Like parent, like child?

Heritability and Theories of Political Preference Formation.

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Introduction

Two theories of political preference formation predominate in the social sciences. According to the first, political orientations such as issue stands and vote choice are transmitted from parent to child through a process of political socialization. The major source of political preferences is thus thought to be social learning and adaption throughout childhood and adolescence. According to the alternative view, preferences are formed out of rational responses to unique life experiences in adulthood. Issue positions or party preferences correspond to perceived interests derived from objective life conditions, such as income or position in the labor market that has nothing to do with socialization experiences while growing up.

However, both these theories, which we shall henceforth call the socialization vs. the rational choice views, neglect a third and alternative source of variation in political preferences, namely genetic heritability. A number of studies have in recent years argued that political orientations are at least in part genetically transmitted. Based on the so-called "classical twin design", in which pairs of monozygotic (or "identical") and dizygotic ("fraternal") twins are compared (Medland and Hatemi 2009), these studies have for example found that genetics play an important role in shaping a large number of political attitudes in the US, Australia and Canada (Alford et al. 2005; Hatemi et al. 2007; Bell et al. 2009). Despite the finding that party preferences in the US do not appear to have a heritable component (Alford et al. 2005; Hatemi et al. 2009c), and that all traits apparently have a large share of unexplained and thus individual-specific component, these results have generally been interpreted as being opposed to the older socialization or rational choice theories of political preference formation. Moreover, explanations as to *why and how* political orientations could be genetically transmitted abound, but without having been systematically tested

Against this drawback, the main argument presented in this paper is twofold. First, based on a new study of 1169 monozygotic and 1285 dizygotic same-sex twin pairs in Sweden, we will test and find evidence for a genetic component in the distribution of a wide array of political issue positions as well as for vote choice. This study employs a more comprehensive set of indicators of political orientations than has been hitherto been the case, and also allows an unprecedented test of whether recent findings travel outside the Anglo-Saxon context. Even more importantly, we are able to show for the first time that a plausible mechanism links genes and political preferences, namely personality types. More specifically, we find that between 23 and 60 percent of the variance in political issue positions, and 25 percent of left-right party bloc vote choice in the 2006 national election, is due to additive genetic effects. Moreover, this variability could be systematically linked to two measures of personality traits, namely (a) the extent to which individuals believe their fate and well-being primarily is the result of their own making (locus of control) and (2) the extent to which they react with withdrawal, avoidance and fear when facing the unfamiliar (behavioral inhibition).

Secondly, we shall argue that both theory and evidence, old and new, speak in favor of reconciliation between the three rival views of the origins of mass public opinion. We thus derive the expectations from socialization theory that issues that are more strongly politicized

in society should show a stronger component of parental influence on offspring as compared to issues less salient, or more recently brought to the fore on the political agenda. Consistent with this expectation, we find the component of shared environment for left-right attitudes and left-right party bloc vote choice in Sweden to be on par with the genetic heritability component, whereas there are no signs of parental socialization at work with respect to the remaining issue dimensions. Moreover, for all traits we find a substantial amount of individual-specific variance that cannot be related to either genes or parental socialization. There is thus still considerable room for rational choice based theories of the origins of preference formation.

The argument unfolds as follows. After presenting the three rival theories of political preference formation and the theoretical expectations following from them, we introduce the twin design methodology and present our strategy for data collection and measurement of key political orientations and personality traits, as well as the hypothesized links between the two. We then present our findings from univariate and bivariate variance decomposition models, respectively, and conclude by discussing the theoretical implications of our results.

Theories of Political Preference Formation

At least since the publication of *The American Voter* (Campbell et al. 1960), early life experiences have been considered one of the most influential forces shaping political orientations. Although different sources of contextual influence during childhood and adolescence have been conjectured, including the impact of peers and school environment, the family has been considered the socialization agent of outmost importance. More specifically, by collecting data independently from both parent and offspring, a correspondence in political issue stands and political behavior between one generation and the next has been systematically evidenced and replicated in a wide set of national contexts (see, e.g., Westholm and Niemi 1992). Even more importantly, this process of social learning in the family has been shown to have its strongest impact under circumstances most favorable to the success of parental transmission. Thus, for example, trait similarity between parent and offspring has been shown to be higher (1) for highly or recently politicized issues as compared to attitudes less salient on the political agenda, and (2) in more highly politicized families, when parental cues are more stable and consistent, and when children are more interested in politics and discuss political issues more frequently with their parents (Westholm 1991; Jennings et al. 2009).

The major theoretical proposition involved in the socialization tradition thus holds that parents, voluntarily or not, transmit their political worldviews to their children. Political preferences, according to this theory, are formed through adaptation and learning early in the life cycle. A radically different view of the origins of political preferences stems from the rational choice tradition. Considering that one of the main criticisms of this tradition is that it lacks a theory of preference formation (REFERENCES), it may come as a surprise to some that we invoke this theory here. However, the fact of the matter is that although rational choice theory is agnostic on the sources of basic tastes and value orientations, it does provide

a framework for deriving preferences from objective conditions or expected outcomes.[1] One prominent example would be the Meltzer and Richard (1981) model of demand for redistribution. In this simple setup, taxes are assumed to be used for a lump sum money transfer distributed equally to all. By implication, each individual's preferred tax rate, and thus "demand for redistribution", follows from their relative position in the distribution of income. Following rational utility calculus, the further below the mean an individual's income, the higher tax rate he or she would prefer in order to close the income gap. In other words, demand for redistribution should be decreasing with increasing income.

While obviously a highly stylized and simplified theory of what determines attitudes toward redistribution, the Meltzer and Richard (1981) model, as well as modified versions of it (Moene and Wallerstein 2001; Iversen and Soskice 2001), are clearly examples of a distinctively different view of what affects political preferences. Family socialization or early life experiences have no significant effect on adult political orientations, which are instead a simple function of current environmental conditions, such as income or position on the labor market. A third source of variability in political orientations that both these theories ignore, however, is genetic heritability. According to this theory, neither current nor early life environmental conditions affect the formation of political preferences, which are instead grounded in the genetic setup of each individual. In a highly influential study, based on twin data from the US and Australia, Alford et al. (2005) uncovered a fairly substantial genetic component involved in explaining a wide array of political orientations tapping into a more general "liberal" vs. "conservative" dimension. In a more recent publication, Bell et al. (2009) by and large replicate these findings in Canada, finding large amounts of heritability at play in left/liberal vs. right/conservative self-placement as well as other more specific issue positions related to that dimension. Moreover, twin studies have found a genetic component in the direction of party preferences in Australia (Hatemi et al. 2007) and Canada (Bell et al.), a pattern that was not present in the US data, where only strength of partisan attachment appeared to be heritable (Alford et al. 2005; Hatemi et al. 2009c; Settle et al. 2009).

Although these novel findings are in many respects impressive, or even path-breaking, we argue there is a crucial white spot in this new and growing field, namely the lack of a theory that could explain how and why genes might affect political orientations. Most of the early twin studies cited above are conspicuously silent on this issue, or simply revert to general statements such as that there are "endless possibilities and we do not pretend to know the actual mechanisms" (Alford et al. 2008, 325). But, after all, political preference formation is the result of complex human psychological processes positioned at a fairly long distance from the physiological body mechanics we most commonly associate with genetic heritability. Similarly, issues such as redistribution, social welfare and state involvement in the economy are a fairly novel phenomenon in the span of human history. So how could stances towards them, by any fathomable mechanism, be genetically transmitted? The answer we provide to this question is that political orientations should be expected to be heritable for the simple

[1] In game theoretical jargon, rational choice theories assume fixed preferences over outcomes, but not over actions (Morrow 1994, 19).

reason that they are at least in part the outcome of another human characteristic that we know to be genetically transmitted, namely personality type. There are numerous studies evidencing the genetic heritability of basic personality profiles or temperaments such as the "Big Five", that is, extraversion, agreeableness, neuroticism, conscientiousness and openness to experience (Bouchard and Loehlin 2001; Bouchard and McGue 2003; Weiss et al. 2008). Equally important, there is a long tradition in political psychology linking personality traits to ideological outlook or specific issue positions, and in recent years a number of these propositions have been corroborated in empirical studies (for an overview, see Gerber et al. 2010). We think this makes up a sound and theoretically plausible argument in favor of a causal pathway running from genes to personality to political orientations. It should be noted that this theory does *not* imply that the evolution of the human race has involved direct election in favor of distinct political personality types, as argued by Bell et al. (2009, 863). We believe evolutionary theories of this sort are unnecessary for the more indirect argument that human evolution has led to the development of various genetically transmitted socio-psychological temperaments, that in certain circumstances and depending on the specific social context could translate into a tendency towards certain political preferences. While we leave the details on how the latter link in this causal chain look more specifically to the section on measures below, we may succinctly state this first twofold theoretical expectation as follows:

H1a. Political preferences should have a heritable component.

