediates part of the genetic influence on political orientations [9]. Additional research is needed in order to develop a better understanding of the pathways that connect genes to political ideology.

Genetic association studies

It is also important to note that researchers interested in the genetic basis of ideology have attempted to conduct genetic linkage [40] and association studies [7,41,42]. The basic idea here is to search the genome for genetic variants that are significantly correlated with ideology in the hope of elucidating the pathways linking genes and ideology. While a large body of evidence has accumulated from twin studies suggesting that genetic factors explain a substantial fraction of the variation in ideology, no study to this point has provided definitive evidence of a specific genetic marker being related to ideology. This should not come as too much of a surprise. It is highly unlikely that a single gene or even a small group of genes will directly influence a complex trait like political ideology. Instead, it is much more likely that thousands of genetic variants scattered across the genome each exert very small effects in an indirect manner [42]. Therefore, extremely large samples are necessary to detect such small effects [43]. It is necessary to point out that there has been debate about the utility of such studies. Although the debate has primarily centered on studies on the genetic basis of political participation, it is relevant to studies on ideology as well since scholars have done similar studies (i.e., candidate gene studies) in the context of ideology. While some scholars have argued that genetic association studies are beset by difficulties [50,51], other researchers believe that they are valuable for understanding the genetic basis of political traits [52,53]. In recent years, scholars have put forward ideas on how gene association studies should be interpreted by scholars and handled by academic journals, which will hopefully help improve the literature in this area [52,53].

Given the types of datasets and sample sizes that are necessary to conduct such an analysis, the search for specific genetic variants associated with ideology will

be extremely challenging. However, alternate approaches may prove fruitful. Rather than test whether individual genes are associated with ideology, researchers have instead begun to construct and analyze individual-level indices called genome-wide polygenic scores that aggregate the effect of genes associated with a particular trait [44]. This approach overcomes issues of statistical power while at the same time illuminating potential pathways through which genes influence ideology. For example, polygenic scores for personality traits can be utilized to test whether the genes associated with personality also influence political orientations. Overall, research in this area is in its infancy and scholars will need to do a great deal of additional work to better understand the genetic etiology of ideology.

Conclusions

Political ideology influences a wide range of variables, including how people perceive and react to others in society (i.e., ingroup versus outgroup), view political events, and vote in elections. Thus, it is not surprising that researchers across different disciplines have been interested in understanding the causes and consequences of ideology. Interest in political ideology has only heightened in recent years given the increase in elite and mass ideological polarization. Importantly, over that past fifteen years or so, political scientists and psychologists have started to take seriously the idea that ideology might be influenced by genes—that it is not entirely explained by environmental factors like parental socialization or demographic variables. Indeed, there is now a solid body of evidence—using different samples (collected across different countries), different measures of ideology, and different methodologies—indicating that ideology is partially heritable. Given this finding, the natural follow-up question is “*how* are genes connected to ideology?” Researchers are currently working to better understand the specific mechanisms that link genes and political orientations. At this point, we have some insights about the pathways that connect genes and ideology, but there is a lot left to learn (For example, one recent study using twin data from Sweden found evidence that cognitive ability mediates part of the genetic influence on ideology [9], but it will be important to replicate this study using different samples and contexts). There are a number of areas for future research on the genetic basis of ideology. Although scholars have long debated whether human behavior and attitudes are driven by nature or nurture, it appears that scholars are now convinced that both sets of factors influence people. Thus, researchers interested in ideology would be well served by focusing on the biological *and* environmental underpinnings of ideology. In fact, work that considers *both* factors and the *interplay* between biology and environmental factors probably offers the greatest potential for developing a realistic picture of how ideology is formed and maintained (or changed) over time. We encourage researchers to utilize

different research designs (i.e., adoption studies) and longitudinal studies on genetically informed samples to separate genes from environment. Another area of research, as Jost has suggested, is to continue to examine whether additional cognitive, motivational, and personality measures are linked to political attitudes. Indeed, scholars have only examined a handful of basic predispositions that could be related to ideology. We note, however, that it will not be possible to establish a definitive causal pathway from genes to ideology given that it is difficult or impossible to experimentally manipulate these potentially mediating factors. One final interesting research area will be in the area of epigenetics. Epigenetics focuses on processes that alter gene activity (i.e., switching genes on or off) without changing the DNA sequence. Although researchers in genetics are learning more and more about epigenetic processes, there has been virtually no work applying epigenetics to politics. Understanding whether and how epigenetic mechanisms are related to political orientations would help to further illuminate the links between genes and ideology. As Smith *et al.* note, “the kinds of phenomena that social scientists study (voting behavior, ideological variations, etc.) are complex and continuous, what geneticists refer to as quantitative traits. For most phenotypes (observable characteristics) that interest social scientists, a large number of different genes are likely to interact with the environment and with other genes and epigenetic markers to shape the behavior of interest” [13*].

Overall, despite the challenges associated with studying genetic influences on ideology (e.g., locating datasets with the necessary information and large sample sizes), now is an incredibly exciting time for political scientists, psychologists, sociologists, and economists to be studying the underpinnings of ideology—while some robust empirical findings have emerged in the literature, existing studies yield more questions than they do answers.

Conflict of interest statement

Nothing declared.

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