The Genetic Foundations of Attitude Formation: The Case of Left-Right Political Orientations

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Abstract

Since the pioneering work of Eaves and Eysenck (1974) appeared in *Nature* some 40 years ago, psychologists, sociologists, political scientists, and behavioral geneticists have investigated the effects of nature and nurture on the formation of social attitudes. It has consistently been found that manifestations of social attitudes (i.e., preferences, values, and beliefs pertaining to things like politics, religion, the treatment of ingroups and outgroups, etc.) are genetically influenced. More recently, researchers have focused their efforts on the psycho-physiological pathways between gene activity and attitudes. In particular, a broad body of research examines how personality traits may be a link between genetic factors and political orientations. The latter are typically treated as either a single left-right dimension or divided into two core aspects: *resistance to change/authoritarian conservatism* and *acceptance of inequality/social dominance orientation*. In this article, we provide an overview of this research, present some findings from our recent international behavioral genetic study on the topic, and identify key issues for future research. We suggest that future studies treat attitude formation as a complex process in which genetic factors and the psycho-physiological phenomena that stem from them are affected by the surrounding social environment and culture. Such research will require: (1) international study designs capturing individual and cultural levels of variation; and: (2) interdisciplinary collaboration among scientists and researchers in various fields of study such as genetics, psychology, sociology, political science, neuroscience, and human biology.

Keywords

Left-right ideology; authoritarian conservatism; social dominance orientation; personality; intercultural twin study

Disciplines

Genetics; Psychology; Sociology; Political Science; Neuroscience; Human Biology

Introduction

An attitude is defined as a personal view or orientation (e.g., a belief, value, or opinion) toward things such as politics, religion, entertainment, or environmental protection. Attitude formation can be affected by social and cultural experiences acquired through social networks, the media, and other forms of contact with people who hold opinions on given issues (Watts & Dodds, 2007; Wu & Huberman, 2006). Moreover, behavioral genetic studies have shown that individual differences in opinions on social, political, and religious issues are partially attributable to genetic influences (e.g., D'Onofrio, Eaves, Murrelle, Maes, & Spilka, 1999; Olson, Vernon, Harris, & Jang, 2001; Renner et al., 2012).

Today, it is important to understand the nature of those genetic influences. One way in which genetic factors may contribute to individual differences in attitude formation is via attributes such as core personality traits. Here we provide an overview of the research that has examined how genetic factors may influence political attitudes and how those attitudes may be affected by personality traits. We also offer our own contribution to this area of research by presenting the results from our recent international project on this topic and by discussing some important issues for future research.

Foundational Research

Core Dimensions of Political Orientations

Political orientations have been studied most often in terms of a single dimension from left to right or from liberal to conservative (Jost, 2006). However, a number of studies suggest that more than one dimension is needed to illuminate most individuals' political opinions (see Jost, Federico, & Napier, 2009, for a review). In fact several studies have provided support for two core dimensions that capture political views (e.g., Duckitt & Sibley, 2010; Jost, Glaser, Kruglanski, & Sulloway, 2003; Treier & Hillygus, 2009). One dimension reflects attitudes toward social, cultural and systemic change versus tradition. It can be characterized as *advocating* versus *resisting change* (Jost et al., 2003); *right-wing authoritarianism* (Altemeyer, 1981); *authoritarian conservatism* (Kohn & Schooler, 1983); or *openness to change* versus *conservation* (Schwartz, 1994). The other dimension reflects attitudes toward social and economic equality versus hierarchy. It can be described in terms of *rejecting* versus *accepting inequality* (Jost et al., 2003); *social dominance orientation* (Pratto, Sidanius, Stallworth, & Malle, 1994); or *self-enhancement* versus *self-transcendence* (Schwartz, 1994).

Presented as fundamental aspects of left-right political orientation (Jost, Nosek, & Gosling, 2008), the two dimensions are factor-analytically distinct but often positively correlated (Kandler, Bleidorn, & Riemann, 2012), at least in Western countries (Aspelund, Lindeman, & Verkasalo, 2013), where resistance to change has generally entailed a defense of social and economic hierarchy. People with left-wing opinions tend to prefer change and hold attitudes advocating equality, whereas right-oriented individuals generally favor system stability and accept inequality.