H1b. This heritability should be explained by genetically transmitted differences in personality types.

Does this novel contribution from behavioral genetics to the study of politics imply that our previous and rival theories of political preference formation need to be dismissed? Sometimes discussions of results are framed in a manner that suggests such a view. In his influential book *The Blank Slate*, for example, Pinker (2002, 380-1) summarizes what he calls the "three laws of behavioral genetics" in terms of the simple equation "Genes 50 percent, Shared Environment 0 percent, Unique Environment 50 percent (or if you want to be charitable, Genes 40-50 percent, Shared Environment 0-10 percent, Unique Environment 50 percent)". To the extent this should be interpreted as a formula covering the sources political preferences as well, this truly sounds like an outright dismissal of the socialization paradigm (even "if you want to be charitable"). And, perhaps because their overall findings for liberal-conservative issue positions by and large seemed to conform to Pinker's formula, Alford et al. (2005, 164) rather conclusively denigrate all former findings in the parental socialization literature.

We believe however such conclusions are overblown. True, the possibility of genetic transmission does cast doubt on the simplistic notion that any parent-offspring correlation in political orientations should be interpreted as evidence of parental socialization. And it does

appear surprising that for 40 years scholars within the parental socialization field never appears to have been even considering the possibility that genes could be doing parts of their explanatory work. Having said this, we find the underlying theory and previous results from this tradition compelling enough to expect parental socialization to be at work in explaining at least *some* political orientations. Most importantly, how could genetic heritability theory explain why the parent-offspring association is stronger for more politicized issues and in more politically involved families where politics are discussed more often? We have a hard time envisioning such an explanation stemming from the theory of behavioral genetics alone. Instead, we expect parental socialization should still be at work, but not necessarily across the board. More specifically, the role of parents in influencing their offspring should be strongest for political issue stands that are highly politicized and thus more often talked about in society. Moreover, previous socialization theory actually offers an explanation for the finding in Alford et al. (2005) and Hatemi et al. (2007) that the "common environment" (usually interpreted to capture the effect of family socialization) has a more pronounced effect on partisan choice than on political issue stands more generally.[2] In particular, according to Westholm and Niemi (1992, 30) "there is a series of factors that, as a rule, will systematically favor the transmission of partisanship over both issue stands and broader ideological positions". In short, parties are both more concrete and more visible, which makes preferences for them more easily communicated by parents. In sum, this leads to the following hypothesis:

H2. Party and other political preferences, particularly over issues that are highly politicized in society, should be affected by parental socialization.

Finally, we by no means expect that genetic and socialization theories exhaust the list of factors that should be expected to influence the formation of political beliefs. If that was the case, one would for example have to argue that all individual-level change in public opinion was due to measurement error. Systematic evidence however supports the contrary. Most importantly, Zaller's (1992) theory of the origins of mass opinion, and the massive amount of evidence accumulated in favor of it, suggests that there is both noise and signal in political issue stands. For any particular issue ordinary people have multiple and ambivalent "considerations", and the opinions they report could be thought of as a random sample of those considerations that are accessible at the top of their head. This explains both random measurement error and attitudinal stability, but also accounts for individual–level opinion change as a response to changes in the set of underlying considerations. Zaller's (1992) theory is thus a prima facie argument for believing that unique life experiences, particularly during adulthood, should shape political preferences.[3] Moreover, there are empirical studies lending

[2] However, cf. Bell et al. (2009) who find no effect of the common environment on party choice in Canada.

[3] This is not to imply, however, that Zaller's theory in any way should be incompatible with heritability or socialization theory. As Zaller (1992, 23) himself recognizes, the role played by "political predispositions" in his theory makes it compatible with both.

direct support for rational choice theories of preference formation, in particular the Meltzer and Richard model (Finseraas 2009; also see Iversen and Soskice 2001). There should thus be considerable room for influence by unique events and experiences occurring over the life course. Our third conjecture is thus:

H3. Political preferences should be affected by individual-specific life experiences.

Methods

In this study we will use the classical twin design (CTD) to estimates the pattern of genetic and environmental influences on political orientations and vote choice. Since a number of recent articles has provided easily accessible introductions of the univariate twin methodology to the political science community we will keep our presentation here quite brief (Alford et al. 2005; Fowler et al. 2008; Medland and Hatemi 2009). The starting point of the twin design is the simple fact that monozygotic (MZ) and dizygotic (DZ) twins differ in their relatedness. MZ twins share all of their genes whereas DZ twins are siblings born on the same occasion and therefore sharing, on average, 50% of their genes.

This natural experiment allows us to estimate the amount of variance of a certain phenotype (eg. political orientations) accounted for by genetic and environmental factors, respectively. Using structural equation modeling and information about three observed statistics (the phenotypic variance and the observed covariances for MZ- and DZ-twins) we can partition the phenotypic variance into three sources: A, C, and E. A, or additive genetic effects, is simply the combined influence of all genes. C, for common environment, includes the family environment within which both twin were raised, exposure to common factors during childhood and adolescence (such as having common friends and attending the same class in school) but also common experiences later in life. E, or unique environment, instead stands for the unshared experiences each twin has been exposed to. In the classical twin design E also includes measurement errors. [4]

Some scholars have objected to the so called equal enviroment assumption (EEA) underlying the classical twin model (Beckwith and Morris 2008; Charney 2008). Above all, if MZ twins in fact are more strongly affiliated compared to DZ twins, then greater concordance among identical twins might as well reflect the fact that MZ twins are treated more similar compared to DZ twins (an environmental effect). That is, violations of the equal environments assumption might lead to upward bias in the estimates of the heritability of a trait.

[4] The full model also includes a D-term for non-additive (dominance) genetic effects. However, using information about only three observed statistics (the phenotypic variance and the observed covariances for MZ- and DZ-twins) precludes estimation of four unknowns. Thus, C and D cannot be estimated simultaneously. In the analyses we have fitted both ACE and ADE models to the data. In all cases the ACE model outperformed the ADE model and consequently we have retained only the former in the results section.

At the first glance the equal environments assumption seems to preclude any firm conclusions about the heritability of political orientations using a twin study design. However, there are good reasons to believe that the EEA assumption is less troublesome for this study. First of all, methodological tests have shown that violations of the equal environments assumption have very small effects on the etsimates of the heritability of a range of personality traits. For example, studies of twins reared apart and research on twins whose zygosity has been miscategorized by the parents validate results from studies on correctly categorized twins raised together (Bouchard 1998; Bouchard and McGue 2003).

Secondly, and more important to this study, in a recent article Hatemi and colleagues test the validity of the EEA assumption for politically relevant traits (Hatemi et al. 2010). Using an extended family design, (including twins and their parents, spouses, and non-twin siblings) the authors found no twin-specific environmental effects across a large set of political and social attitudes, thus disconfirming the charge raised by critics of the EEA assumption.

Moreover, Hatemi et al. (2010) also tests two other assumptions underlying the classical twin design – non-assortative mating and absence of measurement errors. Given assortative mating – if mate choice is based on the trait of interest (eg. political orientations) and this trait is (at least partly) heritable – DZ twins will be more genetically alike than under non-assortative mating. In the end this will lead to overestimation of the part of phenotypic variance attributable to the common environment and underestimation of the genetic factor. As for measurement errors, they are included in the E component and will therefore inflate the estimated importance of unique environmental factors at the expense of both additive genetic (A) and common environmental (C) influences. When taking these assumptions into account Hatemi et al. (2010) show that for a host of political and social attitudes the genetic influence is even greater than reported in earlier studies. Thus, judging by these results we should, if anything, expect our estimates of the heritability of political orientations to be on the conservative side.

Since one of the main aims of this study is to test for possible mechanisms linking genes and political orientations we need to move beyond the simple univariate behavior genetic model described above. To analyze the heritability across traits we will employ so called multivariate Cholesky decomposition (Loehlin 1996; Evans, Gillespie, and Martin 2002; Neale et al. 2004; Hatemi et al. 2007; Medland and Hatemi 2009). A schematic example of a bivariate Cholesky decomposition is provided in Figure 1.

[Figure 1 about here]

The ordering of the variables in a Cholesky model is crucial and should be based on theoretical arguments. Based on the overview of earlier studies presented above, we assume that deep-seated personality traits are causally prior to the political attitudes and behaviors in focus here. Using bivariate Cholesky decomposition we can estimate the extent to which the variance in a dependent trait can be accounted for by the same genetic (A), common

environmental (C), and unique environment factors (E) influencing the (assumed) casually prior trait. Thus, A_1 (C_1/E_1) in Figure 1 is the sole genetic (common environmental/unique environmental) cause of trait 1 (via path a_{11}) and a partial cause of trait 2 (via path a_{21}). A_2 (C_2/E_2), then, represents the genetic (common environmental/unique environmental) variance in trait 2 (via path a_{22}) independent of A_1 (C_1/E_1) and trait 1.

