
Genes, personality, and political behavior *A replication and extension using Danish twins*

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ABSTRACT. In this article, we examine whether there is genetic overlap between personality traits and political participation, interest, and efficacy. We make several contributions to the literature. First, we use new data from a large sample of twins from Denmark to examine the link between genes, the Big Five traits, and political behavior. Previous research in this area has not examined the Danish context. Second, because our measures have some overlap with those used in previous studies, we are able to examine whether previous findings replicate in a different sample. Finally, we extend the literature by examining the possible genetic link between some personality and political traits that have not yet been explored. Overall, we find that genes account for a fairly large share of the correlation between two of the Big Five personality traits (openness and extraversion), political participation, and political interest. Thus, most of the relationship between these personality traits and our measures of political behavior can be accounted for by a common underlying genetic component.

Key words: political behavior, genopolitics, heritability, personality, Big Five, genes

Introduction

While a considerable amount of research has explored the influence of demographic variables, socialization experiences, resources, and mobilization on political engagement and attitudes (Brady et al., 1995; Enos & Fowler, 2018; Holbein, 2017; Holbein & Hillygus, 2020; Jennings et al., 2009; Leighley & Nagler, 2013; McIntosh et al., 2007; Weinschenk & Dawes, 2022), over the past 15 years or so, scholars have expanded the list of possible influences on political behavior to include biological and psychological factors. A growing body of research has examined the genetic underpinnings of political attitudes and participation (see, e.g., Arceneaux et al., 2012; Fowler et al., 2008; Klemmensen, Hatemi,

Hobolt, Petersen et al., 2012; Klemmensen, Hatemi, Hobolt, Skytthe, & Nørgaard, 2012), and a related line of work has examined the association between psychological attributes and measures of political behavior (see, e.g., Blais & Labbé St-Vincent, 2011; Denny & Doyle, 2008; Gerber, Huber, Doherty, Dowling et al., 2011; Mondak, 2010; Mondak et al., 2010). Motivated by these studies and the well-established finding in the psychology literature that most psychological traits are partially heritable (Bouchard, 2004; Bouchard et al., 1990; Bouchard & McGue, 2003; Jang et al., 1998; Loehlin et al., 1998; McCrae & Costa, 1992; Vukasović & Bratko, 2015), some researchers have tried to understand the relationship between genes, psychological traits, and political variables such as participation, interest, and efficacy.¹ Since this

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¹Research on the genetic basis of the relationship between personality and political behavior represents just one stream of research

type of work requires a particular type of data (e.g., surveys with large samples of monozygotic and dizygotic twins and measures of psychological traits and political behavior), the number of studies has been fairly limited (Dawes et al., 2014; Dawes et al., 2015; Weinschenk & Dawes, 2017; Weinschenk et al., 2019). The initial work that has been done in this area has been promising, indicating that some psychological and political traits have a common underlying genetic component. Consequently, we are interested in further developing this line of research.

The key question of interest to us is whether and to what extent psychological and political traits have genetic overlap. We are specifically interested in the Big Five personality traits (neuroticism, agreeableness, extraversion, conscientiousness, and openness) and political participation, interest, and efficacy. We focus on these measures of political behavior given the widely articulated idea that in a democratic society, it is important that people participate in the political process, be politically interested, and feel a sense of efficacy (Galston, 2001; Verba et al., 1995).² For those interested in increasing levels of engagement in democracy at the individual level, it is critical to develop an understanding of the underpinnings of political behavior. As a brief overview, “The Big-Five framework suggests that most individual differences in human personality can be classified into five broad, empirically derived domains” (Gosling et al., 2003, p. 506). The Big Five are among the most widely researched personality traits in psychology, and, as John (2021) notes, “After decades of research, and long debates about the right number of factors and the best labels for these factors, the field has now achieved an initial consensus on a general taxonomy of personality traits: the ‘Big Five’ personality dimensions” (p. 35).³

within the literature on biopolitics (also called genopolitics). For overviews of the state of research on biology and politics, see Dawes and Weinschenk (2020), Ksiazkiewicz and Friesen (2017), Murray (2017), and Wajzer (2020).

²The concept of political participation is fairly straightforward and refers to how engaged people are in political activities (e.g., contacting elected officials, donating, etc.), but it is important to point out what we mean by political interest and efficacy. Political interest refers to “a state of curiosity, concern about or attention to politics” (Haug, 2013, p. 233). Political efficacy refers to “citizens’ perceptions of powerfulness (or powerlessness) in the political realm” (Morrell, 2003, 589). Typically, scholars see political efficacy as being internal (e.g., belief in one’s skills to influence politics) or external (e.g., belief that political institutions or elites will be responsive to attempts to exert influence).

