Sense of Control and Voting: A Genetically-Driven Relationship*

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Objectives. The impact of political efficacy on political participation has been established in numerous classical studies of political behavior. However, the effects of more general measures of efficacy on political efficacy and voter turnout have received almost no attention. Additionally, seemingly independent contemporary developments in the field of political science proposed that political participation is heritable. In this study, we propose to link the two literatures, highlighting one possible mechanism through which genetic inheritance of political behavior is possible in the absence of the evolutionary time horizons of voting behavior. We theorize that heritability of psychological dispositions, such as one's sense of control, is more plausible and indirectly, through political efficacy, could have an influence on one's decision to vote. *Methods.* We test our hypotheses using a classical twin study design (ACE models) and Cholesky decomposition models on data from the MIDUS (first wave) and MNTPS twin surveys. *Results.* Empirically we find a relationship between general efficacy and turnout. We show that numerous operationalizations of efficacy are highly heritable and their covariance with turnout is predominantly driven by underlying additive genetic sources. On the other hand, environmental covariation between general and political efficacy and turnout is not significantly different from zero. *Conclusions.* Our analysis contributes to a better understanding of how one's sense of control influences voting behavior. Our results provide sufficient evidence to claim that the covariation between these two traits can primarily be attributed to genetic factors. However, this is certainly not the only pathway that explains the heritability of voter turnout.

To date, our ability to explain empirically why people vote is limited, with the most extensive behavioral studies explaining only a third of the variance in voter turnout (Plutzer, 2002). Fowler, Baker, and Dawes (2008) suggested that genetic variation could account for a substantial share of individual differences in voting behavior. As a result, rather than look exclusively at environmental factors, the authors suggest that political scientists should begin

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to investigate highly heritable traits that theoretically could link genes to political participation.

The study of political participation has deep-seeted traditions in political psychology. Recent work has demonstrated that individual differences in personality traits strongly predict political behaviors and attitudes (Gerber et al., 2010; Mondak and Halperin, 2008; Mondak et al., 2010; Denny and Doyle, 2008), suggesting that personality traits may be a link between genes and voting behavior. Personality traits have been shown to be highly heritable (Bouchard and McGue, 2003; Bouchard and Loehlin, 2001; Matthews and Deary, 1998; Pervin, 2003) and therefore can potentially explain some of the variation in voting attributed to genetic factors. This article contributes to this nascent literature, focusing on a trait that directly maps to theories of turnout: efficacy.

The contribution of the article is three-fold. First, it takes a well-studied political behavior, turnout, and ties it to a broader psychological predisposition: sense of control. Within political science, a more "task-specific" concept of efficacy, political efficacy, is commonly used to explain political motivation (Karp and Banducci, 2008). Although political efficacy is a strong predictor of voter turnout, few studies have investigated the relationship between feelings of general efficacy measures and turnout (for a notable exception, see Blais and St-Vincent, 2011). In this article, we bring further evidence that a more general notion of individual efficacy can also predict voter turnout.

Second, the heritability of certain elements of general efficacy has already been established (Greven et al., 2009). The same is true for political participation (Fowler, Baker, and Dawes, 2008). This study provides a replication for these findings based on a novel data set.

Finally, we hope to illuminate the relationship between efficacy and voting. A sample of same-sex monozygotic (MZ) and dizygotic (DZ) twins allows us to decompose the covariation between efficacy and turnout into genetic and environmental sources. This design allows us to demonstrate that the association between these two constructs is primarily due to a shared genetic factor.

We begin with an exposition of the general efficacy literature that we link to the notion of political efficacy, a construct commonly linked to voter turnout (Karp and Banducci, 2008).