To simplify the interpretation of the results we will transform the initial Cholesky decomposition into a so called correlated factors model (Loehlin 1996):

[Figure 2 about here]

In the correlated factors model both traits are separately decomposed into their additive genetic (A_1 and A_2), common environmental (C_1 and C_2), and unique environmental (E_1 and E_2) components. Also, estimates of the correlations across the components (r_A, r_C, and r_E) are provided.

Data collection

The Swedish Twin Registry is the world's largest twin registry and it routinely administers surveys to Swedish twins (Lichtenstein et al. 2006). This paper uses data from the most recent of these surveys, called SALTY. The SALTY study was a collaborative effort between researcher in epidemiology, medicine, political science, and economics initiated in 2007. Data collection was completed in the summer of 2010.

Beginning in the fall of 2008 SALTY was sent out to 24,914 Swedish twins born between 1943 and 1958 and the final reminders were sent out in the spring of 2010. The survey generated a total of 11,647 responses. Out of these, 11482 (98.6%) respondents gave informed consent to have their responses stored and analyzed. Zygosity was resolved either by questionnaire items with high reliability or, when available, by analysis of biosamples (Lichtenstein et al. 2006). In total, our sample is comprised of 1169 MZ pairs, 1286 same-sex DZ pairs 1148 opposite sex DZ pairs. Remaining responses were from individuals whose twin siblings failed to respond.[5]

A problem with many earlier studies on the heriatbility of political attitudes and behaviors is that they, for the most part, have relied on secondary analyses of data collected for entirely different purposes (Alford et al; 2005; Hatemi et al 2007; Hatemi et al. 2009c; Hatemi et al. 2009b). Only a handful of indicators directly relevant to political scientists are included in these surveys. However, a couple of recent surveys based on twin registries in Denmark (Klemmensen et al. 2010), Canada (Bell et al. 2009), and Minnesota (Funk et al. 2009; Funk et al 2010) are beginning to ovecome these limitations. The SALTY study adds to this arsenal of new twin studies with a focus on political attitudes and behavior. The survey includes a lengthy battery of items concerning voting participation, partisan attachment, vote choice,

[5] The analyses to follow will only employ data from same sex twin pairs.

attitudes of social trust, left-right self-placement, political interest, trust in politicians, civic norms, political efficacy, membership in political organizations and unions, level of politicial participation, and attitudes towards a host of political issues. In addition, the sample size in the SALTY study is significantly larger compared with any of the newer twin studies mentioned above.[6] This will enable more precise estimates of the genetic and environmental sources of political attitudes and behavior.

Measures

The outcome variables of interest in this paper are political orientations and actual vote choice. The bulk of earlier studies on the heritability of political orientations are based on some version of the Wilson-Patterson (W-P) conservatism scale (Martin et al. 1986; Eaves et al. 1999; Alford et al. 2005; Hatemi and Eaves 2008; Hatemi et al. 2009a; Hatemi et al. 2009b) and/or a single liberal vs. conservative self-placement scale (Bell et al. 2009). A couple of studies have also focused on partisan identity (Hatemi et al. 2009c; Settle et al. 2009; Hatemi et al. 2007) and one study also employs a measure of actual vote choice (Bell at al. 2009).[7]

To measure political orientations and vote choice we will use seven indicators. First of all, actual voting behavior is assessed by the item: "Which party did you vote for in the 2006 general elections?". There are thirteen response alternatives to this question (out of which the seven first alternatives are parliamnetary parties): (1) the Left Party; (2) the Social Democratic Party; (3) the Centre Party; (4) the Liberal Party; (5) the Moderate Party; (6) the Christan Democratic Party; (7) the Green Party; (8) Sweden Democrats; (9) the June List; (10) Feminist Initiative; (11) Other party; (12) Voted blank; (13) Did note vote. A problem here is that the nominal scale vote choice variable needs to be transformed before entered into the SEM-models employed in the analyses. One possibility is to follow Hatemi et al. (2007) and Bell et al. (2009) and divide the seven parliamentary parties into two political blocs (the left/green bloc (alternative 1, 2, and 7) vs. the right bloc (alternatives 3–6)). However, using only seven of the ten parties in the response list would involve a loss of information. Furthermore, a rough dichotomization precludes any distinctions between parties within the two political blocs. In order to tap as much information as possible we have instead constructed an interval level variable based on the vote choice indicator in the twin survey and information from the Swedish Election Study 2006 (SCB 2008). In the election study the respondents were asked to place each of the ten parties on an 11-point left vs. right scale.

[6] For example, the Canadian data analyzed in Bell et al. (2009) comprise of 192 MZ pairs and 61 DZ pairs, the Danish twin study presented in Klemmensen et al. (2010) includes 287 MZ pairs and 163 DZ pairs, and the Minnesota twin survey used in Funk et al. (2009; 2010) and Klemmensen et al. (2010) contains 356 MZ pairs and 240 DZ pairs.

[7] Hatemi et al. (2007) supposedly test the heritability of vote choice in an Australian sample. However, at a closer inspection the indicators used measures partisan identity and not actual voting behavior.

Combining this information with the vote choice variable in the twin survey we are able to measure actual vote choice along the 11-point left vs. right scale.[8]

Apart from actual vote choice we will also use 6 indicators of politcal orentations among the respondents. To measure the dominant left vs. right dimension in Swedish politics the following item is used: "In politics you sometimes talk about left and right. Where would you place yourself on a scale from 1–10 where 1 equals strongly left and 10 equals strongly right?".

Moreover, we agree with Bell et al. (2009) that the focus on the W-P inventory in earlier studies on the heritability of political orientations is unsatisfactory. The inclusion of items with less than obvoius political relevance (eg. conventional clothes and learning Latin) and the exclusion of attitudes towards economic issues render the resulting conservatism scale somewhat dubious from a political science perspective. To better to tap into the ideological dimensions among the Swedish citizenry we included a large battery on attitudes toward 34 different policy issues in the questionnaire.[9] A principal component analysis with varimax rotation yielded 8 factors with eigenvalues greater than unity.[10] However, upon closer inspection of the scree plot and the pattern of variables loading on each factor we decided to retain only the first five of these. Based on these results we created five additive indices including variables with loadings greater than 0.5 on the first five factors. Question wording for all items are found in Appendix A.

The first index – leftist vs. rightist views on economic policy – includes items about attitudes toward taxes, the welfare state, and privatization. This indicator taps into the core of the left-right dimension in Swedish politics and the correlation with the self-placement item decribed above is accordingly substantial (0.61). The second index – immigration policy opinions – consists of six items on attitudes about immigration policies and one question about law and order. Higher values on this dimension reflect a less cosmopolitan outlook. The third index concerns growth oriented attitudes (lower values) vs. environmentalism (higher values). The fourth index measures foreign policy orientations – advocats of closed vs. open foreign policies – and includes items about the attitudes toward the EU, NATO, the UN, involvement in the war in Afghanistan, and free trade. The fifth and final index reflects anti- (low end) vs. pro- (high end) feminist attitudes and includes items concerning attitudes towards pornography, income differences and regulation on shorter working days.

Before proceeding to the results we also need to discuss our measures of personality traits. Past studies on the relationship between personality traits and political ideology and vote choice have for the most part focused on the so called Big Five traits – openness,

[8] Because of the dominace of this dimension in Swedish politics it is natural to focus on the left-right scale when tranforming the original vote choice variable (Westholm 1991; SCB 2008).

[9] The same items have been used in several other large scale Swedish surveys such as the Swedish Election Studies.

[10] Earlier studies based on the same or similar item batteries have found a similar factor structure (SCB 2008).

conscientiousness, extraversion, agreeableness, and neuroticism (Riemann et al. 1993; McCrae 1996; Caprara et al. 1999; van Hiel et al. 2000; van Hiel et al. 2004; Caprara et al. 2006; Schoen and Schumann 2007; Mondak and Halperin 2008; Gerber et al. 2010). However, in this analysis we will employ a different set of personality traits – locus of control and behavioral inhibition.

The argument for this is that the connection between some of the Big Five traits and political ideology and vote choice seem to be somewhat shaky, both empirically and theoretically. The strongest and most consistent relationships are found between openness and liberal ideology and vote choice, conscientiousness and conservative ideology and vote choice, and (to a lesser degree) extraversion and vote choice. Concerning agreeableness and neuroticism the relationship to political orientation and party preferences is less clear. Instead, we argue that our two personlity traits in focus – locus of control and behavioral inhibition –are more clearly related to both political orientations and vote choice.

