The Heritability of Duty and Voter Turnout

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Introduction

Explaining voter turnout is a central preoccupation of political scientists. This is due in no small part to the apparently paradoxical nature of participation (Grofman 1993). The probability of being decisive in any election is very small (e.g. Gelman, Katz, and Bafumi 2004; Riker and Ordeshook 1968) and thus individuals can reasonably expect to receive the same benefits from the outcome of an election if they do not vote. Yet, modern democracies normally witness a majority of citizens casting ballots. Why then do we witness such high rates of turnout? Among the most important explanations is that individuals feel a duty to vote (Riker and Ordeshook 1968; Blais and Young 1999; Blais 2000). According to this explanation, some citizens feel morally compelled to vote and do so independently of the expected benefits of an election and despite the costs of voting.

Duty is not the only explanator of political participation. In their review of work on political participation, Fowler and Dawes (2008) count 33 different factors thought to predict voter turnout, encompassing demographic, attitudinal or behavioral, social, and institutional factors (p 589). These factors have measurably increased our knowledge; however, such environmental accounts still only explain a relatively modest portion of the variance in political participation. In the face of this, some scholars have begun to ask whether variation in political participation can be attributed to biological and genetic factors (Fowler, Baker, and Dawes 2008; Fowler and Dawes 2008; Dawes and Fowler 2009b). The goal of this note is to examine whether one of the most central explanators of the decision to vote – a sense that voting is a duty – is itself heritable. To do so, we employ a twin study design with 561 twin pairs in the United States. We find significant heritable variation in the belief that voting is a duty. These results comport with recent research that other predictors of turnout we previously assumed to be exclusively the product of the environment are also heritable.

The Role of Duty

Duty has long-played a role in the explanation of voter turnout. Beginning with Riker and Ordeshook, duty was used to resolve the paradox of participation. In his comprehensive review of the turnout literature nearly 40 years later, Blais argued that duty, which he defines as "the belief that not voting in a democracy is wrong (Blais 2000, 93)" is the *single* most important predictor of the decision to vote. To demonstrate this, he reviews survey evidence suggesting that a majority of citizens in several countries (Canada, Britain, France, and the United States) express agreement that voting is a duty, even when the outcome of an election is foregone or unimportant (p. 94). Second, in three original studies, he finds that controlling for other factors known to affect the decision to vote, duty is the single largest explanator and proves decisive for about half of respondents (p. 112).

The role of duty in the decision to vote is even more important if we broaden our conception of duty to include a feeling of obligation to others. Indeed, Blais also argues that a sense of duty captures the motivation of citizens who "are concerned with the well-being of their community as much as with their own self-interest (Blais 2000)." Such a broader, *pro-social* definition of duty, draws in other explanations of the decision to vote into the duty category. For example, group-based explanations of the decision to vote (e.g. Uhlaner 1986, 1989b,a, 1999) likewise assume that citizens are motivated by a sense of duty to others. More recently, scholars have argued that a concern for others can account not only for high levels of turnout, but variation in turnout as the importance of an election's outcome changes for other citizens' well-being (see Edlin, Gelman, and Kaplan 2007; Fowler 2006; Fowler and Kam 2007; Loewen 2010; Dawes, Loewen, and Fowler 2011). In sum, we conceive of a sense of duty as a belief that an individual has an obligation to undertake actions that benefit others even when the actions are costly to themselves. In the context of voting, a sense of a duty to vote will then be based on a belief that one has an obligation to others to vote, even though voting is costly. As we show when we present our measure of a sense of duty to vote, it is drawn from a series of other feelings of obligation, for example to contribute to charity, to work hard, and to pay for public services. A sense of a duty to vote is a pro-social orientation applied to politics.