The Genetic Basis of Political Orientations

Heritability and Genes

Twin studies have consistently shown moderate to substantial genetic influences on individual differences in political positions on a left-right (liberalism-conservatism) dimension. These studies provide estimates of *heritability*, which is the proportion of population variation in a variable attributable to genetic differences. Heritability estimates for left-right orientation are generally in the 50%-60% range (Alford, Funk, & Hibbing, 2005; Bouchard et al., 2003). With regard to the two core dimensions, *resistance to change* appears to show a higher heritability (61%) than *acceptance of inequality* (34%) after correction for measurement error (Kandler et al., 2012). Heritability estimates of more specific opinions ranged from about 20% (e.g., attitudes toward federal housing) to 70% (e.g., attitudes toward school prayer; Alford et al., 2005; Hatemi et al., 2010). Even specific political behaviors and decisions (e.g., voter turnout and vote choice) are genetically influenced (Bell, Schermer, & Vernon, 2009; Fowler & Schreiber, 2008).

Recently, molecular genetic studies using the candidate gene approach and genome-wide association scans have detected specific polymorphisms linked to individual differences in political attitudes and behavior (Dawes & Fowler, 2009; Fowler & Dawes, 2008; Hatemi et al., 2011). For example, Hatemi and colleagues (2011) identified several chromosomal regions associated with political orientation. These studies suggest that political orientation is affected by a number of different genes, and that the genetic processes involved in attitude formation are highly complex.

Psycho-Physiological Pathways between Genes and Political Orientations

Since it is unlikely that genes influence attitude formation directly, it is important to examine the pathways between genes and attitudes, which would encompass neuroanatomical and neurobiological processes as well as basic cognitive, affective, and motivational tendencies. Studies in this area of research have already begun (see Jost & Amodio, 2012, and Jost, Nam, Amodio, and van Bavel, 2014, for reviews). For example, greater conservatism was found to be

associated with a smaller anterior cingulate cortex (ACC) and a larger right amygdala volume (Kanai, Feilden, Firth, & Rees, 2011).

In line with the neuroanatomical findings, Oxley et al. (2008) found faster threat reaction (oculi startle blink reflex) for people with more right-wing positions, and it has been observed that threat sensitivity is associated with amygdala activity (LeDoux, 2000). In addition, Amodio, Jost, Master, and Yee (2007) found that left-oriented people showed significantly more activity in the ACC, which was associated with greater behavioral accuracy in the presence of new and unexpected information. Similarly, Weissflog, Choma, Dywan, van Noordt, and Segalowitz (2013) observed that self-reported attitudinal rejection of inequality and low scores on right-wing authoritarianism were associated with greater ACC activity. Thus, greater endorsement of egalitarian values and less authoritarian conservatism (i.e., left-oriented opinions) appear to be associated with less *threat sensitivity* and more *cognitive flexibility*, the latter being defined as the tendency "to seek out new information and integrate potentially conflicting pieces of information in order to arrive at a relatively complex understanding of reality" (Jost & Amodio, 2012, p. 60).

The basic tendency to seek out and integrate new and unexpected information is also known as *openness to experience*, a Big Five personality dimension that reflects the need for variety, novelty, change, and sophistication (McCrae & Costa, 2008). Not surprisingly, personality has been suggested as an important link in the long psycho-physiological chain between genes and political attitudes (Smith, Oxley, Hibbing, Alford, & Hibbing, 2011).

Personality as a Key Link between Genes and Political Orientations

Personality traits are promising candidates in the search for variables that mediate between genetic influences and political orientations for a number of reasons. First, they are highly heritable, largely stable across time, and structurally invariant among different cultures (Kandler et al., 2010; Kandler, Riemann, Spinath, & Angleitner, 2010; Yamagata et al., 2006). Second, political attitudes consistently show significant associations with Openness and other core personality traits, such as Agreeableness and Conscientiousness (Carney, Jost, Gosling, & Potter, 2008; Gerber, Huber, Doherty, Dowling, & Ha, 2010; Sibley & Duckitt, 2008; Riemann, Grubich, Hempel, Mergl, Richter, 1993). Third, longitudinal studies indicate that personality traits predict political preferences rather than vice versa (Perry & Sibley, 2012; Sibley & Duckitt, 2013). Fourth, the links between personality traits and political attitudes are largely driven by genetic factors (Kandler et al., 2012; Verhulst, Hatemi, & Martin, 2010). These findings support a conceptualization of political orientations as attitudes that are influenced by genetically anchored personality traits.

