Control and Turnout

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Abstract

Political scientists have recently explored the genetic basis of political participation. Fowler, Baker & Dawes (2008) recently showed in two independent samples of twins that voter turnout is heritable and Fowler & Dawes (2008). Earlier work (Fowler & Kam 2006) demonstrating a link between turnout and patience suggests that the related personality trait impulsivity, a trait which has also been shown to be heritable (Pedersen, Plomin, McClearn & Friberg 1988, Seroczynski, Bergman & Coccaro 1999, Bouchard & McGue 2003), may share common genetic variation with turnout. Based on large sample of twins and their families, this paper tests whether a widely used measure of impulsivity significantly predicts validated voter turnout and, if so, whether impulsivity and voting behavior share a common genetic source of variation. We find that impulsivity does significantly influence turnout, however the relationship appears to be limited to males. Among males, the effect of impulsiveness is comparable to those of age, income, education. We also find that for males, nearly one-quarter of heritability of turnout is from the same genetic sources as impulsivity. This suggests, at least for males, that a large portion of the influence of genetic factors on turnout may be via impulsivity.
Introduction

Motivated by earlier research studying the genetic basis of political attitudes (Martin, Eaves, Heath, Jardine, Feingold & Eysenck 1986, Alford, Funk & Hibbing 2005) and behavior (Hatemi, Medland, Morley, Heath & Martin 2007), Fowler, Baker & 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. While these results strongly suggest a link between genes and turnout it left an important question unanswered: what is the causal pathway linking these genes to voting behavior?

Alford, Funk & Hibbing (2005) first suggested that genes may be linked to political attitudes through personality traits and the same is likely true for political behaviors like voting. Several recent papers have demonstrated an empirical connection between personality traits and turnout (Gerber, Huber, Raso & Ha 2008, Gerber, Huber, Doherty & Dowling 2009, Mondak & Halperin 2008, Denny & Doyle 2008) as well as develop a theoretical framework marrying personality and politics (Mondak & Halperin 2008). Scholars have long known, based on twin studies, that personality traits are highly heritable (Bouchard & Loehlin 2001). Molecular genetic studies have also found a relationship between specific genetic variants (Stein, Schork & Gelernter 2004, Luo, Kranzler, Zuo, Zhang, Wang & Gelernter 2007, Luo, Zuo, Kranzler, Zhang, Wang & Gelernter 2008) and personality traits. Genes are unlikely to directly influence political behavior; however by shaping our personality genes may indirectly affect whether or not we vote.
Linking Genes, Impulsivity, and Turnout

Fowler & Kam (2006) argue that since the costs of voting are paid on or before election day while the instrumental benefits of having a policy implemented usually take much longer to realize, the rational choice calculation $PB - C$ is largely a comparison of present costs and future benefits. As a result, more patient individuals are likely more willing to pay the present costs even though they do not gain the benefits immediately. Impulsive individuals do not tend to delay gratification and thus are more likely to heavily weight the present costs over future benefits resulting in abstention.

Fowler & Kam (2006) found in an experimental setting where subjects given the choice of receiving some amount of money today versus a larger amount in the future that those more willing to wait for a higher payoff are also more likely to report having voted.

These results suggest that self-reported personality measures of impulsivity may be related to turnout. To date, there has been only one direct study of impulsivity and voting behavior outside of a laboratory setting. Denny & Doyle (2008) analyzed the 1958 National Child Development Study, a British longitudinal study. The authors failed to find a significant relationship between self-reported impulsivity, assessed at age 16, and self-reported turnout in the 1997 British national general election at age 39. Some indirect evidence of a relationship is provided by Gerber et al. (2009) who find that the “Big 5” personality trait conscientiousness is a significant predictor of self-reported turnout. In the five-factor model, impulsivity is associated with low conscientiousness (Congdon & Canli 2005). The authors find that effect size of conscientiousness is similar to that of income and education suggesting that impulsivity may be an important predictor of voting behavior.