Despite the centrality of a sense of duty in explaining voter turnout, debate still exists over the origin of this sense of obligation. Some scholars have emphasized parental influence and socialization (eg. Plutzer 2002). According to this logic, a sense of civic duty is inculcated in children early in life, by their parents, in their school environment (Campbell 2006), and in their social milieu more generally (Coleman 1990; Putnam 2000). Others have pointed to the importance of experiences in early elections (Franklin 2004; Johnston, Matthews, and Bittner 2007), arguing that these may inculcate the habit of voting and a sense of its importance. We take another route in this note by arguing that a sense that voting is a duty is likely to be heritable. This is not to argue that arguments based in socialization are incorrect. Quite the contrary, they tell us much about the factors that influence the decision to engage in politics. However, we recognize that a sense of obligation to vote largely resembles other pro-social orientations which are themselves heritable. Accordingly, as we describe in the next section, we wish to examine the degree to which individual differences in this sense of duty can be explained by genetic variation. In searching for this, we do so with the goal of finding attitudes which we know are closely related to the decision to vote, and which may *mediate* the genetic factors already found to be related to the decision to participate in politics.[1]

Linking Genes, Duty, and Voting

Motivated by earlier research studying the genetic and environmental sources of political attitudes (Martin, Eaves, Heath, Jardine, Feingold, and Eysenck 1986; Alford, Funk, and Hibbing 2005) and behavior (Hatemi, Medland, Morley, Heath, and Martin 2007), Fowler, Baker, and Dawes (2008) tested whether a significant proportion of the variation in voter turnout could be attributed to genetic factors. Based on two different samples of identical and non-identical twins, the authors found that genes accounted for more than half of the variation in turnout. Three follow-up studies (Fowler and Dawes 2008; Dawes and Fowler 2009b; Dawes and Loewen 2011) found significant associations between different versions (or 'variants') of genes known to play an important role in

[1]As will be discussed later, genetic factors may alternatively influence these attitudes and the decision to vote simultaneously rather than serially.

the serotonin and dopamine neurotransmission systems and self-reported turnout. Recent twin studies have also shown other determinants of turnout to be moderately heritable. Klemmensen, Hobolt, Petersen, Skytthe, and Norgaard (2010) and Funk, Smith, Alford, Hibbing, Hatemi, and Hibbing (2010) found approximately one-third of the variation in political efficacy could be attributed to genetic factors. Funk, Smith, Alford, Hibbing, Hatemi, and Hibbing (2010) found similar estimates for political knowledge. However, this is the first study to examine the degree to which individual differences in the view of voting as a duty can be explained by genetic variation.

Our hypothesis is that individual differences in attitudes towards voting as a duty or obligation are heritable. This claim is based first on our conception of duty as a pro-social orientation. The duty to vote appears closely related to other pro-social orientations, as we show in our Data section (see also Blais 2000). Such orientations have routinely been demonstrated to be heritable (McGue, Bacon, and Lykken 1993; Rushton, Fulker, Neale, Nias, and Eysenck 1986; Scourfield, John, Martin, and McGuffin 2004; Cesarini, Dawes, Johannesson, Lichtenstein, and Wallace 2008, 2009). Second, we have a strong prior based on previous empirical findings that have clearly linked duty to traits that have been demonstrated to be heritable. Recently, Blais and Labbé-St-Vincent (Forthcoming) showed that civic duty is influenced by the personality traits personal efficacy and conflict avoidance. Behavior geneticists have long known that related personality traits such as harm avoidance, social potency, and alienation are heritable (Bouchard and Loehlin 2001). Blais (2000) also reported several additional determinants of civic duty, nearly all of which have been previously shown to be heritable. These include political interest (Funk, Smith, Alford, Hibbing, Hatemi, and Hibbing 2010), income (Taubman 1976), and religiosity (Beer, Arnold, and Loehlin 1998; Bouchard, McGue, Lykken, and Tellegen 1999; Koenig, McGue, Krueger, and Bouchard 2005). Taken together, since traits highly correlated with duty have been shown to be heritable it is plausible that we will find heritable variation in duty as well. This is true for two main reasons. First, genes are known to influence multiple traits simultaneously.[2] Therefore, the same genes may be influencing both civic duty and a trait like interest in politics (for example). Alternatively, heritable traits that have been shown to be determinants of civic duty may be mediating the influence of genetic factors. We also know that constructs closely related to civic duty are heritable. Accordingly, we employ a twin study design to estimate the heritability of a duty to vote. In the final section of our note, we discuss how our findings and those discussed above should influence our study of political behaviour.