General Efficacy and Political Efficacy

Self-efficacy refers to people's expectations about their ability to successfully influence outcomes by performing certain tasks (Bandura, 1977). Such expectations mediate the relationship between the preferences and actions of individuals; people who feel more self-efficacious are more likely to make an effort to bring about the outcomes they prefer and are more diligent than their less efficacious peers (Bandura, 1986; Pajares, 1997). Efficacious people

tend to view complicated tasks as challenges rather than as obstacles and they attribute failures to having invested too little effort and not to having limited capabilities. Positive perceptions of self-efficacy are generally associated with better coping skills, optimism, and higher academic achievement, and are negatively correlated with stress, depression, and anxiety (Pajares, 1997). However, efficacy is far from being a rigidly stable characteristic of individuals (Gecas, 1989; Greven et al., 2009; Bandura, 1977); it is constantly strengthened or weakened as a result of various life experiences.

Behavior, environmental factors, and personal factors are closely interwoven into what Bandura (1986) calls a triadic reciprocality: feeling confident in one's capabilities or feeling motivated to influence certain outcomes will only lead to performing necessary tasks if there are no major environmental deterrents. Even the most diligent and motivated person will shy away from performing certain tasks if the environmental factors are too adverse (the relationship between psychological traits and behavior is by no means deterministic). Furthermore, certain actions can alter various elements of one's environment, and to the extent that this happens, it can further reinforce or deter one's motivation and/or expectations regarding the possible consequences of subsequent actions.

Broadly speaking, feelings of self-efficacy are fostered by repeated successful experiences, by seeing other people succeeding against all odds, by social appraisals, and by positive feelings or moods (Bandura, 1994). Additionally, different aspects of efficacy have been demonstrated to be influenced by personality traits (Mak and Tran, 2001; Vecchione and Caprara, 2009; Mondak, 2010). The Big Five personality trait "openness to experience" has repeatedly been found to positively correlate with efficacy. What these studies fail to consider is that, historically, self-efficacy was considered the first facet of conscientiousness, according to the International Personality Item Pool (IPIP), questioning the presumed causal direction of the cited studies. The original construction of the Neo-PI did not decompose conscientiousness into facets; the revised version contained a similar construct but labeled it as competence (McCrae and Costa, 2003). If self-efficacy is indeed a facet or subconstruct of conscientiousness, to say that either of them is causally prior to the other would require unacceptable conceptual stretches. According to its historical place, efficacy is, at minimum, personality-like, and at most is a close relative and subconstruct of a Big Five personality factor.

Efficacy is often task specific (Madsen, 1987; Bandura, 2006) and it includes elements of the perceived adversity of certain environmental factors. In line with this argument, the concept of political efficacy can be viewed as a task-specific case of self-efficacy. However, despite self-efficacy's close relationship to political efficacy, Mondak (2010) did not find a clear connection between conscientiousness and political efficacy. This leads us to believe that the broad concept of conscientiousness is not useful in explaining political efficacy, but we argue that the more narrow self-efficacy facet is. In fact, we specifically argue that looking at more general measures of efficacy is a crucial

step backward in the causal path from political (or other task-specific) efficacy and its consequences.[1]

Since it was introduced by Campbell, Gurin, and Miller in 1954, the concept of political efficacy has undergone transformations that appear closely linked to the parallel developments in the social psychology literature. Early developments in the field of political efficacy were geared toward reconciling its behaviorist, new institutionalist, and normative aspects (see Easton and Dennis, 1967). Later work focused on the separation of political efficacy into two subconstructs (Balch, 1974; Miller, Miller, and Schneider, 1980). The first, *internal efficacy*, refers to whether citizens feel capable of understanding politics and are competent enough to participate in the political process. The second, *external efficacy*, refers to citizens' belief that politicians and institutions are responsive to the needs of the electorate and that the actions of the electorate are, in principle, capable of influencing political outcomes (Karp and Banducci, 2008). In this respect, the perceived internal political efficacy of citizens can be regarded as an assessment of their autonomous capabilities, closely related to self-efficacy, whereas the external political efficacy refers to the perceived constraints of the environment. Thus, political efficacy belongs conceptually to the larger set of task-specific efficacies.