Impulsivity may mediate the link between genes and turnout. Several twins studies have
found evidence that self-reported impulsivity is heritable (Pedersen et al. 1988, Seroczynski, Bergman & Coccaro 1999, Bouchard & McGue 2003) suggesting that up to 45% of the variance in impulsivity can be attributed to genetic factors (Congdon & Canli 2005). Further, Eisenberg, MacKillop, Modi, Beauchemin, Dan, Lisman, Lum & Wilson (2007) reported a significant association between the dopamine neurotransmitter gene DRD2 and impulsivity based on the delay discount task, a measure similar to the one used by Fowler & Kam (2006). Two recent studies have found significant associations between self-reported turnout and other variants known to play an important role in the dopamine neurotransmission system (Fowler & Dawes 2008, Dawes & Fowler 2009). Finally, Dawes & Loewen (2010) found an association between self-reported turnout and a variant strongly related to impulsive behaviors like smoking and drinking.

The goal of this paper is to test whether the personality trait impulsivity shares common genetic variation with voter turnout suggesting impulsivity mediates the relationship between genes and turnout. Our analysis is comprised of three steps: (1) a test of whether impulsivity predicts voting behavior, (2) confirmation that turnout and impulsivity are significantly heritable for our sample, and (3) estimation of the proportion of the covariance between impulsivity and turnout that can be attributed to genetic factors.

Sample

The data set used for this analysis is based on two studies actively being conducted by the Minnesota Center for Twin and Family Research (MCTFR). The first is the Minnesota Twin Family Study (MTFS) which is a population-based, longitudinal study of 1197 monozygotic (MZ) and 684 dizygotic (DZ) like-sex twin pairs and their parents (Iacono, McGue & Krueger 2006). Data was
collected on these twins and their parents at an initial assessment as well as follow-ups for the twins occurring at roughly 3-year intervals. The MTFS is comprised of two age cohorts, one in which subjects were 11 years old at the time of their initial assessment and the other in which subjects were 17 years old. The younger cohort was born between 1977-1984 and the older cohort was born between 1972-1979.

The second study, the Minnesota Twin Registry (Registry), is made up of 4307 twin pairs born between 1936 and 1955 as well as 391 male twin pairs born between 1961 and 1963 (Krueger & Johnson 2002). Subjects have completed several questionnaires as part of the study, however most of them were unique and thus it is not a longitudinal study. The MTFS and Registry sample are often combined in studies investigating data common to both of them (Krueger & Johnson 2002).

In order to construct a genetically informative sample of validated voting behavior, we matched the MTFS and Registry data sets with public voting records available through the Minnesota Secretary of State’s office using subject name, address, phone, and date of birth information. This paper focusses on turnout in the 2006 midterm election. Out of these matched voters, 4440 are registered to vote in the 2006 election have non-missing data and thus were included in the analysis. There are 2334 individual twins that were originally recruited as same-sex twin pairs and 735 complete same-sex twin pairs in our sample. Summary statistics for the sample are provided in the appendix.

MPQ Control-Impulsivity

The Multidimensional Personality Questionnaire (Tellegen 1985) is a factor-analytically derived personality questionnaire that yields 11 primary trait scales and three higher factor scores. The three
higher factors are positive emotionality, negative emotionality, and constraint. The MPQ is widely used in psychology and performs well on measures of internal consistency and test-retest reliability (Tellegen & Waller 2008). Both the MTFS and Registry sample have completed the 198 question Multidimensional Personality Questionnaire (MPQ) (Tellegen 1985).

This paper studies the primary trait *Control-Impulsivity* (Control).\(^1\) Individuals scoring high on Control are characterized as reflective and like to make detailed plans for the future whereas low scorers are careless and do not tend to plan ahead (Tellegen & Waller 2008). In a comparison of several measures of impulsivity, Whiteside & Lyman (2001) found that the MPQ Control measure strongly loaded with other measures that were associated with careful thinking and planning for the future.