Methods: Twin Studies

Twin studies compare the behavior (or *phenotypes*) of twins who share 100% of their genetic material (identical or *monozygotic* twins) to those who, on average, share 50% of their genetic material (fraternal or *dizygotic* twins). In our case, we are interested in knowing whether the rate of concordance (or similarity) in viewing voting as a duty is higher among monozygotic twins than among dizygotic twins. If we can assume that these different sets of twins share comparable environments, then we can further generate estimates of how much of the variance in the sense of duty to vote are attributable to genes, to shared environments, and to individual experiences. Previous studies have examined the assumption of comparable environments and have ameliorated concerns that MZ and DZ twins are raised in significantly different environments (Bouchard 1998; Bouchard and McGue 2003).

To generate such estimates, we assume that variance in behavior is due to three factors: additive genetic factors (A), shared environmental factors among twin pairs (C), and unshared

[2] This is known as *pleiotropy*.

environmental factors among twin pairs (E).[3] Taken together, these estimates give us the ACE model (Evans, Gillespie, and Martin 2002). This model does not allow us to observe environmental and genetic effects directly, but it does allow us to estimate their effects by observing the covariance between different types of twins. The ACE model can be expressed as:

$$y_{ij} = \mu + A_{ij} + C_j + E_{ij} \tag{1}$$

where j denotes the family, i denotes the individual twin in the family, $A_{ij} \sim N(0, \sigma_A^2)$ is the additive genetic component, $C_j \sim N(0, \sigma_C^2)$ is the shared environment component, and $E_{ij} \sim N(0, \sigma_E^2)$ is the unshared environment component.

For MZ and DZ twins:

$$Var(y) = \sigma_A^2 + \sigma_C^2 + \sigma_E^2, \tag{2}$$

$$COV_{MZ}(y_{1j}, y_{2j}) = \sigma_A^2 + \sigma_C^2, \tag{3}$$

$$COV_{DZ}(y_{1j}, y_{2j}) = \frac{1}{2}\sigma_A^2 + \sigma_C^2 \tag{4}$$

The covariance equations reflect that fact that DZ twins share on average 50% of their genes whereas MZ twins share all of their genes. We also assume that MZ and DZ twins are reared in comparable environments. Based on these equations, we can estimate the ACE model via a random effects regression model where the 2×2 variance-covariance matrix is specified as:

$$\mathbf{\Omega_j} = \begin{bmatrix} \sigma_A^2 + \sigma_C^2 + \sigma_E^2 & R_j\sigma_A^2 + \sigma_C^2 \\ R_j\sigma_A^2 + \sigma_C^2 & \sigma_A^2 + \sigma_C^2 + \sigma_E^2 \end{bmatrix}$$

where R is the genetic relatedness of the twin pair equaling 1 for MZ twins and $\frac{1}{2}$ for DZ twins. We follow the ACE model parameterization described in Rabe-Hesketh, Skrondal, and Gjessing (2008). Since our dependent variable has 11 categories, we model it as an ordered probit. We use the variances of the random effects to generate estimates of heritability, common environment, and unshared environment.[4] Since the residual variance is fixed in a probit model this ACE model is unidentified. Therefore, we must fix $\sigma_E = 1$. Also included in the model are controls for age and gender.

The likelihood functions in genetic models often present computational challenges for maximum likelihood approaches because they contain high-dimension integrals that cannot be evaluated in closed form and thus must be evaluated numerically. This has prompted the increasing use of Bayesian methods, implemented using Markov Chain Monte Carlo (MCMC) algorithms, to estimate the variance components in ACE models.[5] This is the approach we take for this note. We choose vague prior distributions to ensure they do not drive our results. For the thresholds we use a mean-zero normal distribution with variance $1,000,000$ and for the precision parameters associated with σ_A^2, σ_E^2 and σ_C^2 we use a Pareto distribution with shape parameter equal to 1 and scale parameter equal to 0.001 which is the equivalent of putting a uniform $(0, 1000)$ prior on the variances.[6] We began sampling from the joint posterior distribution after convergence

[3] We note that C and E do not correspond perfectly to familial and non-familial influences, respectively. It is possible for twins to have idiosyncratic experiences within the home (for example, a parent favoring one child over another) and shared experiences outside of the home (for example, having the same teacher). Likewise, these do not correspond perfectly to childhood and adult experiences, respectively (Turkheimer and Waldron 2000).