³As an overview of the traits, “Extraversion implies an energetic approach toward the social and material world and includes traits such

This study makes several contributions to the literature. First, we use a novel data set from the Danish Twin Registry (DTR), which contains information on a large sample of Danish twins, to examine the link between genes, the Big Five traits, and political behavior. Denmark is an interesting case to explore ideas about biology, personality, and political behavior because previous studies have found that personality traits are heritable in the Danish context (e.g., Weinschenk et al., 2022) and that many different measures of political behavior, including participation, interest, and efficacy, are partially heritable in Denmark (e.g., Klemmensen, Hatemi, Hobolt, Petersen et al., 2012, Klemmensen, Hatemi, Hobolt, Skytthe, & Nørgaard, 2012). Despite the findings from these two streams of research, we are not aware of studies on the extent to which personality traits and measures of political behavior are related in Denmark and whether any relationships that do exist are driven by genetic and/or environmental factors. Another advantage of using data from Denmark is that it allows us to study the relationship between genes, personality, and political behavior in a new context since previous studies have focused on Sweden, the United States, and Germany (Dawes et al., 2014; Dawes et al., 2015; Weinschenk & Dawes, 2017; Weinschenk et al., 2019). Because we employ some of the same measures used in earlier studies, we are able to compare our results to the existing literature to see whether previous findings hold up in a different context.

Second, although our measures have some overlap with those used in previous studies, we are also able to examine the possible genetic link between some personality and political traits that have not yet been explored. For instance, Dawes et al. (2014) used measures of participation, interest, and efficacy, but only one of the Big Five personality traits (extraversion). Dawes et al. (2015) had measures of political engagement (but not interest or efficacy) and traits related to the Big Five (positive emotionality, which is related to extraversion;

as sociability, activity, assertiveness, and positive emotionality. Agreeableness contrasts a prosocial and communal orientation towards others with antagonism and includes traits such as altruism, tender-mindedness, trust, and modesty. Conscientiousness describes socially prescribed impulse control that facilitates task and goal-directed behavior, such as thinking before acting, delaying gratification, following norms and rules, and planning, organizing, and prioritizing tasks. Neuroticism contrasts emotional stability and even-tempereness with negative emotionality, such as feeling anxious, nervous, sad, and tense. Finally, Openness to Experience (vs. closedmindedness) describes the breadth, depth, originality, and complexity of an individual’s mental and experiential life” (John & Srivastava, 1999, p. 121).

negative emotionality, which is similar to emotional stability; and constraint, which is related to conscientiousness). Weinschenk and Dawes (2017) used measures of interest (but not participation or efficacy) and all of the Big Five traits. Finally, Weinschenk et al. (2019) used measures of interest and participation (but not efficacy) and all of the Big Five traits. Thus, we know very little about the genetic overlap between the Big Five traits (beyond extraversion) and political efficacy. We are aware of only one study that has examined the nature of the relationship between openness, conscientiousness, agreeableness, neuroticism, and participation.

Lastly, our data set contains a rich personality battery consisting of 60 items (12 questions for each of the Big Five traits). Many studies have employed short personality batteries, but, when possible, it is generally preferable to use longer measures due to increased reliability and reduced measurement error.⁴

Previous research and expectations

As we noted earlier, there has been increasing interest among political scientists in the relationship between individual differences and political behavior. A number of studies in political science and psychology, for example, have examined the heritability of different measures of political behavior. Numerous studies have found that political participation is heritable (Dawes et al., 2014; Dawes et al., 2015; Fowler et al., 2008; Klemmensen, Hatemi, Hobolt, Petersen et al., 2012; Weinschenk et al., 2019). In addition, attitudes related to politics, including political interest (Arceneaux et al., 2012; Bell et al., 2009; Dawes et al., 2014; Klemmensen, Hatemi, Hobolt, Skytthe, & Nørgaard, 2012; Weinschenk & Dawes, 2017; Weinschenk et al., 2019) and political efficacy (Dawes et al., 2014; Klemmensen, Hatemi, Hobolt, Petersen et al., 2012; Klemmensen, Hatemi, Hobolt, Skytthe, & Nørgaard, 2012), have a high degree of heritability. Although it is interesting to know that political variables are heritable, the next obvious question is *how* genetic factors might be linked

⁴For example, Weinschenk et al. (2019) uses as few as three items to measure some personality traits and Weinschenk and Dawes (2017) uses as few as four items to measure some personality traits. Our argument is not that short personality measures should never be used (or that short measures are inherently bad), but that, when possible, it is preferable to have many items designed to measure the same concept, since this generally reduces the amount of measurement error (see Ansolabehere et al., 2008). For a more detailed discussion of the advantages and disadvantage of measuring personality using long and short batteries, see Bakker and Lelkes (2018).

to political traits. Research on psychological traits provides some insights into the possible association between genetic predispositions and measures of political behavior.