**Control and Turnout**

As a first step in exploring the link between genes, Control, and turnout we test whether or not Control predicts turnout in the 2006 Minnesota midterm election. For Registry subjects and parents of MTFS twins we only have a single Control scale, however MTFS twins completed the MPQ at least twice. We chose the most recent MPQ administered at either age 24 (younger cohort) or age 29 (older cohort). Since the MPQ was completed at different ages for different subsets of our sample, we regressed the Control scale on age and use the Z-scored residual in all subsequent analysis.

The results for the overall sample of twins, parents and siblings as well as the subsample of same-sex twins used for the subsequent genetic analysis are presented below in Table 1 and Table 2 for the samples as well as separately for males and females. We analyze males and females

\(^1\)Control is based on 24 questions in the MPQ.
separately because heritability of the Control scale has been shown to be different for males and females (Finkel & McGue 1997) and ultimately we want to estimate the shared heritability for turnout an Control. The subject’s age at the time of the election, sex, household income, and highest level of educational attainment are also included in the regressions. Since the sample is made up of individuals within families, we employ a fixed effects logit model which estimates a unique intercept for each family.

<table>
<thead>
<tr>
<th></th>
<th>Combined Coef</th>
<th>SE</th>
<th>p</th>
<th>Females Coef</th>
<th>SE</th>
<th>p</th>
<th>Males Coef</th>
<th>SE</th>
<th>p</th>
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<td>0.01</td>
<td>0.02</td>
<td>0.08</td>
<td>0.76</td>
<td>0.21</td>
<td>0.06</td>
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<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
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<td>0.01</td>
<td></td>
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<tr>
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<td>0.00</td>
<td>0.12</td>
<td>0.05</td>
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<tr>
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<td>0.27</td>
<td>0.06</td>
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<td>0.00</td>
<td>-2.52</td>
<td>0.39</td>
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Table 1: The model is a mixed-effects logit which estimates a random intercept for each family (not shown). Logit coefficients (Coef), standard errors (SE), and p-values (p) are presented. Control is the Z-score of residualized Control, Age is the subject’s age at the time of the election, Male is an indicator variable, Income is the subject’s total household income (0-10K, 10-20K, 30-40K, 40-50K, >50K), Education is the subject’s highest level of education (< high school, high school, some college, college degree, post-graduate degree).

Consistent with the proposed theory, there is evidence that more forward looking individuals based on the MPQ Control scale are more likely to have voted in the 2006 election in the overall ($p = 0.01$) and twin ($p = 0.08$). However, the sex-specific regressions reveal that this relationship is only true for men ($p < 0.001$ and $p = 0.03$). The number of males and females is relatively large in the overall sample therefore the insignificant Control coefficient in the female regression is unlikely due to a lack of power. Age, income, and education are significant are nearly significant in all of the
## 2006 Turnout: Twin Sample

<table>
<thead>
<tr>
<th></th>
<th>Combined</th>
<th>Females</th>
<th>Males</th>
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<tbody>
<tr>
<td></td>
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<td>SE</td>
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</tr>
<tr>
<td>Control</td>
<td>0.11</td>
<td>0.06</td>
<td>0.08</td>
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<tr>
<td>Age</td>
<td>0.06</td>
<td>0.01</td>
<td>0.00</td>
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<tr>
<td>Male</td>
<td>-0.24</td>
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</tr>
<tr>
<td>Income</td>
<td>0.14</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>Education</td>
<td>0.26</td>
<td>0.06</td>
<td>0.00</td>
</tr>
<tr>
<td>Intercept</td>
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<td>2334</td>
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<td>Log Lik</td>
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</table>

Table 2: The model is a mixed-effects logit which estimates a random intercept for each family (not shown). Logit coefficients (Coef), standard errors (SE), and p-values (p) are presented. Control is the Z-score of residualized Control, Age is the subject’s age at the time of the election, Male is an indicator variable, Income is the subject’s total household income (0-10K, 10-20K, 30-40K, 40-50K, > 50K), Education is the subject’s highest level of education (< high school, high school, some college, college degree, post-graduate degree).