Starting with locus of control (LOC) this concept refers to the extent to which individuals believe they can control events affecting them (Rotter 1966). At the high end of this dimension we have individuals with high internal locus of control meaning that they hold that events result first and foremost from their own actions and behavior. At the lower end of the dimension we find individuals with a high external locus of control implying beliefs that powerful others, chance, or fate determine events. We will measure locus of control using a 13-item version of Rotter's (1966) locus of control scale. The psychometric properties of the LOC scale and its relationship to the Big Five traits are well documented. The LOC indicator is moderately related to conscientiousness with estimated correlations ranging from 0.3 to 0.6 (Judge et al. 2002; Hattrup et al. 2005). The items included in the scale are found in Appendix A.

We argue here that individuals characterized by a high internal locus of control – that is, individuals who believe their fate and well-being primarily is a result of their own making – should favor a smaller welfare state and less governmental interference in the economy, be more willing to accept liberal immigrant policies, support an open foreign policy, and be against activist measures in order to strengthen supposedly oppressed groups in society. And, vice versa, individuals believing that powerful others, such as economic and social structures, immigration, globalization, or the male patriarchy, determine one's life chances should instead favor a large and redistributive welfare state, oppose what is deemed as too liberal immigration policies, support an isolationist foreign policy, and advocate affirmative action.

In line with this logic we should expect our measure of locus of control to be positively related to two of our five measures of political orientations – immigration policy opinions and foreign policy opinions – and negatively related to the indices measuring leftist vs. rightist views on economic policy and anti- vs. pro-feminism. The LOC indicator should also have a negative relationship to the left-right self-placement scale and the vote choice indicator. Finally, since we have no specific expectations about the attitudes towards environmental issues among individuals at the endpoints of the LOC scale we are agnostic as to the possible connection between the growth vs. environmentalism dimension and locus of control.

Turning now to behavioral inhibition, this trait refers to a pattern of behavior involving withdrawal, avoidance, fear of the unfamiliar, and a propensity to react to both social and nonsocial novelty with inhibition (Shatz 2005). To tap behavioral inhibition we employ the so called Adult Measure of Behavioral Inhibition (AMBI). This is a 16-item instrument developed in order to measure subjective reports of contemporaneous trait inhibition (Gladstone and Parker 2005). The AMBI measure is related to two of the Big Five traits. Gladstone et al. (2005) report correlation coefficients equal to –0.63 (for extraversion) and 0.40 (for neuroticism).

We expect individuals who are fearful of the unfamiliar and react to novelty with inhibition to support a more encompassing welfare state in order to protect against unforeseen risks, to have a more restrictive outlook on immigration, to favor a less open foreign policy, and support measures aiming at a more equal distribution of incomes.

If this is correct the relationships between the AMBI scale and our indicators of political orientations and vote choice should be mirror images of the ones expected between the LOC indicator and the outcome variables. Thus, we should find a positive connection between, on the one hand, AMBI and, on the other, leftist vs. rightist views on economic policy, anti- vs. pro-feminism, the left-right self-placement scale, and vote choice. The relation to our measures of immigration policy opinions and foreign policy opinions should instead be negative. Once again we have no apriori expectation about the relationship between AMBI and the index measuring the green dimension.

Table 1 lists mean values by gender and correlations with age for all nine variables discussed above. Scale properties for the seven indices are also reported. Significant differences between sexes and/or across age were found for all nine indicators. Some of these differences are substantially of less importance and reflect the large sample sizes. Anyway, in line with these results we will include sex and age as covariates influencing the mean values of the traits in the SEM-models presented in the next section.

[Table 1 about here]

Results

As a first step in the analysis Table 2 presents within-twin pair correlations for all nine measures. Correlations are significantly higher among MZ-twins than for DZ twins in all traits. Thus, as expected political preferences and voting behavior seem to have a heritable component. Moreover, in many cases the MZ-correlations approaches or even surpasses twice the size of the DZ-correlations implying a very limited influence of the common environment.

However, looking closer some interesting and opposing patterns appear. Above all, for three variables – vote choice, left-right self-placement, and leftist vs. rightist views on economic policy – the relative size of the DZ-correlations compared to the MZ-correlations is somewhat greater suggesting a more important role for the shared environment in accounting for

phenotypic variance in these cases. For example, simple Falconer calculation indicates that heritability accounts for 14% (2*(0.47–0.40)) of the variance in left- right self-placement (Falconer and Mackay 1996). Of the remaining variance 33% (2*0.40–0.47) can be attributed to shared environment and 53% (1–0.47) to unshared environment. As will be discussed below this pattern of results support our hypothesis concerning the role of socialization in explaining political preferences.

[Table 2 about here]

To more fully investigate these assertions we now turn to the SEM-models in Table 3. The table contains standardized variance components for the ACE- and nested models and goodness of fit tests. For each variable we compare the baseline ACE-model against simpler nested models by systematically dropping the A- and/or C-components. The last four columns report the chi square tests for goodness of fit differences between nested models and the full ACE-models. To save some space we have only retained the results for the ACE-models and the best fitting models (if other than the ACE-model) in the table.

Looking first at the bottom of the table we can see that AE-models provide the best fit for our two measures of personality traits – LOC and AMBI. The significant heritable component of locus of control confirms the results in past studies (Goldsmith 1983; Bouchard and Loehlin 2001). Concerning behavioral inhibition we are not aware of any earlier studies testing the heritability of our specific measure of adult inhibition – AMBI. However, twin studies on childhood behavioral inhibition reports heritability estimates ranging from 0.40–0.70 (Smoller et al. 2003). These results are well in line with the estimate of the additive genetic component for AMBI (0.458) provided in Table 3.

Turning next to the political traits we can see that for four of the five issue dimensions AE-models are best fitting. Consequently, concerning preferences on immigration policy, environmentalism, foreign policy, and feminist issues shared environmental experiences have only minor or no influence at all. The variance among individuals along these dimensions is instead attributable to genetic heritability and unique life experiences in roughly equal amounts.

These findings corroborate earlier studies that report significant and substantially large heritability estimates for the liberalism-conservative dimension as measured by the Wilson-Patterson attitude inventory (Martin et al 1986; Eaves et al. 1999; Alford et al. 2005; Hatemi and Eaves 2008; Hatemi et al 2009a; Hatemi et al. 2009b, Funk et al. 2009; Funk et al. 2010). Bell et al. (2009) recently showed that a larger set of issue dimensions – attitudes toward religiosity and social conservatism, economic equality, ethnic and racial minorities, and views on competition and business – have heritable components in the Canadian context. However, the small sample size renders their estimates quite imprecise. For example, for one of their issue dimensions – environmentalism – a CE-model is best fitting despite the fact that the MZ-correlation (0.59) is substantially larger than the DZ-correlation (0.42). Thus, our study

provides a large sample confirmation of the heritability of a wide range of political orientations.

At the top of the table results for left-right self-placement, leftist vs. rightist opinions on economic policy, and vote choice are presented. In all three cases full ACE-models fit best. Chi square tests (not shown) comparing restricted models with the ACE-model were all significant implying that genetic heritability, shared environmental influences, as well as unique environmental experiences belong in the model.

Regarding vote choice, the pattern of estimated variance components seems to square well with earlier studies showing that partisan identity is only weakly, and sometimes not at all, genetically transmitted (Alford et al. 2005; Hatemi et al. 2007; Hatemi et al. 2009c; Settle et al 2009).[11] The usual interpretation of this result is that partisan identity and vote choice is something different than reactions to issue items. Referring to previous studies on the heritability of religiosity and identification with particular religious groups Alford et al. (2005, 157) hold "that party identification will be influenced more by parental socialization (shared environment) than by genetic inheritance but that this pattern will be reversed for political attitudes with inheritance playing a role at least as large as the shared environment."

However, this distinction cannot help us understand the results for the two variables measuring leftist vs. rightist attitudes. According to the estimates shared environment is a more important source of the variance in left-right self-placement than genetic heritability. Also, the C-component in the model for rightist vs. leftist opinions on economic policy is significant, but this time somewhat smaller than the additive genetic component. These results are at odds with both Alford et al.'s assertion and also earlier studies showing that genetic inheritance together with non-shared environmental experiences, but not parental socialization, are the roots of political attitudes (Martin et al 1986; Eaves et al. 1999; Alford et al. 2005; Hatemi and Eaves 2008; Hatemi et al 2009a; Hatemi et al. 2009b, Funk et al. 2009; Funk et al. 2010).

We argue here that these results make perfectly good sense within the Swedish context. As outlined in the theoretical section we expect that shared environmental experiences, especially when understood as parental socialization, should make the political preferences of siblings more alike, particularly over issues that are highly politicized in society. The reason is that we expect parents to be more eager to transmit their views on highly salient issues to their children (Westholm and Niemi 1992). In the Swedish context this translates into the left-right dimension, that is attitudes towards taxes, the welfare state, and privatization. Although other ideological divides have entered the Swedish political landscape during the last decades – for example the green dimension, xenophobia vs. cosmopolitanism, and anti- vs. pro-feminism – the left-right dimension is still the by far most salient politcal dimension, both among the citizenry and the parties (Holmberg and Oscarsson 2004).