[4] They are defined as $\frac{\sigma_A^2}{\sigma_A^2+\sigma_C^2+\sigma_E^2}$, $\frac{\sigma_C^2}{\sigma_A^2+\sigma_C^2+\sigma_E^2}$, and $\frac{\sigma_E^2}{\sigma_A^2+\sigma_C^2+\sigma_E^2}$ respectively.

[5] For a detailed discussion of Bayesian ACE models, we refer to van den Berg, Beem, and Boomsma (2006).

[6] A Pareto distribution has proven to work well for variance components in genetic models (Burton, Tiller, Gurrin, Cookson, Musk, and Palmer 1999; Scurrah, Palmer, and Burton 2000).

was established using the Brooks and Gelman (1998) statistic (values of less than 1.1 on each parameter indicate convergence). For all of the models the burn-in period was $100,000$ iterations and the chains were thinned by 100.

In addition to estimating an ACE model, we estimated all of the possible submodels models to compare model fit. These include an AE model, which assumes only heritability and common environment, a CE model, which assumes only common and unshared environment, and an E model. If a submodel fits better than the general ACE model, this suggests the variance or variances not included in the submodel should not be included. To compare the submodels we used the deviance information criterion (DIC), a Bayesian method for model comparison analogous to the Akaike Information Criterion (AIC) in maximum likelihood estimation. Models with smaller DIC are considered to be superior (Gelman *et al.* 2004).

Data

For data, we rely on the MacArthur Foundation's Survey of Midlife Development in the U.S. (MIDUS) survey. The survey was conducted in 1994-1995. The entire survey is based on a probability sample of all adults in the United States aged 25-74, with an oversample of men aged 65-74. A separate sampling procedure was adopted for twins in which 50,000 American were canvassed; when twins were located in the sample, their twin was also invited to complete the survey. This generated an effective sample of 303 monozygotic twin pairs and 258 dyzygotic twin pairs.

MIDUS is principally concerned with physical and mental health, but does include some questions related to politics, embedded in a larger set of nineteen questions related to social obligations.[7] We performed a principal components factor analysis on these 19 questions. The strongest factor is comprised of seven items, including our measure of an obligation to vote. These items include feeling obligated to keep informed about politics, to vote in national and local elections, to work hard even if one does not respect their supervisor, to pay more for health care so that everyone can have access, to volunteer time to social causes one supports, to collect contributions for heart or cancer research if asked, and to vote for a law that would help others who are worse off, but which would increase the respondent's taxes. Cronbach's α suggests that these 7 items have a high internal consistency ($\alpha = .81$). This suggests that a sense of duty to vote is a part of a more general sense of social obligation, as we suggest in our previous sections.

For our dependent variable, we make use of the question related to voting. The precise question wording was: "Here is a list of hypothetical situations. Please rate how much obligation you would feel if they happened to you, using a 0 to 10 scale where 0 means 'no obligation at all' and 10 means 'a very great obligation.' If the situation does not apply to you, please think about how much obligation you would feel if you were in this situation.... To vote in local and national elections?" The median answer was 9.

Table 1 presents the key demographic characteristics of our sample for each type of twins pair, including age, income, education, gender, and ethnicity. It also includes our dependent variable.

We did find some significant environmental differences between MZ and DZ twins (*Table 1*). These could represent violations of the comparable environments assumption. We do note, however, that these twins were all drawn from the same random sample of American adults.

[7] Those interested in the full schedule of questions can access the MIDUS codebook at `http://www.midus.wisc.edu/midus1/mail_parts_1_2.pdf`. The complete list of 19 obligations questions range from K7a to K7s on page 73

	Monozygotic		Dyzygotic		Difference of
	Mean	S.E.	Mean	S.E.	Means Test p-value
Age	44.8	0.49	45.9	12.5	0.29
Male (%)	44.4	2.0	38.0	2.1	0.14
Income	77435	2537	70034	2636	0.08
Education	6.91	0.10	6.37	0.11	0.00
Religious attendance	1.88	0.06	1.96	0.06	0.41
Black (%)	4.4	0.8	4.3	0.9	0.94
Duty to Vote	7.97	0.11	7.98	0.12	0.99

Table 1: Summary Statistics, by Zygosity. Note: These data test for significant differences in environments between monozygotic and dyzygotic twin paris. Age is measured in years. Male is measured 0 or 1. Income is measured in thousands of dollars. Education is measured by level on a scale from 1 to 12. Religious attendance is measured on a scale from 0 to 4. Black ethnicity is measured as 0 or 1. Duty to Vote is measured 0 to 10. The p-value is for the test of the hypothesis that the mean of the MZ and DZ distributions are the same. We utilized adjusted Wald tests for equality taking into account nonindependence within twin families (Liang and Zeger 1986).