Figure 1 displays the simulated first differences and 95% confidence intervals for Control as well as the other variables in the male overall and twin-only regression models. The first difference for Control is significant for both models and, similar to what Gerber et al. (2008) found in their study of Connecticut voter files, the magnitude is similar to those for age, income, and education. These results suggest that among males, the effect of a proclivity for forward looking thinking and behavior is on par with variables political scientists believe to be among the most predictive of turnout.

### Genetic Analysis

The second step in our analysis is to separately determine whether voting in the 2006 election and Control are heritable based on our sample. In order to do this we study (identical) monozygotic
Figure 1: First differences, based on simulations of Table 1 and Table 2 parameters for the male sample, are presented along with 95% confidence intervals. All other variables are held at their means. Control is the effect of moving from one standard deviation above to one standard deviation below the mean; Age is the effect of moving from age 50 to 61; Income is the effect of moving from an income of 20-30K to > 50K; Education is the effect of moving from being a high school graduate to having an undergraduate college degree.

(MZ) twins who were conceived from a single egg and (non-identical) dizygotic (DZ) twins who were conceived from two separate eggs. MZ twins share 100% of their genes, while DZ twins share only 50% on average. Thus, if these two traits each have a genetic basis, MZ twins should exhibit more concordance (both twins vote or both twins abstain) than DZ twins. Moreover, if we assume that MZ twins and DZ twins share comparable environments, then we can use these concordances to estimate explicitly the relative influence of genetic, shared environmental, and unshared environmental factors.

The basic twin model assumes that the variance in observed behavior can be partitioned into additive genetic factors (A), and environmental factors which are shared or common to co-twins (C),
and unshared environmental (E). This is the so-called ACE model. Common environment includes the family environment in which both twins were raised, as well as any other factor to which both twins were equally exposed. In contrast, the unshared environment includes idiosyncratic influences that are experienced individually.

The purpose of the univariate ACE model is to measure the total variance in a given trait or “phenotype” and then estimate the extent to which genetic and environmental influences separately contribute to the total observed variance. The role of genotype and environment are not measured directly but their influence is inferred through their effects on the covariances of twin siblings (Neale & Cardon 1992). More formally, these components are derived from known relationships between three observed statistics (Evans, Gillespie & Martin 2002):

\[
\sigma_P^2 = \sigma_A^2 + \sigma_C^2 + \sigma_E^2 \quad (1)
\]

\[
COV_{MZ} = \sigma_A^2 + \sigma_C^2 \quad (2)
\]

\[
COV_{DZ} = \frac{1}{2} \sigma_A^2 + \sigma_C^2 \quad (3)
\]

where \( \sigma_P^2 \) is the observed phenotypic variance (the same for MZ and DZ twins), \( COV_{MZ} \) and \( COV_{DZ} \) are the observed covariances between MZ and DZ twins, and \( \sigma_A^2, \sigma_C^2, \) and \( \sigma_E^2 \) are the variance components for genes, common environment, and unshared environment, respectively. These relationships yield three equations and three unknowns. The most common approach to estimating the parameters is to employ structural equations modeling within a maximum likelihood framework based a sample of monozygotic and same-sex dizygotic twins (Medland & Hatemi 2009).
and this is the approach we take.\textsuperscript{3} Using the estimates of latent variances we can characterize the proportion of the variation the phenotype to additive genetic factors, common environment, and unique environment.\textsuperscript{4}

The results for the univariate ACE models for turnout and Control for both the overall and male samples are presented in Table 3. The heritability estimates for turnout in the Minnesota 2006 midterm election for the overall sample and the male subsample are very similar to that reported by Fowler, Baker & Dawes (2008) for validated turnout in eight Los Angeles elections. The heritability estimates for Control are also similar to those reported by Finkel & McGue (1997) based on Registry twins.