Related to the aforementioned research is a series of studies exploring the association between individual psychological traits and political behavior. Numerous scholars have found that the Big Five personality traits are related to participation in politics. The most consistent finding has been a positive relationship between openness, extraversion, and political participation (Gerber, Huber, Doherty, Dowling et al., 2011; Mondak, 2010; Mondak et al., 2010). We note, though, that Gerber, Huber, Doherty, Dowling et al. (2011) found that conscientiousness has a negative and statistically significant effect on a participation index and that emotional stability is a positive and statistically significant predictor of participation.⁵ Studies have also found that several of the Big Five traits are related to political interest. Indeed, numerous scholars have found that extraversion and openness are positively correlated with political interest (Furnham & Cheng, 2019; Gerber, Huber, Doherty, & Dowling, 2011; Mondak, 2010). Gerber, Huber, Doherty, & Dowling (2011) also reported that conscientiousness and emotional stability have a positive and statistically significant effect on interest in politics. Finally, several studies have reported a link between a number of the Big Five traits and measures of political efficacy (Cooper et al., 2013; Mondak, 2010; Mondak & Halperin, 2008; Vecchione & Caprara, 2009). Here, the most consistent finding, which is in line with the research mentioned earlier on participation and interest, is that people with high scores on openness and extraversion are more politically efficacious than their counterparts.

It is important to note that most psychological traits are moderately heritable. A voluminous body of research has examined the etiology of psychological traits, and studies consistently find that the Big Five personality traits are heritable (Bouchard, 1994, 2004; Jang et al., 1996; McCrae & Costa, 2003; Riemann et al., 1997). A meta-analysis of the heritability of personality across studies (Vukasović & Bratko, 2015) found that heritability estimates run from 0.31 [0.22, 0.40] for conscientiousness to 0.41 [0.31, 0.51] for openness, with the other traits falling within that range. Given research

⁵Interestingly, Mondak (2010) found a negative relationship between emotional stability, conscientiousness, and participation in politics. Thus, there are some mixed findings for these two personality traits.

showing that political participation, interest, and efficacy are all partially heritable; that the Big Five traits are correlated with these measures of political behavior; and that the Big Five traits are heritable, it seems worthwhile to examine whether psychological and political traits have similar biological underpinnings.

Only a handful of studies have explored the nature of the relationship between genes, personality traits, and political behavior. In large part, this stems from data limitations—a limited number of data sets contain twin samples, personality measures, and measures of political traits. Dawes et al. (2014) examined whether extraversion and several traits outside of the Big Five model overlap genetically with measures of political participation. Using a bivariate Cholesky decomposition model on Swedish twin data, they found that genetic factors explain 67% to 89% of the correlation between extraversion and four measures of political engagement—voting, contacting a public sector official, contacting a politician, and an overall participation index. In addition, genetic factors account for about 58% of the correlation between extraversion and political interest, 64% of the correlation between extraversion and external efficacy, and 71% of the correlation between extraversion and internal efficacy. In a related study, Weinschenk and Dawes (2017) used two U.S. twin samples to examine the association between genes, the Big Five, and political interest. Their study showed that genetic factors account for 49% to 72% of the correlation between interest and four personality measures (extraversion, conscientiousness, emotional stability, and openness).⁶ Finally, we note that Weinschenk et al. (2019) were also able to examine the link between genes, the Big Five, and political participation and interest. Using data from a sample of German twins, they found that genes account for 67% of the correlation between openness and participation and 63% of the correlation between openness and interest.

In this article, our goal is to examine whether the relationship between personality traits and political traits is driven primarily by genetic or environmental factors. To do this, we first need to examine the extent to which the

⁶Interestingly, since both Dawes et al. (2014) and Weinschenk and Dawes (2017) had measures of extraversion and political interest, it is possible to compare their results for this psychological trait. Weinschenk and Dawes (2017) found that percentage of the total correlation between extraversion and political interest due to genetic factors was 66%, which is very similar to the 58% reported by Dawes et al. (2014).

Big Five traits and political measures in our sample are heritable, which is what previous research suggests, and to examine the extent to which personality traits are correlated with our political measures. The initial evidence from the studies mentioned earlier suggests that there is a genetic correlation between psychological traits and measures of political engagement. Thus, we expect that personality and political traits will overlap genetically.

Data and measures

We use data from the Danish Twin Registry at the University of Southern Denmark.⁷ The DTR is one of the oldest twin registries in the world and contains data on more than 75,000 twin pairs born in Denmark over the last 130 years. Participants were drawn from the DTR's younger cohort of twins (all of whom were born between 1970 and 1989). Here, we use data collected via a survey conducted in 2012. Respondents were asked to complete a 60-item personality battery (12 measures per trait for five traits); they also answered questions about political participation and attitudes.⁸

To construct our measures of the Big Five traits, we conducted reliability analyses for each of the five sets of 12 personality traits and generated overall measures of each personality trait based on the items that maximized the reliability score (each of the Big Five traits is made up of 9–12 items). Overall, the alpha scores for the traits are as follows: conscientiousness (0.78), emotional stability (0.83), extraversion (0.82), agreeableness (0.73), and openness (0.72).