However, the genetic contributions to political orientations cannot be completely accounted for by personality traits (Kandler et al., 2012). Other individual attributes with a strong genetic basis may account for genetic variance in political orientations beyond that explained by personality traits. General cognitive ability, for example, showed substantial links to left-right political orientation at the individual and national levels (Stankov, 2009), and a longitudinal study found that intelligence in childhood predicted liberal and anti-traditional attitudes in adulthood (Deary, Batty, & Gale, 2008). It is also plausible to conceive of political views as distinct elements in a broad system of dispositional attributes. That is, political opinions may be systematically and genetically associated with personality traits, intelligence, or other dispositional variables, but not caused by them. In line with that position, Verhulst, Eaves, and Hatemi (2012) found no support for the hypothesis that the direction of causation flows from personality factors to political attitudes. One possibility examined by Verhulst et al. is that political attitudes and personality traits are distinct phenomena that are influenced by common genetic factors.

The study of the psycho-physiological pathways between genes and political opinions has only recently entered the field of science. Future studies will provide more insight into the mechanisms and processes involved, and may help to reconcile some contradictory findings and perspectives. But the accumulated evidence leaves little room for doubt that political attitudes are genetically influenced.

Political Attitude Formation beyond Genetic and Physiological Factors

Like other kinds of social attitudes, political positions are also affected by environmental factors such as education and media exposure. Several genetically informed studies have reported that individual life experiences and experiences shared by family members have a significant impact on political attitudes (e.g., Alford et al., 2005; Hatemi et al., 2010). In fact genetically informed research designs provide the best means to examine the relative contribution of environmental and genetic influences.

On the basis of an extended twin family design that included parents and spouses of twins, Kandler and colleagues (2012) studied several sources of individual differences in the two core political orientations *acceptance of inequality* and *resistance to change*. They found significant environmental sources that act to increase the similarity of twins, spouses, brothers- and sisters-in-law, and other family groups. This highlights the importance of social interaction and social networks in political opinion formation, and illustrates how non-genetic factors have a major impact on political attitudes. The evidence suggests that political attitudes are shaped by both the

social environment and by underlying genetic effects that influence individual receptiveness to specific opinions.

Cutting-Edge Research: Our Cross-Cultural Twin Study

Behavioral genetic studies of political opinions typically use subjects from a single nation or culture, thus ignoring the effect that cultural differences may have on political attitude formation. To rectify this shortcoming, we started an international project that combines twin samples from three different countries (Kandler, Bell, Shikishima, Yamagata, & Riemann, 2013). Our focus was on the etiology of the relationship between the Big Five personality traits (Openness, Agreeableness, Conscientiousness, Neuroticism, and Extraversion) and political orientations.

Sample and Design

In February 2013, genetically informative data from three separate studies were assembled (see Table 1). The sample included over 3000 individuals and over 1400 twin pairs from three different continents. Monozygotic (MZ) and dizygotic (DZ) twin pairs are listed separately in the table because a crucial aspect of twin studies involves a comparison of those two types of twin pairs. Greater similarity of MZ compared with DZ twins on a characteristic of interest indicates that genetic factors are at play. That is because MZ twins are virtually genetically identical while DZ twins share on average about 50% of their genetic makeup that can vary among humans (see Alford et al., 2005, for more details on the methodology and assumptions that underlie twin studies).

Table 1. Sample Characteristics

			Age	Number of complete twin pairs					
Data source	Nation	*N*	range	N_{PAIRS}	MZ_M	MZ_F	DZ_M	DZ_F	DZ_{OS}
JeTSSA	Germany	875	17-82	394	48	178	20	81	67
Minnesota Twin Study	USA	1349	52-61	596	143	213	86	154	0
Keio Twin Project	Japan	942	16-38	470	85	233	33	69	50
TOTAL		**3166**	**16-92**	**1460**	**276**	**624**	**139**	**304**	**117**

Note. JeTSSA: Jena Twin Study of Social Attitudes; MZ: monozygotic twin pairs; DZ: dizygotic twin pairs; $_M$: male; $_F$: female; $_{OS}$: opposite sex. The American data employed in this project are in the public domain at: http://www.unl.edu/polphyslab/data, and were collected with the financial support of the National Science Foundation in the form of SES-0721378, PI: John R. Hibbing; Co-PIs: John R. Alford, Lindon J. Eaves, Carolyn L. Funk, Peter K. Hatemi, and Kevin B. Smith, and with the cooperation of the Minnesota Twin Registry at the University of Minnesota, Robert Krueger and Matthew McGue, Directors.