[11] We have also reestimated the vote choice models employing a rough dichotomy distinghuishing between a left/green and a right bloc among the seven parliamentary parties. The estimates from these models are very similar to the ones obtained when using the vote choice variable used here.

This interpretation of the results for the two indicators on leftist vs. rightist attitudes also casts new light on the estimates of the vote choice variable. We disagree with Alford et al.'s interpretation that the key to understand the weak or insignificant herritability estimates for vote choice and partisan identity is to focus on the difference between partisan identity and reactions to issue items. Instead we argue that the reason that vote choice and partisan identity are less heritable and relatively more influenced by shared environment is the fact that voting behavior reflects the most salient and politicized attitude dimensions within the polity. In Sweden, the connection between leftist vs. rightist attitudes and voting behavior has always been strong (Holmberg and Oscarsson 2004). This is also reflected by the substantially large correlations between our vote choice variable, on the one hand, and left vs. right self-placement (r=0.77) and opinions on economic policy (r=0.57), on the other.

A possible objection against our interpretation of these results, and also against Alford et al.'s interpretation, is that the supposed effects of parental socialization should have vanished when the individuals reach adulthood (see for example Hatemi et al. 2009a). The C component in the ACE model is quite often equated with parental socialization, or, somewhat broader, early life and adolescence socialization. But it is important to note that later life common experiences are also included in the shared environment component. However, establishing this latter fact does not mean that parental socialization is an unimportant part of the shared environment. On the contrary, as long as we cannot come up with any other plausible later life shared environmental mechanism we believe that the significant estimates of C for vote choice and leftist vs. rightist attitudes are clear indications of the importance of parental and early life socialization. The significant estimates of the shared environment are even more impressive considering that the individuals in our sample are in their fifties and sixties.

Thus, we can conclude that our three univariate hypotheses are supported by the results in Table 3. Consistent with our expectations based the rational choice framework on preference formation we find that unique experiences, or unshared environmental effects, are important sources of variance in our measures of political orientations and behavior. Furthermore, the consistently significant and often large estimates of the additive genetic component corroborate the results of earlier research on the heritability of political attitudes and partisan identity. Finally, and in line with our socialization hypothesis, we have seen that shared environment accounts for substantial parts of the variance in vote choice and leftist vs. rightist attitudes.

[Table 3 about here]

With moderate to strong heritability in all our measures of political orientations and vote choice the question about possible mechanisms linking genes to the attitudinal and behavioral outcomes come to the fore. In the theoretical section we argued that deep-seated personality traits are evident candidates for such mechanisms. Thus, we hypothesized that the genetic heritability of the political outcomes should, at least in part, be accounted for by genetically transmitted differences in personlity traits. We have already shown that the traits in focus in

this study – locus of control and adult behavioral inhibition – are significantly influenced by an additive genetic component.

As an initial step in testing this hypothesis Table 4 presents the bivariate correlations between, on the one hand, locus of control and behavioral inhibition and, on the other, the seven political outcome variables. Our expectations about the relationship between LOC/AMBI and political preferences and voting behavior are borne out by the results in Table 4. Individuals high in both external locus of control and behavioral inhibition – that is, individuals who believe that powerful others determine one's life chanses and who are fearful of the unfamiliar and react to novelty with inhibition – tend to hold more leftist attitudes and vote for parties at the left hand side of the ideological spectrum. They are also more sceptic toward immigration and favor isolationist foreign policies. Finally, they are more pro-femisinst in the sense that they support measures aiming at a more egalitarian distribution of incomes and shorter working days and oppose pornography. Individuals scoring high on the LOC measure and low on AMBI are instead characterized by a tendency to think and vote rightist, favor cosmopolitan immigration and foreign policies, and oppose supposedly pro-feminist policy proposals. Also as expected, neither locus of control nor behavioral inhibition is significantly related to the green dimension.

These results are interesting in their own right. They contribute to a growing number of studies on the relationship between personality traits, above all the Big Five traits, and political orientations (Riemann et al. 1993; McCrae 1996; van Hiel et al. 2000; van Hiel et al. 2004; Mondak and Halperin 2008; Gerber et al. 2010) and voting behavior (Caprara et al. 1999; Caprara et al. 2006; Schoen and Schumann 2007). But in contrast to these studies we focus on a different set of personality traits. To the best of our knowledge, the results in Table 4 are the first evidence that locus of control and behavioral inhibition are related to political attitudes and behavior. The correlations are also a first sign of the relevance of the two personaliy traits as possible mechanisms linking genes to political orientations and voting behavior. However, to fully address the mechanism hypothesis we need to decompose these phenotypic correlations into their genetic and environmental parts using bivariate behavior genetic models.

[Table 4 about here]

We will test each personality trait with each attitudinal and behavioral outcome separately. This means that we need to estimate fourteen bivariate Cholesky models. Fit statistics and chi square tests for model comparisons are presented in Table 5. The model comparisons are conducted in two steps. First of all the full ACE model, including all three variance components for both variables and also the three covariance paths connecting A_1, C_1, and E_1 to the second trait in the model, is compared to models in which one or several variance paths are forced to equal zero. The best of these models are then used as the baseline comparison in the next step where we test whether any of the remaining covariance paths can be removed from the model.

The fourteen best fitting models are of two types. For the bivariate models including vote choice and the two indicators of leftist vs. rightist attitudes the preferred model retains all three variance components for the second trait but only the additive genetic and unshared environmental paths to the personality trait. The best fitting model for the other eight pairs of variables drops the shared environment component for both traits. Also, all fourteen best fitting models include only one covaraince path – the genetic covariance path (a_{21}) connecting A_1 to the outcome variable.

[Table 5 about here]

To get a better sense of the bivariate results Figure 3 depicts examples of both types of best fitting models (transformed to correlated factors models). The upper part of the figure illustrates variance components and the relationship between the latent genetic factors for the model including LOC and vote choice. As they should be, the variance components are very similar to the univariate estimates from Table 3. More interesting is instead the degree to which the latent factors are correlated. Since we have dropped the covariance path connecting E_1 to vote choice the correlation between the two unshared environmental components is of course forced to equal zero. The correlation between the two genetic factors is positve and substantially large indicating that the genetic sources of locus of control to a certain degree overlap with the genetic roots of vote choice. More precisely, A_1 accounts for 16% (0.40^2) of the genetic variance in vote choice. Put differently, the results support the hypothesis that locus of control is an important mechanism linking genes to vote choice.

The interpretation carries over to the lower part of the figure where the relationship between locus of control and attitudes on immigration policies are portrayed. The magnitude of the genetic correlation here is slightly greater and therefore we can conclude that A_1 accounts for somewhat bigger share of the genetic variance in opinions on immigration: 17.6% ($(-0.42)^2$). Thus, also for this attitude dimension it seems as locus of control is a central mechanism in the transmission from genes to attitudes.

[Figure 3 about here]

The results in Table 6 provide a more extensive test of the mechanism hypothesis for all fourteen pairs of variables. We can first turn to the column $prop_r$. $Prop_r$ is the share of each phenotypic correlation from Table 4 due to the genetic corrletion between A_1 and A_2 in the respective correlated factors model. If this share approaches one there is clear evidence for LOC/AMBI being one mechanism linking genes to the outcome in focus (as long as the phenotypic correlation is statistically significant and not overwhelmingly small in size). As is evident from the $prop_r$ column the estimates provide excellent support for the mechanism

hypotehsis. In all fourteen cases the corresponding phenotypic correlations from Table 4 are fully accounted for by the genetic correlations given in the column r_a.

An obvious objection here is that these estimates are artificially inflated. Since we have dropped all covariance paths except for the one connecting A_1 to the political attitudes and behaviors we will automatically get the result that the genetic correlations pefectly explain the phenotypic correlations. On the other hand, the estimates of $prop_r$ are impressively large also when based on the results for the non-restricted, full ACE-models, varying between 0.79 and 1.00.[12]

In the end, however, this is a weak interpretation of the hypothesis since high values for $prop_r$ only tell us that the personality type is one, out of possibly many, mechanisms. In the end, the importance of the mechnism is dependent on the magnitude of the phenotypic correlation. For example, the fact that the genetic correlation between A_1 and A_2 can account for a large share of the correlation between AMBI (or LOC) and attitudes on environmental issues is of less importance since none of the two personality traits are significantly related to this attitude dimension in the first place. Thus, neither LOC nor AMBI function as mechanisms linking genes to opinions on environmental issues.