Self-efficacy and political efficacy are generally regarded in the social psychology and political science literature as being driven by environmental factors (Pajares, 1997). However, there are notable exceptions to this rule. Self-efficacy's connections to personality suggest a possible genetic basis. Further, Easton and Dennis (1967) found that IQ, which is known to be highly heritable (Devlin et al., 1997; Plomin and Loehlin, 1989; Greven et al., 2009; Bouchard and McGue, 2003), is a good predictor of political efficacy. These findings raise important questions regarding the source of the perceptions of political efficacy.[2] Elements of general self-efficacy, operationalized as self-perceived abilities (SPA), were also found to be genetically heritable and, much like political efficacy, the effects of SPA on behavior tend to overlap with the effects of IQ (Greven et al., 2009). While a direct link between general notions of efficacy and political efficacy has yet to be identified, the extant literature and logical connection between the two concepts suggest that they are likely to be closely linked as well as positively correlated.

Genetic variation accounts for a significant share of individual differences in acts of political participation such as voter turnout (Fowler, Baker, and Dawes, 2008; Loewen and Dawes, forthcoming; Dawes, Loewen, and Fowler, forthcoming). Moreover, feelings of political efficacy (Campbell et al., [1960] 1980; Pollok, 1983; Karp and Banducci, 2008) have been found to be

[1]The argument has been made in terms of perceived efficacy of medical treatment (Seeman and Seeman, 1983; Rapley, 2001), but this is the first time it has been applied to political efficacy.

[2]External and internal components were not explicitly separated in the Easton and Dennis study; however, the indicators that were used can easily be grouped along the internal/external divide.

FIGURE 1

The Proposed Pathway

substantively and statistically significant predictors of individual-level turnout. We argue in this article that the relationship between genes and participation is, at least in part, mediated by psychological dispositions. To the extent that general efficacy is a predictor of political efficacy, this article presents a plausible causal pathway linking genetic factors to political behavior (see Figure 1).

There is a large set of psychological constructs that are likely to be directly influenced by genes. Behaviors, such as voting in an election, that are relatively recent phenomena are probably not directly influenced by genes since the development of genes responsible for behaviors or habits undertaken by just a few consecutive generations is evolutionarily and biologically unlikely (Alford, Funk, and Hibbing, 2005). However, durable psychological inclinations or personality traits are likely to be directly influenced by genes, as their roots can be linked to the coping needs of humans at most, if not all, conceivable points in history (Alford, Funk, and Hibbing, 2005). The causal mechanism that links genetics to turnout, thus, must include intermediate steps. In this article, we explore whether perceived self-efficacy is one such mediator.

In the following sections, we test the relationship between efficacy and turnout. We estimate the heritability of both traits and assess what proportion of the covariation between them can be attributed to genetic and environmental factors. The next section contains the description of the data used to complete these tasks.

The Data

To test our hypotheses, we utilize two data sets: (1) the first wave of the National Survey of Midlife Development in the United States (MIDUS) panel study (Brim et al., 1996) and (2) the Minnesota Twins Political Survey (MNTPS). The first wave of MIDUS is a U.S. general population representative survey collected in 1995–1996. The study also included an oversample of twins. Random-digit dialing was used to recruit the sample. Following the phone interview, a mail survey was sent to all respondents. Aggressive refusal conversion strategies were used, which led to an impressive 60 percent response rate for the mail questionnaire. MIDUS contained a number of oversamples (families and urban areas) that we did not include in any of our analyses. Our

representative sample is comprised of $N = 3{,}487$ participants between the ages of 25 and 75.

The twin oversample of MIDUS was ascertained through approximately 50,000 random-digit dialing screening calls where the respondents were asked if they have a twin in the family. This procedure identified 998 twin pairs. Opposite-sex twin pairs and twins with uncertain or conflicting self-reported zygosity were excluded from the sample. Since the twin oversample contained several families with more than one twin pair, to ensure the independence of all co-twins in the data, we excluded twins who were related to other twins in the data set. Ultimately, we were left with 348 monozygotic and 329 same-sex dizygotic twin families for our analysis.