Core Dimensions of Political Orientations

Though the items measuring political opinions varied across the German, American, and Japanese data, principal component analyses (PCA) yielded at least two components which were interpretable as the two core political dimensions. Right-wing authoritarianism items (e.g., "Obedience and respect for authority are the most important virtues children should learn"; Altemeyer, 1996; Funke, 2005), conservatism items (e.g., "It's wrong to do things differently from the way our forefathers did"; Kohn & Schooler, 1983), and specific ideological attitudes (e.g., lenience vs. law and order) characterized the first component. It was interpreted as a dimension capturing political opinions toward social and system change versus tradition (i.e., Resistance to Change or Authoritarian Conservatism; RC/AC). Items from a social dominance orientation (SDO) scale (e.g., "We should strive to make incomes as equal as possible"; Sidanus & Pratto, 2001), other items on equality (e.g., "If wealth were more equal in this country we would have many fewer problems"), and specific ideological positions (e.g., support vs. rejection of minority groups) comprised the second component. It was interpreted as a dimension capturing attitudes toward social and economic equality versus inequality (i.e., Acceptance of Inequality or Social Dominance Orientation; AI/SDO).

In addition, we combined all items to create a composite score for each person in the study. This composite reflects the individual's position on a global left-right ideological spectrum. We then created RC/AC and AI/SDO subscale scores based on all items that were clearly related to one of the two dimensions derived from the PCAs (i.e., factor loadings > .30). Internal consistency and correlations between RC/AC and AI/SDO are shown in Table 2 for each national sample.

For the Japanese data, the internal consistency of the left-right composite scores was comparatively low. However, this may be attributable not only to lower psychometric quality but also to the fact that in Eastern and other relatively collectivistic nations the two core components RC/AC and AI/SDO are often marginally or even negatively interrelated. This would lead to low internal consistency in left-right composite scores. Several studies have shown that the relationship between the core political dimensions can vary between cultures as a function of their historical economic arrangements (Duriez, Van Hiel, & Kossowska, 2005; Thorisdottier, Jost, Liviatan, & Shrout, 2007). For example, conservative individuals living in formerly communist states tended to favor egalitarian ideas, while conservative individuals in states with histories of capitalism tended to favor inequality. In our study, the RC/AC and AI/SDO scores were uncorrelated in the Japanese sample.

Table 2. Internal Consistency (Cronbach's α) of Scales and Interrelations between RC/AC and AI/SDO

	Left-Right		RC/AC		AI/SDO		Correlation
Data source	n_{ITEMS}	α	n_{ITEMS}	α	n_{ITEMS}	α	RC/AC ↔ AI/SDO
JeTSSA	57[a]	.89	25	.88	22	.84	.29
Minnesota Twin Study	26[b]	.88	15	.87	9	.65	.43
Keio Twin Project	18[c]	.63	10	.73	8	.63	.00

Note. JeTSSA: Jena Twin Study of Social Attitudes; n_{ITEMS}: number of items; Left-Right: left-right political dimension; RC/AC: Resistance to Change/Authoritarian Conservatism; AI: Acceptance of Inequality/Social Dominance Orientation

[a] Left-Right composite scale includes a 12-item Right-Wing-Authoritarianism (RWA) short scale (Altemeyer, 1996; Funke, 2005), a 16-item social dominance orientation (SDO) scale (Sidanus & Pratto, 2001), 21 self-constructed conservatism items, and eight items on political orientation (e.g., "support vs. rejection of minority"; Kandler et al., 2012)

[b] Left-Right composite scale includes a 15-item RWA short scale (Altemeyer, 1996), nine items on attitudes toward social and economic equality, and two items on political positions (liberalism vs. conservatism and Democrat vs. Republican)

[c] Left-Right composite scale includes a 10-item authoritarian conservatism scale (Kohn & Schooler, 1983) and eight self-constructed items on attitudes toward equality

In summary, our data indicate that political attitudes can be organized along a left-right political dimension in these three nations, although the underlying structure of those attitudes varied due to varying correlations between the two core dimensions (RC/AC and AI/SDO) (see Figure 1). In societies where political attitudes are polarized along a single left-right dimension such as in the USA and Germany, RC/AC and AI/SDO are expected to be positively correlated, as they were here for those two countries. But the two core dimensions can be unrelated in other societies (Mirisola, Sibley, Boca, & Duckitt, 2007), as we found with the Japanese sample.