A stricter interpretation of the mechanism hypothesis instead holds that the personality trait should not only be one out of many possible mechanisms linking genes to the particular attitude or behavior. Instead we should test if locus of control and/or behavioral inhibition are substantially important mechanisms in the sense that the genetic sources of the personality trait to a high degree overlaps with the genetic sources of our measures of political orientations and voting behavior. As mentioned when discussing the results in Figure 3, a direct measure of this is the square of the genetic correlation. Estimates of this property are given in the rightmost column in Table 6. The amount of genetic variance in the outcome variables accounted for by A_1 varies greatly across the different measures of political attitudes and behavior. Once again we can conclude that the two personlity traits in focus here cannot help us illuminate the genetic transmission of opinions on environmental issues. Plausible mechanisms for the genetic component of this attitude dimension must be sought elsewhere.

For the other attitudes and for vote choice the amount of shared genetic variance with both locus of control and behavioral inhibition is quite substantial. For example, the left-right self-placement variable share almost a third of its genetic variance with the LOC indicator and 20% with the measure of behavioral inhibition. However, since these are estimates from bivariate models the proportions do not necessarily add up. To estimate the joint effect of both LOC and AMBI on the outcome variables we need to proceed to trivariate models. However,

[12] There is one exception to this pattern. $Prop_r$ for the bivariate model between LOC and leftist vs. rightist opinions on economic policy is equal to 0.28. But in the full ACE model the estimate of the covariance path c_{21} is implausibly large resulting in a estimated correlation between C_1 and C_2 equal to –1 (with the 95% CI ranging from –1 to 1). When dropping the C-components from the model $prop_r$ increases to 0.63.

given the weak correlation between the two personality types (–0.22) these bivariate estimates should be close to the net effects obtainable from trivariate models.[13]

In the end, then, we can conclude that the hypothesis that locus of control and behavioral inhibition are important mechanisms connecting genes to political orientations and vote choice is quite strongly supported.

Conclusion and discussion

In sum, the data at our disposal has confirmed all our theoretical expectations. Based on twin data from a hitherto unexplored political context (Sweden), and from an unprecedentedly wide array of indicators of political orientations, we have found that variability in a wide range of political issue stands, as well as bloc party vote choice, is affected by genetic heritability (H1a). Moreover, our results add substantially to our understanding of the genetic transmission mechanism by showing that the heritability of political orientations can be systematically linked to the heritability of personality traits (H1b). But we have also found evidence for what we interpret as an impact of family socialization. As expected, this is the case with respect to left-right issues and left-right bloc party choice, the most highly politicized issue dimensions in the Swedish context (H2). Finally, barring the unlikely possibility that all the remaining variance is pure measurement noise, our results also confirm the hypothesis that political preferences are also affected by unique and individual-specific life experiences (H3).

We would argue that two theoretical implications follow most importantly from these results. First, the contention that there are universal sources of political preference formation that do not vary by context must be rejected. Thus, for example, our study has added yet another piece of evidence showing that the initial finding by Alford et al. (2005) that issue positions but *not* partisanship preferences are shaped by genetic heritability was specific to the US context. As already mentioned, other studies have already found that also the direction of partisanship does have a genetic component in Australia (Hatemi et al. 2007) and Canada (Bell et al. 2009). To this list of countries we can now add Sweden. What explains this cross-national variation in the heritability of party choice? This is an important question that needs to be addressed in future work. We can here only provide a tentative answer, but a plausible contention would be that since issue positions appears to be more generally affected by heritability, the extent to which this also affects party choice should vary with the strength of the connection between partisan attitudes and vote choice. Systematic evidence from the Comparative Studies of Electoral Systems confirms this view in that Sweden scores highest

[13] The only exception here is leftist vs. rightist opinions on economic policy. According to the estimates in Table 6 this variable shares only about 3% of its genetic variance with each of the personality traits. This result is all the more peculiar considering the strong evidence in favor of the mechanism hypothesis for the left-right self-placement indicator. A partial explanation here might be the difference in magnitude of the genetic variance components across the two variables. The heritability of leftist vs. rightist opinions on economic policy (0.328) is more than twice as large as the heritability estimate of the self-placement scale (0.154). Thus, in the former case there is more genetic variance to account for and therefore a lesser share of this variance will overlap with the genetic variance of the personality traits.

among all countries in terms of the association between liberal/left vs. conservative/right self-placement and party choice, but also Canada and Australia scores higher than the United States (Holmberg and Oscarsson 2004, 106). In Alford et al.'s (2005, 165) own words, "Issues do not explain American politics." That is a plausible reason for why the genetic heritability of issue positions is not translated into partisan preference in the US context.

Another example of an area in need for context-specific explanations is why the common environment, or what we have here interpreted as parental socialization, exerts a varying impact on issue positions across countries. Thus, as opposed to most previous studies, we found in Sweden a significant effect of parental socialization in the key issue area of left-right self-placement, and also in the rightist vs. leftist economic policy domain. Does our conjectured explanation for that effect *within* the Swedish context, that is, that this is the most politicized and hence also most talked about issues within families in Sweden, also travel across other national contexts? This would imply that the left-right issue in Sweden is more politicized than, say, the liberal-conservative dimension in the US, a contention that we do not find all that likely. Hence, something else must explain the difference, and an important part of future studies must be to present and test such context-specific explanations.

The second and from our perspective even more important theoretical implication is that future attempts to explain the formation of political preferences need to integrate behavioral genetics, parental (and, potentially, other sources of) socialization, and rational choice theories into a single, consistent framework. That is, the three theoretical traditions ought not to be juxtaposed as rival, but reconciled as complementary explanations of political preference formation. We envision two key components of such an integrative framework. The first would be to develop testable propositions regarding the circumstances under which we should expect more or less influence from either of the three sources. The second would be to uncover more systematically the ways in which the three forces should be expected to interact. After all, hardly anyone even in the field of behavioral genetics believes that any important human trait or behavior is driven by either heredity or environment alone. The key is to understand how nature and nurture interacts, and this applies to the field of political preference formation as well.

Appdendix A – items included in the indices

Five indices on political orientations

Additive indices based on the results of a principal component analysis on 34 items about suggested policy proposals to be implemented. The response alternative range from (1) “very godd proposal” to (5) “very bad proposal”. The following items are inlcuded in the five indices:

Liberal vs conservative immigration policy opinions

Introduce much harder punishments for criminals

Increase labor immigraion to Sweden

Introduce a language test to become a Swedish citizen

Decrease foreign aid

Accept fewer refugees in Sweden

Increase the economic support to immigrants so that they can preserve their own culture

Remit debt to developing countries

Liberal vs conservative economic policy opinions

Decrease the public sector

Decrease taxes

Sell public companies to private buyers

Have more private comopanies in health care

Have more private schools

Give private companies more freedom.

Growth vs. environmentalism

Strengthen animal rights

Stop motoring in the inner city

Invest more to prevent environmental damages

Decrease carbon dioxide emissions

Closed vs. open foreign policy

Sweden should leave the EU

Sweden should introduce the EURO

Sweden should become members in NATO

Sweden should work for increased free trade all over the world

Sweden should actively support the US war on terrorism

Anti- vs. pro-feminism

Decrease income inequality in society

Introduce 6-hour working day for all employees

Forbid all kinds of pornography

Locus of Control (LOC)

"In the following 12 statements, mark the alternative best describing how you feel."

1. a. Many of the unhappy things in people's lives are partly due to bad luck.
1. b. People's misfortunes result from the mistakes they make.

2. a. One of the major reasons why we have wars is because people don't take enough interest in politics.
2. b. There will always be wars, no matter how hard people try to prevent them.

3. a. In the long run people get the respect they deserve in this world.
3. b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

4. a. The idea that teachers are unfair to students is nonsense.
4. b. Most students don't realize the extent to which their grades are influenced by accidental happenings.

5. a. Without the right breaks, one cannot be an effective leader.
5. b. Capable people who fail to become leaders have not taken advantage of their opportunities.

6. a. No matter how hard you try, some people just don't like you.
6. b. People who can't get others to like them don't understand how to get along with others.

7. a. I have often found that what is going to happen will happen.
7. b. Trusting fate has never turned out as well for me as making a decision to take a definite course of action.

8. a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.
8. b. Getting a good job depends mainly on being in the right place at the right time.

9. a. The average citizen can have an influence in government decisions.
9. b. This world is run by the few people in power, and there is not much the little guy can do about it.

10. a. When I make plans, I am almost certain that I can make them work.
10. b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.

11. a. In my case getting what I want has little or nothing to do with luck.
11. b. Many times we might just as well decide what to do by flipping a coin.

12. a. What happens to me is my own doing.
12. b. Sometimes I feel that I don't have enough control over the direction my life is taking.

Adult Measure of Behavioral Inhibition (AMBI)

Additive index based on the 16 items. The response alternatives are (1) "Yes/most of the time", (2) "Some of the time", and (3) "No hardly ever".