Moreover, this twin sample has been widely used elsewhere. Finally, these differences appear substantively small, representing, for example, a difference of just 10% in income.

Results

The first step in assessing the potential role of genetic factors is to compare the correlation among MZ twins to that of DZ twins. As was stated earlier, greater concordance among MZ twins than DZ twins suggests a role for genetic factors. For a sense of duty, the bootstrapped spearman correlation for MZ twins is 0.39 (95% CI = 0.29, 0.48) and for DZ twins is 0.22 (95% CI = 0.09, 0.33). The difference in correlations is significant ($p = 0.014$, one sided). These correlations are suggestive that genetic factors play a significant role. The ACE model, controlling for gender and age, yields a heritability estimate of 34% (95% CI = 12%, 50%). The estimate for common environment is 11% (95% CI = 1%, 29%) and the estimate for unshared environment is 55% (95% CI = 45%, 66%). *Figure 1* shows the 95% credible area of the joint estimates. We examine submodels in *Table 2*. The best fitting model, based on the DIC value, is the AE model in which the total variation is decomposed into additive genetic and unshared environmental factors. This model suggests a heritability estimate of 46% (95% CI = 35%, 56%) and unshared environment estimate of 54% (95% CI = 44%, 65%).

Whether we take the ACE or the AE model, it remains that a moderate degree of the sense that voting is a duty appears to be heritable. In the ACE model the role of shared environment is relatively small which is often the case in the behavior genetics literature. This suggests that the influence of parental socialization on the development of duty is much smaller than those of genetic and unique environmental factors. This may seem odd to political scientists, but it is also consistent with previous twin studies of political behaviors and attitudes. It is also important to note that the heritability estimate we report here is similar to those found by Klemmensen, Hobolt, Petersen, Skytthe, and Norgaard (2010) and Funk, Smith, Alford, Hibbing, Hatemi, and Hibbing (2010) for political efficacy. Funk et al. also found similar estimates for political knowledge. Finally, these estimates are of a similar magnitude of those that (Cesarini, Dawes,