Genetic and Environmental Sources of Political Attitudes

Twin model analyses using data from all three countries (which took variation in measurement error among the national samples into account) indicated that genetic effects explained 49% of individual differences in left-right political orientation and about one third of the variance in the two core political dimensions (see Figure 2). The remaining variance was due to environmental effects that were shared by twins (including shared cultural influences) and environmental influences not shared by twins.

Estimates of genetic and environmental effects on individual differences in global left-right political orientation did not vary significantly between the US and German samples, but the results

from both of those countries differed significantly from the Japanese results. For RC/AC and AI/SDO, model fitting analyses yielded significant differences among all three nations. In general, the multinational analyses yielded slightly lower heritability estimates and stronger environmental effects for political orientations compared to previous, single-nation studies (e.g., Alford et al., 2005; Bouchard et al., 2003; Kandler et al., 2012). This was primarily due to lower heritability estimates produced by the Japanese data. Thus, it appears that cultural variation contributed to these differences, although methodological artifacts stemming from differences in the way the variables were measured among the national samples cannot be ruled out.

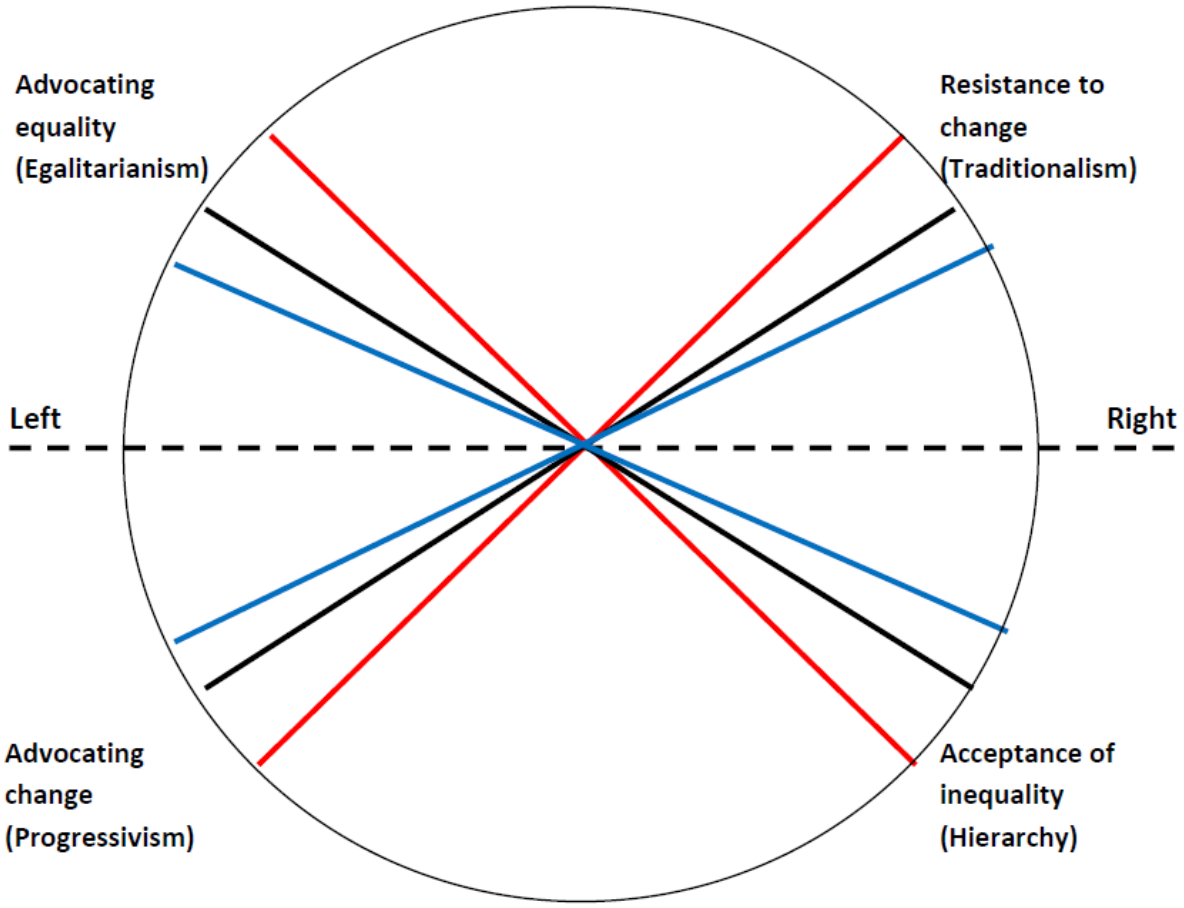

Figure 1. Left-right ideological spectrum and its two core dimensions (1) advocating equality versus acceptance of inequality and (2) advocating change versus resistance to change. Data for Germany (black lines), USA (blue lines), and Japan (red lines) are shown. The smaller the angle between the left-right continuum and its two core dimensions, the higher the correlations between the two core dimensions.

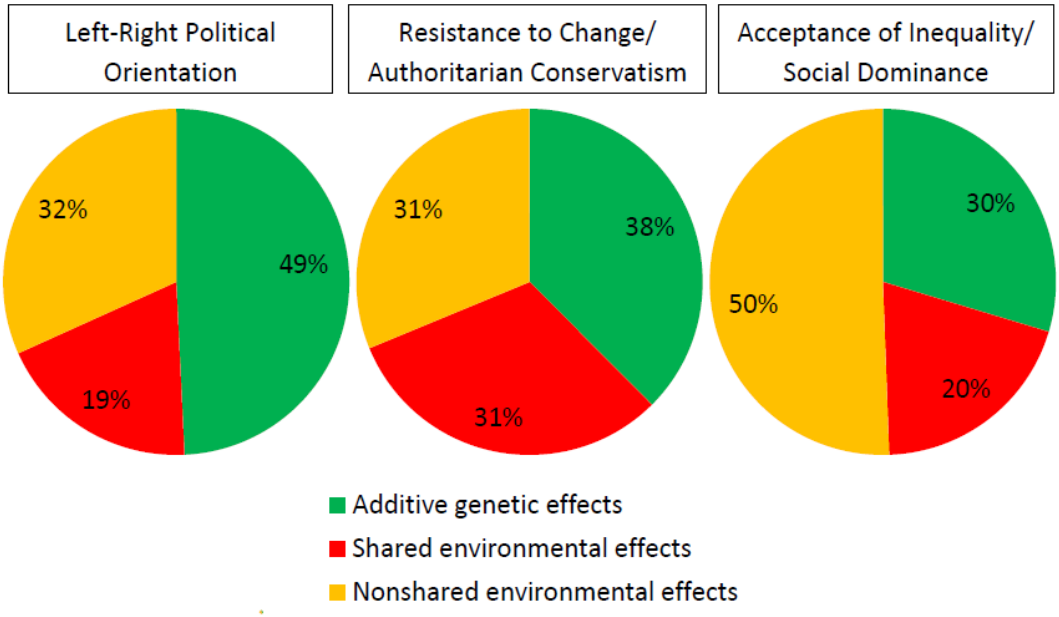