<table>
<thead>
<tr>
<th>Univariate ACE Model</th>
<th>Heritability</th>
<th>p</th>
<th>Common Environment</th>
<th>p</th>
<th>Unique Environment</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Turnout</td>
<td>0.52</td>
<td>0.04</td>
<td>0.00</td>
<td>1.00</td>
<td>0.48</td>
<td>0.00</td>
</tr>
<tr>
<td>Overall Control</td>
<td>0.34</td>
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<td>0.00</td>
<td>1.00</td>
<td>0.67</td>
<td>0.00</td>
</tr>
<tr>
<td>Male Turnout</td>
<td>0.45</td>
<td>0.04</td>
<td>0.00</td>
<td>1.00</td>
<td>0.55</td>
<td>0.00</td>
</tr>
<tr>
<td>Male Control</td>
<td>0.30</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.70</td>
<td>0.00</td>
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</table>

Table 3: Parameter estimates and p-values for heritability, common environment, and unshared environment from a univariate ACE model. The overall sample is made up of 474 MZ and 261 DZ twin pairs. The male sample is made up 283 MZ and 148 DZ pairs.

Based on these results we can be confident that both turnout in the 2006 election and Control are heritable and therefore it is worthwhile to explore how much of the covariation between these two variables can be attributed to genetic factors. In other words, how much of the heritability of voting overlaps with control? The degree of overlap provides a baseline for how much of the relationship between genes and turnout flows through Control. To investigate this question we

\textsuperscript{3}All models are estimated using Mplus (Muthen & Muthen 2007).

\textsuperscript{4}Formally, they are mathematically defined as $h^2 = \frac{\sigma_A^2}{\sigma_P^2}$, $c^2 = \frac{\sigma_C^2}{\sigma_P^2}$, $e^2 = \frac{\sigma_E^2}{\sigma_P^2}$ respectively.
employ a bivariate structural equations model (Prescott 2004, Prescott, Cross, Kuhn, Horn & Kendler 2004) illustrated by Figure 2. Since the univariate models strongly suggest variation in neither turnout nor Control can be attributed to common environment the C factor is not included in the bivariate model. In the model, effects of the genetic and unique environmental factors influencing turnout are decomposed into those specific to turnout, represented by $a_1$ and $e_1$, as well as those shared with Control, represented by $a_{12}$ and $e_{12}$. The direction of causality is assumed to flow from Control to turnout, therefore the shared variation suggests the existence and strength of a potential mediation relationship.

Figure 2: Bivariate AE model of common influences on Control and turnout. G is the latent construct of genetic influence and E is the latent construct of unique environment. The path coefficients are represented by $a_1$, $e_1$, $a_{12}$, $e_{12}$, $a_2$, and $e_2$. 
The results of the bivariate AE model for turnout in the 2006 election and Control are presented in Table 4. The rows labelled Turnout and Control (Overall and Male) report the estimates unique to turnout and Control (corresponding to $a_1$, $e_1$, $a_2$, and $e_2$) whereas the overlap rows correspond to the shared heritability and unique environment ($a_{12}$ and $e_{12}$). For this analysis these are the rows we are most interested in. Within the overall sample, the shared heritability among turnout and Control is relatively modest constituting approximately 4% of the heritability of turnout. For the male sample nearly 25% of the heritability of turnout is shared with Control.\(^5\) These results also show that all of the covariation between turnout and Control can be attributed to additive genetic factors.

<table>
<thead>
<tr>
<th>Bivariate AE Model</th>
<th>Heritability</th>
<th>p</th>
<th>Unique Environment</th>
<th>p</th>
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<tbody>
<tr>
<td>Overall Overlap</td>
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<td>0.05</td>
<td>0.00</td>
<td>0.67</td>
</tr>
<tr>
<td>Overall Turnout</td>
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<td>0.00</td>
<td>0.50</td>
<td>0.00</td>
</tr>
<tr>
<td>Overall Control</td>
<td>0.30</td>
<td>0.00</td>
<td>0.68</td>
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<tr>
<td>Male Overlap</td>
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<tr>
<td>Male Turnout</td>
<td>0.34</td>
<td>0.00</td>
<td>0.55</td>
<td>0.00</td>
</tr>
<tr>
<td>Male Control</td>
<td>0.29</td>
<td>0.00</td>
<td>0.71</td>
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</tbody>
</table>

Table 4: Parameter estimates and p-values for heritability and unshared environment from a bivariate AE model. The overall sample is made up of 474 MZ and 261 DZ twin pairs. The male sample is made up 283 MZ and 148 DZ pairs.