"When you enter a new or unfamiliar social situation or whenever you are faced with new and unfamiliar surroundings or people…"

1. Do you tend to become vigilant and wary of your surroundings?

2. Do you feel awkward when you are approached by someone new?

3. Do you tend to become quiet?

4. Do you tend to approach people whom you don't know and talk to them?

5. Do you tend to spend time observing strangers from a distance first, before being able to mix in?

6. Do you tend to be chatty in conversation when you are speaking to someone new?

7. Are you likely to spend most of your time next to a person whom you know well?

8. Do you tend to feel physically anxious (e.g. racing pulse, sweaty, butterflies)?

9. Do you tend to introduce yourself to new people?

10. Do you tend to keep a fair distance away from strangers?

11. Do you tend to withdraw and retreat from those around you?

12. Do you prefer your own company over the company of others?

13. Do you usually enjoy going to social events with large crowds of people?

14. Would you tend to choose solitary leisure activities over spending time with close friends?

15. Do you prefer to be surrounded by lively activity rather than a quiet gathering?

16. If physically able, would you enjoy adventure holidays with some element of risk?

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Figure 1: Bivariate Cholesky decomposition

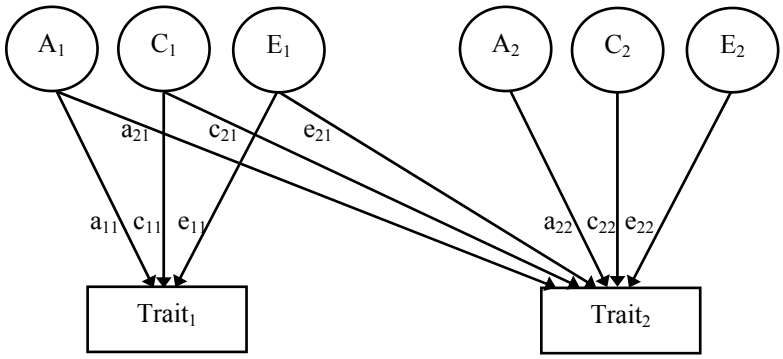


Figure 2: Correlated factors model

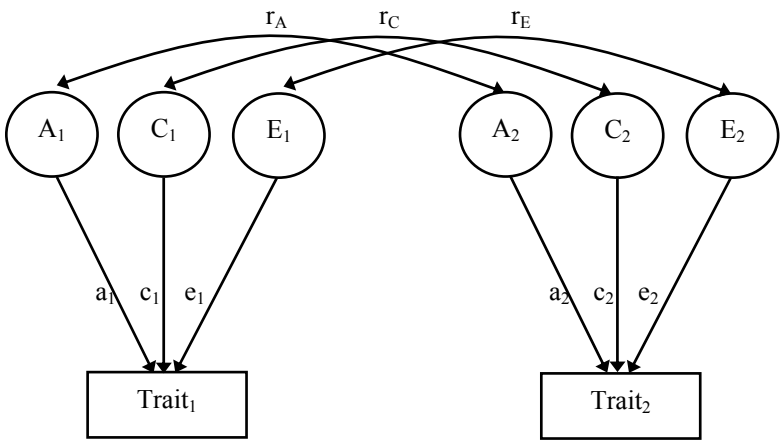
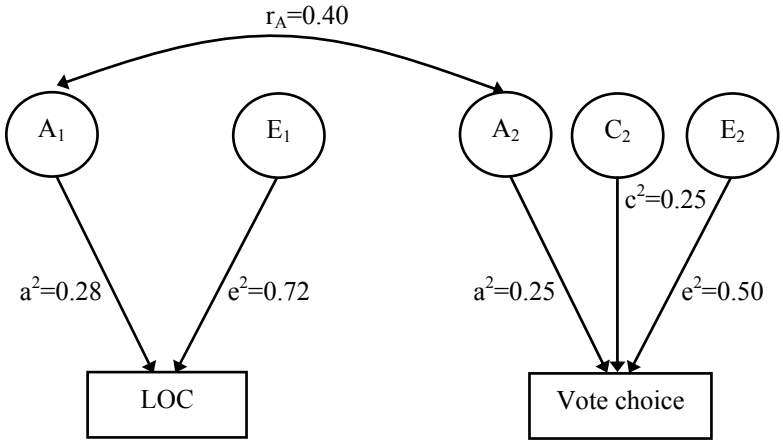
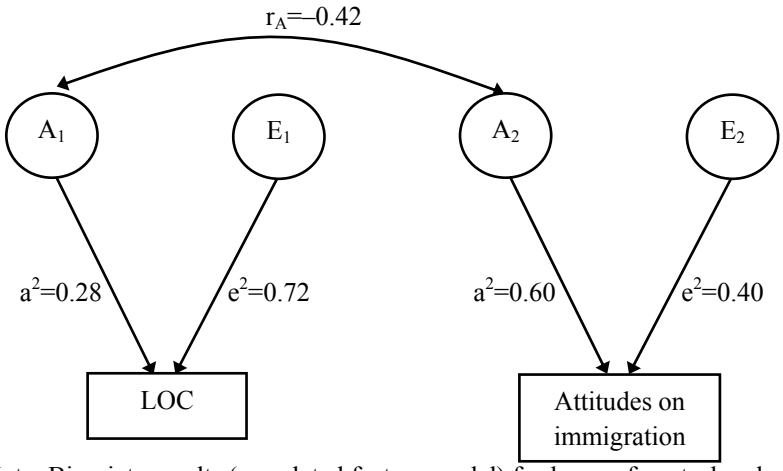


Figure 3: Best fitting bivariate models – two examples



Note: Bivariate results (correlated factors model) for locus of control and vote choice.



Note: Bivariate results (correlated factors model) for locus of control and attitudes on immigration policies.

Table 1: Descriptive statistics and scale properties

Variable	Number of items	α	Male M (SD)	Female M (SD)	t_{sex}	r_{age}
Vote choice along the left vs. right scale	1		5.53 (2.31)	5.33 (2.28)	–4.32*	0.05*
Left vs. right self-placement	1		5.32 (2.48)	5.30 (2.45)	–0.42	0.04*
Leftist vs. rightist views on economic policy	6	0.79	16.79 (4.85)	16.73 (4.64)	–0.59	0.04*
Liberal vs conservative immigration policy opinions	7	0.80	23.53 (5.29)	23.44 (5.24)	–0.96	0.07*
Growth vs. environmentalism	4	0.61	15.01 (2.56)	15.98 (2.45)	20.71*	–0.04*
Closed vs. open foreign policy	5	0.61	16.14 (3.93)	14.91 (3.79)	–16.95*	0.09*
Anti- vs. pro-feminism	3	0.50	10.15 (2.54)	12.16 (2.16)	45.75*	0.00
Locus of control	12	0.78	17.37 (2.26)	17.82 (2.23)	10.66*	–0.03*
Behavioral inhibition	16	0.55	33.49 (4.91)	33.22 (5.06)	–2.94*	–0.06*

Note: α = Cronbach's Alpha (since the component items in the AMBI measure are dichotomies the Kuder-Richardson Formula 20 is used instead of Cronbach's Alpha); t = mean differences; * = $p<0.01$, two-tailed tests.

Table 2: Twin correlations (95% CI in brackets)

Variable	MZ twins	DZ twins	p ($COV_{MZ} = COV_{DZ}$)
Vote choice	0.506 [0.457;0.551]	0.373 [0.320;0.424]	<0.001
Left vs. right self-placement	0.470 [0.423;0.515]	0.401 [0.353;0.448]	<0.01
Dimension 1 (Views on economic policy)	0.433 [0.385;0.479]	0.282 [0.230;0.333]	<0.001
Dimension 2 (Immigration opinions)	0.588 [0.549;0.625]	0.343 [0.293;0.392]	<0.001
Dimension 3 (Environmentalism)	0.396 [0.346;0.444]	0.222 [0.167;0.274]	<0.001
Dimension 4 (Foreign policy opinions)	0.439 [0.391;0.485]	0.221 [0.167;0.274]	<0.001
Dimension 5 (Feminism)	0.529 [0.486;0.570]	0.296 [0.243;0.362]	<0.001
Locus of control	0.300 [0.246;0.353]	0.126 [0.070;0.181]	<0.001
Behavioral inhibition	0.476 [0.431;0.520]	0.193 [0.139;0.246]	<0.001
n pairs	954–1135	1027–1223	

Table 3: Univariate results (95% CI in brackets)