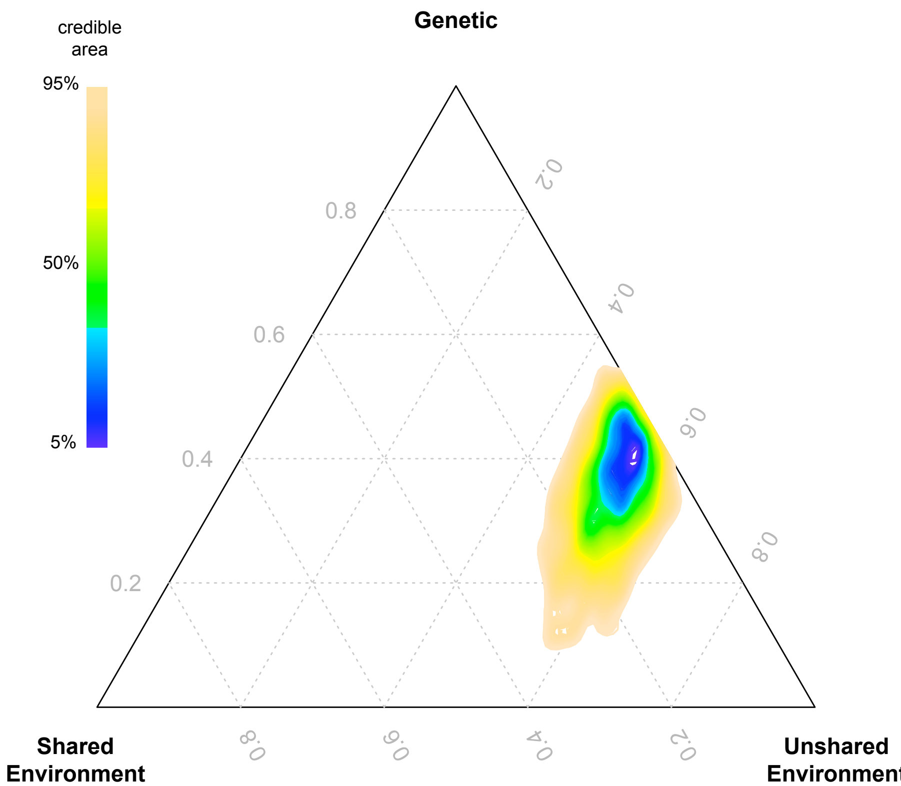

Figure 1: The heritability of a sense of duty to vote. Ternary plot shows the posterior distribution of estimated components of total variance in an ACE model of voting among MIDUS subjects. The plot represents the proportions of three variance components (genetic, shared environment, and unshared environment) that sum up to one. A point in the center indicates all three components contribute equally, whereas a point at a vertex indicates that a single component fully explains the variance. Colors indicate credible areas calculated by using 2,000 posterior draws to estimate a three-dimensional kernel density. The blue areas indicate the highest density regions with the most credible estimates, while the beige areas contain 95% of the draws (i.e., the probability that the true estimates lie outside the colored region is 0.05. Mean heritability is estimated to be 34%.

Johannesson, Lichtenstein, and Wallace 2009) found for other-regarding preferences.

Discussion and Conclusions

We have used a twin-study design to examine whether the belief that voting is a duty is heritable. Our results suggest that this is the case and thus concord with earlier work that has demonstrated the heritability of voter turnout and political participation (Fowler, Baker, and Dawes 2008) and the molecular basis of participation (Fowler and Dawes 2008; Dawes and Fowler 2009a; Dawes and Loewen 2011). This work likewise complements that demonstrating that partisan attachment, another strong predictor of participation, is also heritable (Settle, Dawes, and Fowler 2009). It likewise accords with work suggesting that more general pro-social orientations may be heritable

Model	Heritability (%)	Shared Environment (%)	Unshared Environment (%)	DIC
ACE	34 (12, 50)	11 (1, 29)	55 (45, 66)	3992
AE	46 (35, 56)		54 (44, 65)	3987
CE		35 (27, 44)	65 (56, 73)	4044
E				4179

Table 2: Summary of Model Results. Note: The ACE model consists of additive genetic factors (A), shared or common environmental factors (C), and unshared environmental factors (E). The model includes 303 MZ and 258 DZ twin pairs. It is estimated with controls for age and gender

(McGue, Bacon, and Lykken 1993; Rushton, Fulker, Neale, Nias, and Eysenck 1986; Scourfield, John, Martin, and McGuffin 2004; Cesarini, Dawes, Johannesson, Lichtenstein, and Wallace 2008, 2009). Overall, then, our work adds to the growing literature suggesting that genetic variation is a source of individual differences in political orientations and behaviors (Alford, Funk, and Hibbing 2005; Hatemi, Hibbing, Alford, Martin, and Eaves 2009; Oxley, Smith, Alford, Hibbing, Miller, Scalora, Hatemi, and Hibbing 2008).

The results reported in this note are important because they give political scientists a better understanding of the sources of individual differences in a key determinant of voting behavior. This is not restricted to genetic sources of variation, but also shows that parental socialization plays a limited role. Knowing the sources of individual differences in feelings of duty may help to inform extant and future theoretical models of political behavior and attitude generation as well as inform policy making decisions. Work by Blais (2000), and more recently (Gerber, Green, and Larimer 2008), has shown that feelings of duty are malleable and can be manipulated by contextual influences. Our results do not contradict these findings. Simply because a trait is heritable does not imply that it is unchangeable. Twin models examine individual variation holding the context constant thus heritability estimates are context-specific. Differences in the framing political choices or debates clearly have an individual-level effect on feelings of voting as a duty Gerber, Green, and Larimer (2008). Our analysis also cannot fully account for the role of environmental forces in determining complex political attitudes like duty. In what is likely a very complicated causal pathway leading from genes to any attitude or behavior, genetic factors may interact with environmental stimuli to produce outcomes. While twin studies such as this are an important first step, future work must attempt to better understand the specific genetic mechanisms underlying duty and as well as how different environmental stimuli combine with genetic factors to produce political attitudes and behaviors.