Originally designed as an item for the civic obligation scale, the MIDUS survey included the question: "Please rate how much obligation you would feel if the following hypothetical situations happened to you . . . . To vote in local and national elections." The response to this question is coded on an 11-point scale ranging from 0 (no obligation at all) to 10 (a very great obligation). This response serves as our dependent variable. While this question measures voting obligation and not actual voting, we consider it a good proxy measure. Also, asking the question this way is likely less susceptible to social desirability bias to affirm voting behavior and more broadly applicable to a context-free election than if it was asked directly whether the person voted in the last election or in any specific election. Finally, this type of question also has the advantage of offering reasonable variance across respondents. A question inquiring about a specific election only provides binary information that potentially lacks the variance necessary for a multivariate twin analysis. However, we do not disregard the possibility that general predisposition toward obligation could pollute the construct and introduce a component in its variation attributable not solely to voting but also to the feeling of obligation.

General efficacy, or sense of control as labeled by the MIDUS team, was measured with seven-point agree-disagree questions combining two scales closely aligned with the more task-specific internal and external political efficacy constructs (see Table 1 for a more detailed summary of the data). The items were averaged to form each of the subscales. To ensure all questions point to the same direction, the perceived constraint scale had to be reversed. Personal mastery and perceived constraint scales were weighed equally in calculating overall sense of control despite the different number of items within the subscales. For each of the subscales and the combined scale, the lowest value is 1 and the highest is 7. For the personal mastery scale, MIDUS documentation reports a Cronbach's alpha of 0.7, while perceived constraint is 0.86 (see Documentation of Scales in Brim et al., 1996). The higher reliability for perceived constraint is not surprising since the higher number of survey items means it is measured with more precision. The combined scale has an alpha of 0.85.

It is important to note that the assessment of the respondents' level of general efficacy is done using "can you" and not "will you" questions because the

TABLE 1

Indicators of General Efficacy (MIDUS) and Political Efficacy (MNTPS)

Construct	Questionnarie Items	Scale Range	Cronbach's Alpha
	MIDUS		
Sense of control: personal mastery	(1) I can do just about anything I really set my mind to; (2) When I really want to do something, I usually find a way to succeed at it; (3) Whether or not I am able to get what I want is in my own hands; (4) What happens to me in the future mostly depends on me.	6	0.7
Sense of control: perceived constraints (scale reversed for easier interpretation of the results)	(5) There is little I can do to change the important things in my life; (6) I often feel helpless in dealing with the problems of life; (7) Other people determine most of what I can and cannot do; (8) What happens in my life is often beyond my control; (9) There are many things that interfere with what I want to do; (10) I have little control over the things that happen to me; (11) There is really no way I can solve the problems I have; (12) I sometimes feel I am being pushed around in my life.	6	0.86
	Minnesota Twin Political Survey		
Internal political efficacy	People like me don't have any say in what the government does.	4	-
External political efficacy	Public officials don't care much about what people like me think.	4	-

perceptions of self-efficacy are statements of capability and not of intentions (Bandura, 2006). Furthermore, binary questions are inappropriate due to their lack of precision in differentiating between individuals with different levels of self-efficacy, which is an inherently quantitative construct. Bandura (2006) proposes 11-point scale variables with labels for middle and extreme values; MIDUS employed the quasi-continuous variables (seven-point scales) in the "Personal Mastery" and "Perceived Constraints" batteries. These items are in line with the "capabilities" and "expected external adversity" that were discussed previously as principal elements of both self-efficacy and political efficacy.

The second data set used for the analysis does not contain general efficacy questions but, unlike MIDUS, has broadly accepted political efficacy measures and a direct measure of voter turnout. While an ideal data set would have both general and political efficacy measures, to date such a data set is not available. The Minnesota Twins Political Survey (MNTPS) is a recent data set of political attitudes and behaviors that was administered to a sample of twins from the Minnesota Twin Family Registry. The registry contains 8,000 pairs of twins born between 1936 and 1955 in the State of Minnesota. The MNTPS data were collected using a web survey in 2008, followed by a paper-and-pencil survey in 2009 collected with support from the National Science Foundation Grant SES-0721378 (John R. Hibbing, PI). A total of 1,349 respondents completed the survey and 1,192 were part of same-sex matched twin pairs (356 MZ and 240 DZ pairs). All respondents to the political questionnaire were born between 1947 and 1955, producing a relatively restricted sample from the perspective of age and geographic diversity.