To measure political efficacy, we created an index based on the following four items, each of which is coded on a 4-point scale ranging from “completely agree” to “completely disagree”: “People like me have no

⁷We are unable to share or post the Danish Twin Registry data used in this article. However, information on how to apply for and get access to the data can be found at https://www.sdu.dk/en/om_sdu/institutter/centre/ist_sundhedstjenesteforsk/centre/dtr/researcher/guidelines. The data used for this research was provided by the Danish Twin Registry, University of Southern Denmark. The findings, opinions, and recommendations expressed therein are those of the author(s) and are not necessarily those of the Danish Twin Research Center. The Danish Twin Registry has been approved by SDU RIO (SDU Legal Services) and the Committee on Health Research Ethics. The participants were enrolled by informed consent. The Danish Twin Registry, SDU RIO notification no. 10.585.

⁸To measure personality, respondents were asked to assess the extent to which 60 different statements (e.g., “I like having a lot of people around me”) describe their personality. Each item was assessed on a 4-point scale ranging from “completely agree” to “completely disagree.”

influence on government decisions,” “Government does not care about what people like me think,” “People like me have no say on local government decisions,” and “Local government does not care what people like me think.” The reliability score for the overall measure is 0.89. To measure political interest, we used a single item (“How interested are you in politics?”), which is coded on a 4-point scale ranging from “very” to “not at all.” Finally, to measure political participation, we made use of a series of questions about participation in nine different political acts.

Given the diverse range of acts included in the survey, we conducted a factor analysis of the political activities to explore whether there were different dimensions of political participation. We created two indices based on the loadings. Our first index is based on the following acts: participated in a political meeting; contacted/been on the media to express my point of view; contacted/tried to contact a politician/public official; and participated in political forum or discussion group on the internet. We label this measure “communication,” given that all of the acts entail some form of communication. The reliability score for this measure is 0.76. Our second index is based on the following items: signed a petition; boycotted or deliberately purchased certain goods for political, ethical, or environmental reasons; participated in a demonstration; and contributed/collected money in support of social/political activities. To differentiate it from the first participation measure, we refer to this measure as “activism” in the analyses that follow. The reliability score for this measure is 0.70.

Before proceeding, it is worth noting that participants in the DTR seem to mirror the general Danish population quite well (see Klemmensen, Hobolt et al., 2012). Thus, we believe that the estimates obtained from our sample of twins are generalizable to at least some extent.

Analysis and results

In this article, our analysis is based on two steps. In the first step, we estimate univariate twin models for each of the measures. The purpose of these models is to ascertain how much of the variation in each measure can be attributed to environmental and genetic factors. Twin studies make use of the fact that monozygotic (MZ) twins share 100% of their genes and dizygotic (DZ) twins share approximately 50% of their genes. Comparing the trait similarity among MZ twins to that of DZ twins enables us to estimate the extent to which

that trait is influenced by genes.⁹ In a more formal sense, a univariate twin model is rooted in the idea that the *variance* in a given trait can be divided into additive genetic factors (A), environmental factors that are shared by twins in a pair (C), and unique environmental factors (E). This is what researchers typically call the ACE model.¹⁰ The common environment includes factors to which both twins in a pair were equally exposed (e.g., rearing environment, etc.). Unique environmental factors refer to things that twins in a pair experienced individually (e.g., different teachers at school). The influence of genes and environment is inferred via their effects on the covariances of twins (Neale & Cardon, 1992).¹¹

In the second step of our analysis, we use a bivariate Cholesky decomposition (Martin & Eaves, 1977) to assess how much of the *covariation* between each political measure and each personality trait can be attributed to common genes. This model assumes that the latent factors underlying personality also influence the political measures but that the latent factors underpinning political measures do not influence personality traits.¹² One useful feature of the bivariate model is that we can use the parameter estimates to construct several different quantities that aid in interpreting the results. Here, we focus on two quantities. First, the genetic correlation is a measure of the degree to which the genetic component of two traits covary. A correlation value of 0 indicates that two traits are influenced by completely different genes. On the other hand, a correlation value of 1 (or -1) indicates that the same genes influence both traits. We also calculate the percentage of the phenotypic correlation between two traits that can be explained by additive genetic factors.¹³

⁹This model requires an assumption known as the equal environments assumption (EEA). A violation of this assumption would lead to an overestimate of heritability and an underestimate of common environmental influence. Some studies have looked at whether there is an upward bias in the heritability of political attitudes as a result of EEA violations, but they have not found much evidence (Hatemi et al., 2009; Hatemi et al., 2010; Littvay, 2012; Smith et al., 2012). We include a more in-depth overview of the EEA in the Online Appendix.

¹⁰See Medland and Hatemi (2009) for an excellent overview of biometric modeling aimed at social scientists.

¹¹We include for interested readers a more formal overview of the univariate model in the Online Appendix.

¹²In the Online Appendix, we include a more formal overview of the bivariate model.

¹³We indicate the genetic correlation as r_g , the common environment correlation as r_c , and the unique environment correlation as r_e . Additionally, we indicate the percentage of correlation that is accounted for by genetic factors as $\%r_g$ (we use $\%r_c$ for common environment and $\%r_e$ for unique environment). It is important to note

Table 1. Heritability estimates for Big Five personality traits and political measures.