The fact that genetic differences underly individual differences in duty suggests that genes may affect political behavior via duty, something future work should explore. Also, based on Blais and Labbé-St-Vincent (Forthcoming), the pathway may be longer, going from genes to personality traits to duty to voting. These two relationships are illustrated by *Figure 2*. However, it may alternatively be the case that genes influence duty and political behavior independently. This relationship, where the same gene affects more than one trait, is known as pleiotropy. For example, Verhulst, Hatemi, and Martin (2010) and Verhulst, Hatemi, and Eaves (2009) argue that genes influence both personality traits and political attitudes in this fashion leaving us with the false impression of a causal ordering from personality to ideology. This is an area for future research; the findings we report here for one link in a possible chain help to inform this question. Ultimately, a genetically informative data set containing measures of personality traits, political attitudes, and turnout behavior is required to better understand and test our proposed causal chain.

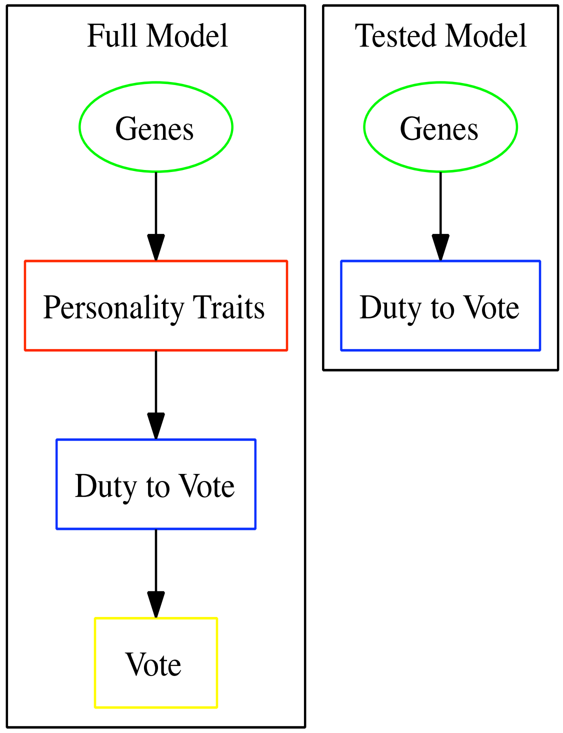

Figure 2: Proposed and tested causal relationships.

Our results potentially shed light on one of the key paradoxes in political science: Why do some individuals vote in elections when the costs likely outweigh the instrumental benefit while others conform to our expectations based on expected utility theory and abstain? As discussed in this note, it is believed that many of those willing to incur the costs of voting do so out of a sense of obligation. However, since this explanation has been criticized for potentially being tautological it is important to understand the source of these feelings of obligation. We find that genetic variation accounts for a moderate share of individual differences in feelings of obligation to vote suggesting that some individuals select into the political process due to their genetic endowments.

This work has four limitations. First, we are not examining whether voter *turnout* is heritable. While this has been previously demonstrated (Fowler, Baker, and Dawes 2008), it is still the case that we are assuming that those who answer in the affirmative that voting is a duty are in fact more likely to participate in politics. Previous work suggests this is the case (see Blais 2000). Nonetheless, we note the assumption. Second, our work has not identified how much heritability a sense of duty shares with other explanators of political participation. For example, we might suspect that senses of trust and efficacy will share much of the same genetic basis as a sense of duty. Accordingly, while we have demonstrated a large degree of variance a duty to vote is attributable to genes, we also acknowledge that we are likely capturing in this other elements of the decision to vote. Identifying the unique genetic component of a duty to vote requires further study. Third, we have not identified which more general personality traits (e.g. the "Big Five") may encapsulate a sense of duty. Finally, our sample is composed principally of middle-aged, American adults. Whether our results generalize to other ages and other populations is an open question.

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