The MNTPS contains the political efficacy variables that we used to augment our analysis of the MIDUS data set. Although our first rounds of analyses test the heritability of self-efficacy and turnout, as well as the bivariate heritability of the two, it is apparent that a complete test of our hypothesis (as summarized in Figure 1) would require a data set that contains both general and political efficacy measures. However, in this article we wish to demonstrate that our proposed relationship also holds for political efficacy. As part of the MNTPS analysis, we used measures of both internal[3] and external political efficacy (see Table 1 for a verbatim presentation of the questions). These measures are consistent with our theoretically established parallel between self-efficacy and political efficacy on the personal mastery and perceived constraint dimensions. In the following section we explain the methodology and results.

Methods and Results

All models run were estimated with full information maximum likelihood to ensure no information in the data set is excluded due to case elimination stemming from incidental item missing data. Significance levels are determined using a traditional t test. Bollen-Stine bootstrapped 95 percent confidence intervals (CI95) were calculated for components where symmetric confidence interval estimates were inappropriate (Bollen and Stine, 1992). We used the analytical software package Mplus (Muthén and Muthén, 2010) for all the analyses presented.

[3]Both our political efficacy variables could be considered perceived external political efficacy. The content of the two questionnaire items is, indeed, strikingly similar; however, it is likely that the item in which "government" is the object will capture at least some of the true variance of internal political efficacy existent in the population.

TABLE 2

General Population Regression Model; $N = 3{,}487$

	Coef	p	Coef	p	Coef	p	Coef	p
Self-efficacy	0.337	***						
Personal mastery			0.224	***			0.124	*
Perceived constraint					0.246	***	0.204	***
Age	0.055	***	0.054	***	0.055	***	0.055	***
Female	0.265	**	0.251	**	0.246	**	0.263	**
Education	0.139	***	0.154	***	0.133	***	0.136	***
Household income	0.09	**	0.11	***	0.084	**	0.085	**
R^2	0.11		0.103		0.109		0.111	

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

In the nontwin population (only available in MIDUS), voting and general efficacy shows a significant bivariate correlation (GENERAL SELF-EFFICACY: $r = 0.125$, $p < 0.001$; PERSONAL MASTERY: $r = 0.073$, $p < 0.001$; PERCEIVED CONSTRAINT: $r = 0.133$, $p < 0.001$). Table 2 presents the turnout model for the general population with demographic controls for age, gender, income, and education.[4] The magnitude and significance of the relationship between turnout and the three efficacy measures remained unchanged with the inclusion of controls. Perceived constraint clearly has a stronger influence on turnout, although this could be due to the better reliability and precision of that scale. Turning to the control variables, older, more educated, and higher income people are more likely to vote.

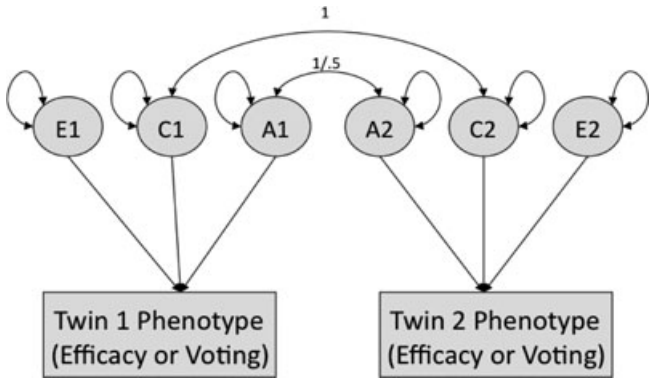
To estimate the heritability of voting and efficacy, we utilized a classical twin design (Neale and Cardon, 1992). We used a univariate structural equation model that is graphically illustrated in Figure 2. This model decomposes the total variation of a studied trait into additive genetic, common, and unique environmental components. The ideal data for assessing genetic heritability come from twins reared apart; however, the separation of twin pairs at birth or early in life is done relatively rarely and thus this type of data is unavailable for most traits. With certain assumptions, data from MZ and DZ twins allow us to quantify the additive genetic and environmental sources of variance. Based on genetic theory, we know that MZ twins share 100 percent of their segregating genes, whereas DZ twins share, on average, 50 percent of their genes. For this reason, if monozygotic twins are more similar to their co-twin for a particular trait than dizygotic twins, we can infer that genes influence that trait.