	Heritability	Common environment	Unique environment
Extraversion	0.47 [0.21, 0.63]	0.09 [0.00, 0.30]	0.44 [0.37, 0.53]
Agreeableness	0.33 [0.05, 0.53]	0.13 [0.00, 0.35]	0.55 [0.46, 0.65]
Conscientiousness	0.32 [0.00, 0.47]	0.06 [0.00, 0.32]	0.62 [0.53, 0.73]
Openness	0.52 [0.30, 0.59]	0.00 [0.00, 0.18]	0.48 [0.41, 0.57]
Emotional stability	0.29 [0.02, 0.56]	0.20 [0.00, 0.43]	0.51 [0.42, 0.60]
Participation [communication]	0.49 [0.20, 0.59]	0.02 [0.00, 0.26]	0.49 [0.41, 0.58]
Participation [activism]	0.00 [0.00, 0.27]	0.41 [0.19, 0.49]	0.59 [0.50, 0.67]
Efficacy	0.02 [0.00, 0.36]	0.36 [0.07, 0.46]	0.61 [0.51, 0.71]
Interest	0.55 [0.29, 0.63]	0.00 [0.00, 0.23]	0.44 [0.37, 0.53]

Note: Parameter estimates and 95% confidence intervals (CIs) in brackets are shown for a univariate ACE model.

Before proceeding, it is important to note that all of our analyses are based on complete same-sex twin pairs reared together with non-missing responses for the political measures and the Big Five personality traits. All measures are residualized of gender and age.¹⁴ To start, the univariate estimates of heritability, common, and unique environment are shown in Table 1. Turning first to the personality traits, we see that four of the five estimates are statistically significant (the confidence intervals for the heritability estimate for conscientiousness contain 0) and the estimates range from 0.33 to 0.52. Our results are in line with previous twin studies on the Big Five (Jang et al., 1996; Loehlin et al., 1998; Riemann et al., 1997). Indeed, a meta-analysis (Vukasović & Bratko, 2015) of the heritability of personality found that the average heritability estimates for the Big Five traits were as follows: openness (.41), conscientiousness (.31), extraversion (.36), agreeableness (.35), and emotional stability (.37). In Table 1, we see that the estimates for the common environment are not statistically significant for any of the Big Five traits. This aligns with earlier work on the genetic and environmental underpinnings of the Big Five personality traits (Funk et al., 2013; Jang et al., 1996; Loehlin et al., 1998; Riemann et al., 1997).

Turning to the political measures in Table 1, we see that several of the heritability estimates are statistically significant at the 5% level. The heritability estimate for our communication index is 0.49. In addition, the heritability estimate for political interest is 0.55. Both of these estimates are in line with those obtained in previous studies on the heritability of participation and interest (Arceneaux et al., 2012; Bell et al., 2009; Dawes et al., 2014; Dawes et al., 2015; Fowler et al., 2008; Klemmensen, Hatemi, Hobolt, Petersen et al., 2012; Klemmensen, Hatemi, Hobolt, Skytthe, & Nørgaard, 2012; Weinschenk & Dawes, 2017; Weinschenk et al., 2019). We note that the estimates for common environment are at or near zero for both of these measures, and neither is significantly different from zero. In contrast, the unique environment estimates are statistically significant. These patterns are also consistent with earlier studies on the underpinnings of these concepts. Interestingly, Table 1 indicates that the heritability estimates are nearly zero and not statistically significant for political efficacy and the political activism index. The common environment estimates, however, are significant in both cases, as are the unique environment estimates. It is worth noting that different processes appear to be at play when it comes to the different political concepts examined here. Common environmental influences have a sizable impact on the formation of political efficacy and political activism in Denmark but play no role when it comes to political interest or our communication index; genetic factors play an important role when it comes to interest

that % r_g , % r_c , % r_e must sum to 1, but r_g, r_c, r_e do not (necessarily) sum to 1. For interested readers, the Online Appendix provides a more formal overview of how to calculate each of these quantities.

¹⁴We used the Mx software package (Neale et al., 2003).

Table 2. Phenotypic correlations between Big Five personality traits and political measures.

	O	C	E	A	ES
Efficacy	0.207	0.065	0.171	0.090	0.104
Interest	0.141	0.111	0.151	-0.061	0.143
Participation [communication]	0.253	0.035	0.202	-0.137	0.072
Participation [activism]	0.400	-0.021	0.134	0.132	-0.042

and communication but no role when it comes to activism or efficacy.