Variable	Model	Heritability A	Common env. C	Unique env. E	–2LL	$\Delta\chi^2$	Δdf	p (comparison model)
Vote choice								
	ACE	**0.251 [0.121;0.382]**	**0.250 [0.138;0.355]**	**0.500 [0.457;0.546]**	**18977.13**			
Left vs. right self-placement								
	ACE	**0.154 [0.032;0.276]**	**0.321 [0.220;0.417]**	**0.526 [0.483;0.571]**	**21091.03**			
Dimension 1 (Views on economic policy)								
	ACE	**0.328 [0.195;0.462]**	**0.113 [0.001;0.220]**	**0.559 [0.515;0.607]**	**27428.35**			
Dimension 2 (Immigration opinions)								
	ACE	0.528	0.070	0.402	28065.20			
	AE	**0.604 [0.570;0.636]**		**0.396 [0.364;0.430]**	**28067.03**	**1.82**	**1**	**0.18 (ACE)**
Dimension 3 (Environmentalism)								
	ACE	0.375	0.002	0.623	21564.58			
	AE	**0.377 [0.331;0.421]**		**0.623 [0.579;0.669]**	**21564.59**	**0.00**	**1**	**0.99 (ACE)**
Dimension 4 (Foreign policy opinions)								
	ACE	0.417	0.000	0.582	25392.70			
	AE	**0.417 [0.371;0.460]**		**0.583 [0.540;0.629]**	**25392.70**	**0.00**	**1**	**1.00 (ACE)**
Dimension 5 (Feminism)								
	ACE	0.414	0.000	0.586	20765.26			
	AE	**0.414 [0.370;0.456]**		**0.586 [0.544;0.630]**	**20765.26**	**0.00**	**1**	**1.00 (ACE)**
Locus of control								

	ACE	0.281	0.000	0.719	20689.51			
	AE	**0.281 [0.232;0.329]**		**0.719 [0.671;0.768]**	**20689.51**	**0.00**	**1**	**1.00 (ACE)**
Behavioral inhibition								
	ACE	0.458	0.000	0.542	28445.30			
	AE	**0.458 [0.416;0.499]**		**0.542 [0.501;0.584]**	**28445.30**	**0.00**	**1**	**1.00 (ACE)**

Note: Best fitting models in bold face.

Table 4: Phenotypic correlations

	LOC	AMBI
Vote choice	0.111*	–0.088*
Left vs. right self-placement	0.125*	–0.102*
Dimension 1 (Views on economic policy)	0.056*	–0.050*
Dimension 2 (Immigration opinions)	–0.167*	0.148*
Dimension 3 (Environmentalism)	0.017	0.018
Dimension 4 (Foreign policy opinions)	0.164*	–0.132*
Dimension 5 (Feminism)	–0.166*	0.118*

* = $p<0.05$, two-tailed tests.

Table 5: Model comparisons, bivariate Cholesky models

Variables	Models	–2LL	$\Delta\chi^2$	Δdf	p (comparison model)
Locus of control & Vote choice	Full ACE	39616.22			
	AE/ACE (c_{21}=0)	39616.28	0.06	2	0.97 (Full ACE)
	AE/ACE (c_{21}=e_{21}=0)	**39616.63**	**0.35**	**1**	**0.55 (AE/ACE (c_{21}=0))**
Behavioral inhibition & Vote choice	Full ACE	47382.35			
	AE/ACE (c_{21}=0)	47382.35	0.00	2	1.00 (Full ACE)
	AE/ACE (c_{21}=e_{21}=0)	**47382.49**	**0.14**	**1**	**0.71 (AE/ACE (c_{21}=0))**
Locus of control & Left vs. right self-placement	Full ACE	41715.89			
	AE/ACE (c_{21}=0)	41715.89	0.00	2	1.00 (Full ACE)
	AE/ACE (c_{21}=e_{21}=0)	**41718.47**	**2.58**	**1**	**0.11 (AE/ACE (c_{21}=0))**
Behavioral inhibition & Left vs. right self-placement	Full ACE	49476.84			
	AE/ACE (c_{21}=0)	49477.17	0.33	2	0.85 (Full ACE)
	AE/ACE (c_{21}=e_{21}=0)	**49477.37**	**0.20**	**1**	**0.65 (AE/ACE (c_{21}=0))**
Locus of control & Dimension 1 (Economic policy)	Full ACE	48102.70			
	AE/ACE (c_{21}=0)	48103.00	0.30	2	0.86 (Full ACE)
	AE/ACE (c_{21}=e_{21}=0)	**48104.50**	**1.50**	**1**	**0.22 (AE/ACE (c_{21}=0))**
Behavioral inhibition & Dimension 1 (Economic policy)	Full ACE	55855.98			
	AE/ACE (c_{21}=0)	55855.98	0.00	2	1.00 (Full ACE)
	AE/ACE (c_{21}=e_{21}=0)	55855.99	**0.01**	**1**	**0.92 (AE/ACE (c_{21}=0))**
Locus of control & Dimension 2 (Immigration)	Full ACE	48613.87			
	AE/AE	48615.86	1.99	3	0.58 (Full ACE)
	AE/AE (e_{21}=0)	**48616.79**	**0.93**	**1**	**0.34 (AE/AE)**
Behavioral inhibition & Dimension 2 (Immigration)	Full ACE	56436.80			
	AE/AE	56438.61	1.81	3	0.61 (Full ACE)
	AE/AE (e_{21}=0)	**56441.70**	**3.09**	**1**	**0.08 (AE/AE)**

Locus of control & Dimension 3 (Environmentalism)	Full ACE	42245.49			
	AE/AE	42245.49	0.00	3	1.00 (Full ACE)
	AE/AE (e_{21}=0)	**42247.92**	**2.43**	**1**	**0.12 (AE/AE)**
Behavioral inhibition & Dimension 3 (Environmentalism)	Full ACE	50002.01			
	AE/AE	50002.11	0.10	3	0.99 (Full ACE)
	AE/AE (e_{21}=0)	**50002.59**	**0.48**	**1**	**0.49 (AE/AE)**
Locus of control & Dimension 4 (Foreign policy)	Full ACE	45991.98			
	AE/AE	45991.98	0.00	3	1.00 (Full ACE)
	AE/AE (e_{21}=0)	**45995.15**	**3.17**	**1**	**0.08 (AE/AE)**
Behavioral inhibition & Dimension 4 (Foreign policy)	Full ACE	53752.37			
	AE/AE	53752.37	0.00	3	1.00 (Full ACE)
	AE/AE (e_{21}=0)	**53753.94**	**1.57**	**1**	**0.21 (AE/AE)**
Locus of control & Dimension 5 (Feminism)	Full ACE	41369.32			
	AE/AE	41369.32	0.00	3	1.00 (Full ACE)
	AE/AE (e_{21}=0)	**41370.17**	**0.85**	**1**	**0.36 (AE/AE)**
Behavioral inhibition & Dimension 5 (Feminism)	Full ACE	49134.59			
	AE/AE	49134.59	0.00	3	1.00 (Full ACE)
	AE/AE (e_{21}=0)	**49134.59**	**0.00**	**1**	**1.00 (AE/AE)**

Note: Best fitting models in bold face.

Table 6: Factor correlations, share of phenotypic correlations due to genetic effects, and share of genetic variance in each political phenotype accounted for by A_1

Variables	Models	r_A	$prop_r$	$prop_{genvar}$
Locus of control & Vote choice	AE/ACE (c_{21}=e_{21}=0)	0.405	1.00	0.164
Behavioral inhibition & Vote choice	AE/ACE (c_{21}=e_{21}=0)	– 0.295	1.00	0.087
Locus of control & Left vs. right self-placement	AE/ACE (c_{21}=e_{21}=0)	0.568	1.00	0.323
Behavioral inhibition & Left vs. right self-placement	AE/ACE (c_{21}=e_{21}=0)	– 0.449	1.00	0.201
Locus of control & Dimension 1 (Economic policy)	AE/ACE (c_{21}=e_{21}=0)	0.175	1.00	0.031
Behavioral inhibition & Dimension 1 (Economic policy)	AE/ACE (c_{21}=e_{21}=0)	– 0.164	1.00	0.027
Locus of control & Dimension 2 (Immigration)	AE/AE (e_{21}=0)	–0.423	1.00	0.179
Behavioral inhibition & Dimension 2 (Immigration)	AE/AE (e_{21}=0)	0.246	1.00	0.060
Locus of control & Dimension 3 (Environmentalism)	AE/AE (e_{21}=0)	0.109	1.00	0.012
Behavioral inhibition & Dimension 3 (Environmentalism)	AE/AE (e_{21}=0)	0.096	1.00	0.009
Locus of control & Dimension 4 (Foreign policy)	AE/AE (e_{21}=0)	0.388	1.00	0.150
Behavioral inhibition & Dimension 4 (Foreign policy)	AE/AE (e_{21}=0)	–0.313	1.00	0.098
Locus of control & Dimension 5 (Feminism)	AE/AE (e_{21}=0)	–0.384	1.00	0.148
Behavioral inhibition & Dimension 5 (Feminism)	AE/AE (e_{21}=0)	0.296	1.00	0.088

Note: r_A is the estimated correlation between A_1 and A_2 in the correlated factors model; $prop_r$ is the share of the phenotypic correlation (see Table 4) due to genetic correlation between A_1 and A_2; $prop_{genvar}$ is the share of genetic variance in each the seven political variables (see Table 3) accounted for by A_1 (equals r_A squared).