The structural equation model presented in Figure 2 assumes that the distribution of the shared environment is the same for both MZ twins and DZ

[4]The inclusion of other controls such as ideology, strength of ideology, political interest, and media consumption (see Mondak et al., 2010) would have been ideal but they were not available in the MIDUS data set, which was predominantly collected for nonpolitical research.

FIGURE 2

Univariate ACE Model



twins. This assumption is also known as the equal environment assumption (or EEA). Within the social sciences, twin models are often criticized for having to make this assumption (Charney, 2008; Alford, Funk, and Hibbing, 2008a, 2008b; Hannagan and Hatemi, 2008; Beckwith and Morris, 2008) though none of the critics identify the specific component of the environment that violates the EEA or propose specific mechanisms for how the assumption violation leads to different outcomes for MZ and DZ twins. Additionally, the model presented in Figure 2, and explained below, can incorporate an EEA violation correction if the specific component of the environment that causes the assumption violation is explicitly measured (Kendler et al., 1993; Littvay, forthcoming). Careful survey of the literature fails to identify a single study where such a correction confirmed an assumption violation.[5]

Finally, the model allows for the existence of environmental influences that are not shared among the co-twins. Deviations from perfect co-twin correlations for MZ twins suggest that the unique environment has an impact on our construct of interest, but there is a caveat. Another source of such deviations is measurement error (Littvay, 2011). If a construct is measured with error, correlation across two measurements will always be below 1, even if the two people measured are identical on the construct. This caveat must be considered when evaluating the unique environmental component and attention should be paid to the expected or explicitly calculated measurement error (such as Cronbach alpha reliability estimates) present in the construct. Higher measurement error leads to an artificially increased unique environmental

[5]The components of the environment that are known to differ across MZ and DZ twins, such as sharing a bedroom during childhood or being dressed in identical clothes, do not influence most traits social scientists are interested in studying. In the absence of specific hypotheses about assumption violation and specific measures of the environmental component leading to the violation, we employ no correction in this study.

component and, consequently, a proportional decrease in the other estimated effects. Such a decrease also leads to higher chance of Type II error for the detection of significant genetic and common environmental components.

More formally speaking, the proportion of the variance explained by additive genetic (A), common environmental (C), and unique environmental (E) components is estimated with a two-group structural equation model presented in Figure 2. A, C, and E are latent (unobserved) variables influencing the observed phenotype of one of the twins. Identification of the model relies on the known genetic relationships of the sibling pairs used in the analysis. A is perfectly correlated across MZ co-twins and 0.5 correlated for the DZ co-twins (based on the genetic theory described above), and C is perfectly correlated for both MZ and DZ twins (based on the EEA). E, by construction, is unique to each individual and therefore is uncorrelated across the twins.

Following conventions of twin modeling, age and sex were controlled for in the model. Biological sex is entirely genetically determined as it is fully driven by the presence of a Y chromosome. Biological age is completely "environmental" and although it can have an impact on gene expression, strictly speaking it is not influenced by genetic factors.[6]

Correlations for both vote and efficacy for both data sets are presented in Table 3 separately for monozygotic and dizygotic twins. Table 3 also presents the heritability estimates. All variables of interest in both data sets exhibit a significant heritable and unique environmental component. Personal mastery has a slightly higher unique environmental component, which is expected due to the lower reliability. In fact, the difference in Cronbach alpha is almost the same as the difference in the unique environmental component. We observe a similar pattern for internal political efficacy. All studied variables are moderately heritable, approaching the 50 percent estimate generally reported for personality traits (Bouchard and McGue, 2003). The estimated common environmental components, with the exception of voting, are under 5 percent and none are significantly different from 0 in the MNTPS.[7]

Finally, the bivariate genetic analysis derives the magnitude of the covariation between the two constructs of interest (voting and general efficacy) and estimates what proportion of this correlation is attributable to common underlying genetic and environmental factors. This correlation and the proportions are presented in Table 4. This analysis is done using a bivariate Cholesky

[6]Additional controls were not included due to the fact that these variables may also have a heritable component. Explaining away variation shared with these control variables would prevent us from arriving at a complete picture of the proportions of variation attributable to genetic and environmental components in the key variables of interest.