Numerous previous studies have found evidence that political efficacy is partially heritable (with a significant unique environment component and an insignificant common environment component) (Dawes et al., 2014; Klemmensen, Hatemi, Hobolt, Peterson et al., 2012; Klemmensen, Hatemi, Hobolt, Skytthe, & Nørgaard, 2012). Thus, it is somewhat surprising that the heritability estimate is not significant in our sample and that our measure of efficacy is instead influenced by shared and unique environmental factors. Given the nature of the data and models used in this article, we cannot say for sure why shared environmental factors (e.g., home environment, schooling, etc.) play an important role in shaping efficacy (and activism) but not communication or interest. One idea that should be explored in future research is whether some dimensions of political engagement and some attitudes receive more emphasis than others as people are socialized about politics. It would also be interesting to examine the role of genetic and environmental factors in influencing political attitudes and behaviors over the life cycle in Denmark. In an analysis of data on U.S. twins over the life cycle, Hatemi et al. (2009) found that when it comes to political ideology, there is no evidence of genetic influences in childhood or late adolescence, but genetic influences on ideology emerge around age 21 and continue throughout adulthood. Thus, it is possible that for some measures of political behavior such as political efficacy, the influence of genetic and environmental factors varies at different points in the life course. This is a question that deserves additional study.

We also want to note that when it comes to our activism measure, many measures of political participation have been found to be heritable (Dawes et al., 2015; Klemmensen, Hatemi, Hobolt, Petersen et al., 2012; Weinschenk et al., 2019). Thus, the finding that genetic factors matter for our communication index but not for activism may initially seem surprising. Interestingly, one study by Dawes et al. (2014) provides some insight into the differential influence of genes depending

on the type of political activity. More specifically, Dawes et al. (2014) examined the heritability of eight political acts using data on Swedish twins and found that all of the acts in their data set related to communication (e.g., contacting politicians, contacting government officials) were heritable (and had a significant unique environment component but insignificant common environment component, which is similar to what we find here), but that all of the acts in their data set that are similar to our “activism” participation measure were not heritable and driven by unique environmental factors. Indeed, the heritability estimates for their measures of boycotting, attending a protest, contributing, and signing a petition were not distinguishable from zero in their data set. Thus, the patterns of heritability for our measures of participation are consistent with previous research on the heritability of different dimensions of political participation.¹⁵

Turning to the second step of our analysis, we focus on the amount of the covariation between our political measures and each of the personality traits that can be attributed to shared genes. To start, Table 2 shows the phenotypic correlations between our political measures and the Big Five traits. The correlations are small or modest. Among the Big Five measures, the two traits that have the strongest and most consistent relationship with our political items are openness and extraversion. Both measures are positively related to each of our political items. Because the correlations for agreeableness, conscientiousness, and emotional stability are fairly small (and inconsistently related to political behavior), making it hard to decompose their covariance without large samples, we exclude them from the bivariate analyses that follow. In addition, given that the heritability estimates for the activism index and efficacy were not significant in Table 1 (and we are interested in the genetic

¹⁵Our measure of activism has a significant unique environmental estimate (59%) and a significant common environmental component (41%). Dawes et al. (2014) found a significant unique environmental estimate for boycotting, contributing, attending a protest, and signing a petition, but they did not find a significant common environmental component.

Table 3. Top panel: Genetic (*rg*) and unique environmental (*re*) correlations and 95% CIs from bivariate ACE models of political participation and interest with the traits openness and extraversion. Bottom panel: % of total correlation due to genetic and unique environmental correlation and 95% CIs from bivariate ACE models of political participation and interest with the traits openness and extraversion.

Participation [communication]	Interest			
	<i>rg</i>	<i>re</i>	<i>rg</i>	<i>re</i>
Openness	0.20 [0.07, 0.36]	0.04 [-0.07, 0.15]	0.32 [0.19, 0.59]	0.15 [0.03, 0.27]
Extraversion	0.19 [0.06, 0.37]	0.06 [-0.05, 0.17]	0.24 [0.11, 0.43]	0.13 [0.01, 0.24]
	% <i>rg</i>	% <i>re</i>	% <i>rg</i>	% <i>re</i>
Openness	0.86 [0.38, 1.32]	0.14 [-0.32, 0.62]	0.70 [0.43, 0.94]	0.30 [0.06, 0.57]
Extraversion	0.79 [0.32, 1.20]	0.21 [-0.20, 0.68]	0.69 [0.36, 0.97]	0.31 [0.03, 0.64]

overlap between personality and political behavior), we focus on the communication and political interest measures.

In Table 3, we present the genetic and environmental correlations (top panel) and the share of the total correlation due to genetic and environmental factors (bottom panel).¹⁶ Both openness and extraversion have significant genetic overlap with our communication index and political interest. Turning first to the communication measure, we see that the genetic correlations are similar in magnitude, and both are statistically significant. The bottom panel in Table 3 indicates that genetic factors make up 86% of the correlation between our communication index and openness. This finding is similar to what has been reported in previous studies. For example, Weinschenk et al. (2019) found, using data on German twins, that genetic factors make up 67% of the correlation between openness and political participation. When it comes to extraversion, Table 3 indicates that genetic factors make up 79% of the correlation between the communication index and extraversion. Interestingly, Dawes et al. (2014) found, using data from Sweden, that genetic factors account for 88% of the relationship between extraversion and contacting a politician and 79% of the relationship between extraversion and con-

tacting an elected official. Although Weinschenk et al. (2019) examined extraversion in their study, they did not find a significant genetic correlation between this personality trait and political engagement in Germany.