**Discussion**

Based on large sample of over 4000 subjects, our results show that impulsivity predicts validated turnout in the 2006 Minnesota midterm election. However, this relationship appears to only hold for men. Among men, the effect size for Control is comparable to variables that tend to be among

\[^{5}\text{The proportion shared is } \frac{0.02}{0.04} = 0.04 \text{ for the overall sample and } \frac{0.10}{0.45} = 0.22. \text{ The numerator is taken from Table 4 and the denominator from Table 3.}\]
the strongest predictors of turnout such as age, education, and income. On its own, this findings makes an important contribution to the nascent literature studying the role of personality in shaping political behavior. It also follows in the footsteps of (Gerber et al. 2009) in showing that the effect of personality on political behavior is unlikely to be monolithic and that studying specific subgroups is important.

While the literature studying the role of personality and turnout is growing, there are very few published results with which to compare our findings to. Denny & Doyle (2008) analyzed the 1958 National Child Development Study, a British longitudinal study. The authors failed to find a significant relationship between self-reported impulsivity, assessed at age 16, and self-reported turnout in the 1997 British national general election at age 39. Gerber et al. (2009) found that higher levels of the “Big 5” personality trait conscientiousness, which is associated with lower levels of impulsivity (Congdon & Canli 2005), significantly predicts self reported turnout in their overall sample. However, they fail to find a significantly different effect for males and females. Gerber et al. (2008) and Mondak & Halperin (2008) fail to find a significant relationship between self-reported or validated turnout and conscientiousness. The lack of consistent findings for these limited studies of impulsivity are likely do to different sample sizes, measures of turnout, and measures of impulsivity and much more work is required before a consensus is reached regarding the role of impulsivity in shaping voting behavior.

The ultimate goal of this research is to test whether Control shares common genetic variation with turnout. For males, nearly one-quarter of the heritability of turnout is shared with a single personality trait. In terms of the search for common genetic sources of personality traits and behavior behaviors or attitudes, there is also a dearth of research. Similar to our findings, Verhulst,
Hatemi & Eaves (2009) showed that political attitudes and personality share a modest amount of common genetic variance. Dawes (2010) found that the “Big 5” personality trait extraversion mediates 8% of an association between a well-studied catecholamine gene and partisan attachment. To date, this is the first study to investigate the shared variance between turnout and personality.

Our results can be viewed from two perspectives. For those expecting personality traits to be the missing link between political behavior, our results are not strongly supporting. More than 75% of the heritability of turnout is left unaccounted for among males and we did not find any shared variance for females. For those recognizing that the relationship between genes and complex behaviors like voting is very complex, the amount of variation we have been able to pin down is striking. These findings raise the possibility that personality traits can illuminate a significant portion of the causal chain between genes and political behavior, but that these relationships will likely be nuanced.

There are several limitations to the present study. First, we only consider turnout among registered voters in the 2006 election. This restricts the amount of variation in our dependent variable as evidenced by the fact that the turnout rate was 81% in the sample. It is also possible that impulsivity influences the decision whether or not to register and thus restricting the variation in our measure of impulsivity assuming that more impulsive people will register. However, since Minnesota citizens can register the day of the election the cost of registering is low. Finally, we may have mismatched subjects to the voter file leading to incorrect voting information. However, we were very conservative in our matching criteria and as long as the mismatches were the result of a random process the resulting measurement error should only make it harder to detect a true significant relationship rather than bias the results either upward or downward.
Sample Statistics

<table>
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<td>Twins</td>
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<tr>
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</tr>
<tr>
<td>Education (median)</td>
<td>2.00</td>
<td>3.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Sample means, medians, and standard deviations.
References