[7]Since the MNTPS variables are less continuous than their MIDUS counterparts, as part of a sensitivity analysis we also replicated the univariate models using a version of the ACE model designed for ordinal data. The results were practically identical, with slightly higher heritability estimates for efficacy and a slightly lower heritability estimate of voting. The latter was significant only at the $p < 0.1$ level, which is understandable due to the lower power these ordinal models have. Given the practically identical results, we proceeded to use a continuous bivariate model.

TABLE 3

Univariate Heritability Assessment

MIDUS	rMZ		rDZ	
Vote	0.39	***	0.196	***
Self-efficacy	0.475	***	0.238	***
Personal mastery	0.384	***	0.141	*
Perceived constraint	0.462	***	0.252	***

MNTPS	rMZ		rDZ	
Vote	0.52	***	0.322	***
Political efficacy	0.396	***	0.126	+
Internal political efficacy	0.201	***	0.088	*
External political efficacy	0.212	***	0.062	+

MIDUS	A	A Low	A High	C	C Low	C High	E	E Low	E High
Vote	0.39	0.183	0.548	0	0	0.287	0.61	0.474	0.728
Self-efficacy	0.47	0.349	0.594	0	0	0.268	0.53	0.436	0.268
Personal mastery	0.37	0.209	0.482	0	0	0.223	0.63	0.523	0.729
Perceived constraint	0.42	0.134	0.546	0.04	0	0.325	0.54	0.444	0.631

MNTPS	A	A Low	A High	C	C Low	C High	E	E Low	E High
Vote	0.4	0.023	0.599	0.12	0	0.419	0.48	0.377	0.594
Political efficacy	0.38	0.296	0.471	0	0	0	0.62	0.528	0.703
Internal political efficacy	0.34	0.173	0.434	0	0	0.256	0.67	0.574	0.757
External political efficacy	0.37	0.277	0.449	0	0	0.187	0.63	0.55	0.72

NOTE: $^{+}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.
Low and high estimates denote 95 percent Bollen-Stine bootstrapped confidence intervals.

decomposition, which is an extension of the univariate ACE model. A detailed explanation of how this model works is beyond the scope of this article. For a detailed derivation of the Cholesky decomposition, see Medland and Hatemi (2009). Since neither voting nor efficacy has a common environmental component, C was completely removed (equated to 0) from the Cholesky decomposition.

The age and sex corrected correlation between voting and general efficacy in the MIDUS twin sample is comparable to the magnitude observed in the MIDUS general sample ($r = 0.137$, $p < 0.001$). In the MNTPS, this relationship is $r = 0.162$ ($p < 0.001$). More interestingly, it appears that the relationship between voting and efficacy in both data sets is predominantly driven by common genetic variation. In MIDUS, only 30 percent of the correlation is due to environmental components and this estimate; in MNTPS,

TABLE 4

Cholesky Decomposition Between Vote and Efficacy

	Correlation		A	A Low	A High	E	E Low	E High
MIDUS								
Self-efficacy	0.137	***	0.7	0.165	1.107	0.3	−0.11	0.83
Personal mastery	0.096	**	0.56	−0.44	1.233	0.44	−0.25	1.155
Perceived constraint	0.14	***	0.81	0.352	1.271	0.19	−0.27	0.64
MNTPS								
Political efficacy	0.162	***	0.82	0.495	1.125	0.18	−0.13	0.503
Internal political efficacy	0.189	***	0.8	0.508	1.082	0.2	−0.08	0.487
External political efficacy	0.106	***	0.86	0.367	1.421	0.14	−0.42	0.633

NOTE: $^{+}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.
Low and high estimates denote 95 percent Bollen-Stine bootstrapped confidence intervals.

the relationship attributable to E is even lower (18.3 percent). Both estimates are statistically indistinguishable from 0. The results for the subcomponents of efficacy show a similar pattern, although the covariation between obligation to vote and personal mastery in MIDUS cannot be decomposed with reasonable statistical confidence.