Turning to political interest, we again see that the genetic correlations are fairly similar in magnitude, and both are statistically significant. The bottom panel in Table 3 indicates that genetic factors make up 70% of the correlation between political interest and openness. This finding is similar to what has been reported in several previous studies. For example, using data from two different U.S. twin samples, Weinschenk and Dawes (2017) found that roughly 60% of the correlation between openness and political interest was due to genetic factors. In addition, in a sample of German twins, Weinschenk et al. (2019) found that genetic factors make up 63% of the correlation between interest and openness. For extraversion, Table 3 indicates that genetic factors make up 69% of the correlation between this trait and political interest. We note that our estimate is in line with what Dawes et al. (2014) found using a sample of Swedish twins. In their study, 58% of the correlation between extraversion and interest could be accounted for by genetic factors in their sample of Swedish twins. Similarly, Weinschenk and Dawes (2017) found that 66% of the correlation between extraversion and interest could be attributed to genetic factors in one of their samples (in their second sample, the estimate was 40%, but it was not significant at the 5% level).

Given the results discussed here, it is worth highlighting a few of the general trends that have emerged across different studies on the association between genes, personality traits, and political behavior and suggest a few ways to build on these patterns. First, most previous

¹⁶Since the common environment point estimates for our two political traits with significant heritability estimates and for the personality traits are insignificant in the univariate models, we estimated a bivariate model that assumes the common environment correlation is zero. Results for the unrestricted models (and fit statistics comparing the restricted and unrestricted models) are available upon request. In all cases, the common environment correlation is insignificant in the full model.

studies in this area have found fairly limited (or inconsistent) phenotypic correlations between several of the Big Five traits and political behavior. For example, across a variety of studies, conscientiousness, agreeableness, and emotional stability have not stood out as particularly strong correlates of different measures of political engagement (Weinschenk & Dawes, 2017; Weinschenk et al., 2019). The results presented in this study are generally consistent with that pattern. Extraversion has been more consistently related to measures of political engagement, but there has not been a significant relationship in all samples. By far, the most consistently performing personality trait has been openness. Across all studies on the link between genes, the Big Five, and political engagement, including this one, openness has been at least moderately associated with different measures of engagement in politics and bivariate decomposition models indicate that there is evidence of common underlying genetic component that underpins openness and political engagement (Weinschenk & Dawes, 2017; Weinschenk et al., 2019). It is especially interesting to note that the substantive findings regarding openness (e.g., magnitude of correlation, share of the correlation due to genetic factors) have been very similar across different studies, which were conducted in different countries and used different measures to capture openness. In short, a clear pattern has started to emerge regarding openness. As more studies are conducted on the connection between genes, the Big Five, and political measures, we encourage future researchers to consider conducting a meta-analysis. Such a study would be helpful in synthesizing findings (i.e., identifying average effect sizes) but may also allow for tests regarding moderators that could potentially influence results (e.g., personality measurement battery used, country/region, sample size, etc.) (see, e.g., Vukasović & Bratko, 2015).

Discussion and conclusion

Our primary goal in this article was to better understand the nature of the association between personality and several different measures of political behavior. While a great deal of research has examined the relationship between personality traits and politics (Gerber, Huber, Doherty, Dowling et al., 2011; Mondak, 2010; Mondak et al., 2010), most previous studies in this area have not examined the role of genetics. Here, we used a data set that contained a sample of twins, extensive personality measures, and measures of several different

political traits, which allowed us to reexamine and build on the findings from previous studies. Overall, we found that genes account for a fairly large share of the correlation between two of the Big Five personality traits (openness and extraversion), political participation, and political interest. In short, our results indicate that most of the relationship between these personality traits and our measures of political behavior is accounted for by a common underlying genetic component. One important thing to keep in mind is that just because a trait is partially heritable, that does not mean that it is determined by genes or that it cannot be changed or influenced by environmental factors or interventions (de Jong, 2000).¹⁷ Rather than thinking about genetic influences in a deterministic way, they should be thought of in a probabilistic manner (e.g., genetic factors may increase the probability of exhibiting a given trait or traits) (see Resnik & Vorhaus, 2006).

This study has several limitations worth noting. First, one interpretation of the results is that they signal that personality traits *mediate* the relationship between genes and political behavior. This would suggest a particular causal ordering (e.g., that genes influence the likelihood of having a personality trait and that exhibiting that personality trait influences the probability of engaging in a political behavior) (Mondak, 2010). An alternative perspective is that while personality traits and political traits may have the same underlying genetic components, the relationship is not causal in nature (Posthuma et al., 2003). This scenario is known as *pleiotropy*. The bivariate model used in this article does not allow us test which type of relationship exists. Although some analyses (e.g., Dawes et al., 2014; Verhulst et al., 2012) have employed the direction of causation (DoC) model to test whether personality traits have a causal impact on the odds of exhibiting certain political attitudes or behavior, recent work suggests that there are some important limitations associated with DoC models that make it difficult to disentangle causal relationships (see Rasmussen et al., 2019).