Limitations

This study evaluated efficacy's impact on voter turnout. While past literature only assessed the impact of the task-specific political efficacy on turnout, our study contributes to the emergent literature around the relationship between the general notion of efficacy and political behavior. Ideally, we would have assessed whether political efficacy measures mediate the relationship between general efficacy and turnout; however, the necessary data were not readily available. Such an assessment is left to future researchers and we hope this article will convince them to include both measures in their data-collection efforts.

A better operationalization of the voter turnout would also have been preferable. For example, the voting records used by Fowler, Baker, and Dawes (2008) provide a much cleaner measure of turnout than sense of obligation or even the self-report of MNTPS. A general sense of obligation could be influenced by obligation-related traits completely independent of voting. Social desirability bias can have an impact on self-reported turnout tendencies. Although we argue that our measures of the dependent variable are a good proxy for measuring turnout, we do need to consider how systematic bias of the sense of obligation in MIDUS and social desirability in MNTPS might bias our estimates.

Admittedly, our operationalization of internal political efficacy is not optimal. The main difference between our measure of external political efficacy and our proxy for internal political efficacy lies in the wording of the questionnaire items on which they are based. The closeness of the heritability estimates for the two may have been augmented by our chosen operationalization. It is apparent that this limitation reduced our ability to draw separate conclusions for internal and external political efficacy; however, our ability to draw the conclusions relevant for our theory is likely to be virtually unaffected.

Finally, regression analysis and twin modeling both come with a set of assumptions that need to be recognized. For discussion of the former, see Fox (1991) and for the latter, see Medland and Hatemi (2009).

Discussion

Claims about heritability of political behavior are often greeted with puzzlement. How can a behavior that emerged so recently from an evolutionary standpoint be heritable? This study attempts to link genes to political behavior via psychological traits.

Based on the theoretical framework and empirical analysis presented, we find support for this proposed pathway. However, despite the strong genetic covariation between efficacy and voting, we cannot claim this is the only mechanism through which genes may influence political participation. While additive genetic factors explain nearly 40 percent of the variance in our turnout measures, the correlation between efficacy and turnout is between 0.1 and 0.2. Translated into the amount of variance explained (or r^2), efficacy explains 1 percent to 4 percent of the variation in turnout. What this means is that a majority of the heritable variation in our measure of political participation remains unaccounted for. However, it is unrealistic to expect that any single variable could explain a large amount of variation in a complex political behavior like voting.

On the other hand, our analysis does contribute to a better understanding of how one's sense of control influences voting behavior. The twin study provided sufficient evidence to claim that the covariation between these two traits can primarily be attributed to genetic factors. In fact, we found only an insignificant environmental covariation between efficacy and turnout. We argue that genes influence general efficacy, which, in turn, influences political efficacy, which goes on to influence one's decision to vote. This mechanism is one, but definitely not the only, pathway that explains the heritability of voter turnout.

Unfortunately, data limitations prevent us from testing every link in our proposed causal chain. Although the MNTPS provides the political science community with an excellent genetically informative sample containing a wealth of information about political attitudes and behaviors, the effort to collect additional data necessary to better understand relationships between biological factors and political traits needs to continue beyond what is available

today. More specifically, to fully test all the theoretical propositions asserted in this study requires a genetically informative data set with general efficacy and political efficacy measures and a better operationalization of voter turnout.

Finally, our study should be viewed as only a starting point. Understanding completely the physiological mechanisms underlying the relationship we have proposed starts with the identification of the specific genes related to efficacy and continues with the mapping of the physiological functions that finally lead to neural processes manifested in predispositions of efficacious behavior. The complexity of this pathway cannot be fully addressed by a study such as ours. We are optimistic that the increasing popularity and accessibility of molecular genetic data collection in conjunction with surveys will produce the data necessary to better understand the physiology of our proposed pathway.

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