Overall, our perspective is that studies like ours are important even if they do not provide a clear answer

¹⁷De Jong (2000) points out that “Genetic determinism is the view that the phenotype is precoded in or determined by the genotype. However, evidence from developmental biology and neural modeling indicates that development is a result of interactive processes at many levels, not only the genome, so that geneticism must be rejected” (p. 615). Additionally, as Fazekas and Littvay (2015) note, the “heritability of political characteristics, like all others, is population specific and highly context dependent stressing its nondeterministic nature” (p. 369).

about the direction of causality. Establishing a genetic correlation between traits is the first step toward understanding how biological factors are related to attitudes and behaviors. Ultimately, we believe that scholars should build on the findings presented here by using new approaches to study genes and political behavior. In our view, the next step in research on genes, personality, and political behavior should entail the use of polygenic indices (PGIs), which are measures that aggregate the impact of many genetic variants on an individual's phenotype. Such measures, which are increasingly available to social scientists (Becker et al., 2021), allow researchers to directly measure the genetic propensity to exhibit particular traits (e.g., extraversion, openness, etc.) and to examine the impact of such propensities on outcomes of interest (e.g., political attitudes or participation). Research using PGIs to study genes, psychological traits, and political behavior is in its infancy, but one recent analysis found that a PGI for cognitive ability predicted individual differences in voter turnout (Aarøe et al., 2021).¹⁸ Such analyses will be helpful in further clarifying how genes, psychological measures, and political behavior are related. When PGIs are used in the context of within-family models, they are especially useful since any genetic differences that exist between full siblings are random (Becker et al., 2021). Thus, one interesting way of building on the analyses presented in this paper will be to examine the influence of PGIs for personality traits on measures of political behavior in the context of models that control for family fixed effects (which would account for all common factors shared by siblings within a family, including shared parents).

It is also worth noting that while twin models are quite common in some fields (e.g., in behavior genetics), some of the assumptions of such models are quite strong, especially the equal environments assumption (EEA). A violation of the EEA would lead to an overstatement of the extent to which a trait is heritable and an understatement about the extent to which common environmental factors influence that trait, though some studies (e.g., Conley et al., 2013; Littvay, 2012) have failed to find evidence of unequal MZ and DZ environments. A second important assumption of classic twin models, like the ones used here, is that gene-environment interactions are assumed not to exist. In this article, we focused on the average heritability of personality traits and political measures (and on the overlap among the measures) in

our sample, but we cannot not rule out gene-environment interactions, which can either increase or decrease heritability estimates.¹⁹ We encourage future researchers to explore ways in which genetic and environmental factors may interact to shape political behavior.

Finally, we note that classic twin models assume that genotypic and environmental variables are uncorrelated. Dolan et al. (2021) developed a method for incorporating PGIs into the univariate twin model in order to estimate genetic and common environmental covariance. Unfortunately, there are no PGIs in the data set employed here, so we are unable to use this approach. We encourage future research in this area, though, as it represents an interesting potential way of getting some sense of the extent to which gene-environment correlation exists and influences estimates of interest.

Beyond the future research ideas mentioned here, our results suggest a number of additional avenues for researchers. First, we strongly encourage researchers to collect new data sets that will enable analyses of the biological and psychological underpinnings of political behavior. It would be especially useful to collect such data in a wide array of different contexts. Comparing results across different studies and samples will provide us with a better understanding of how genes, psychological traits, and political traits are related. Second, we note that while we found that genetic factors account for a large amount of the correlation between two of the Big Five traits and interest in politics and political engagement, the phenotypic correlations that we uncovered suggest that the personality traits examined here (and hence genetic factors related to them) account for only a small portion of the variation in political engagement.²⁰ Thus, it will be especially valuable to gather data sets that include measures of the Big Five traits *and* traits outside the Big Five model (e.g., conflict avoidance or need to evaluate). This would allow for an even more comprehensive understanding of how genetic factors and personality traits are related to political behavior.

¹⁹A study by Krueger et al. (2008), e.g., demonstrated that the heritability of positive emotionality increased as a function parental regard and the heritability of negative emotionality decreased as a function of parent conflict.

²⁰For example, based on the results in Tables 2 and 3, the correlation between the political communication measure and openness that can be attributed to genetic factors is 0.215 (calculated by multiplying the phenotypic correlation of 0.25 by the share of the correlation due to genetic factors, 0.86). This indicates that genetic factors related to openness account for about 4.6% of the variation the political communication index (calculated by squaring the correlation that can be attributed to genes).

¹⁸Another analysis by Dawes et al. (2021) found that a PGI measuring the genetic propensity for education predicted voter turnout.

Supplementary Materials

To view supplementary material for this article, please visit <http://doi.org/10.1017/pls.2022.11>.

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