Figure 2. Cross-cultural estimates of genetic and environmental sources of individual differences in left-right ideology and core ideological opinions Resistance to Change/Authoritarian Conservatism and Acceptance of Inequality/Social Dominance Orientation.

Patterns and Sources of the Links between Personality Traits and Political Attitudes

The primary aim of the multinational twin study was to examine the relationship between personality traits and political attitudes. Despite the fact that different measuring instruments were used to capture political opinions in the US, German, and Japanese samples, the correlation patterns were fairly similar (see Figure 3). The three measures of political attitudes were primarily linked to Openness, Agreeableness, and Conscientiousness. More specifically, Openness was negatively correlated with all three political measures; Agreeableness showed negative associations to AI/SDO; and Conscientiousness was positively related to global left-right orientation and RC/AC.

We also investigated the etiology of six associations that were consistent across the three subsamples: Left-Right political orientation and RC/AC with Openness and Conscientiousness, and AI/SDO with Openness and Agreeableness. As shown in Table 3, significant genetic correlations were observed for each pair of variables. A significant genetic correlation suggests that some of the genetic influences involved are the same for both variables. For example, the data in our study indicate that left-right orientation and Openness are affected by common genetic influences. Environmental correlations (corrected for measurement error), which are indicative of common environmental effects, were found to be lower or non-significant, which suggests that the genetic influences on the variables are more similar than the environmental influences. In layperson's

terms, there was more nature in common than there was nurture in each of the pairings shown in Table 3.

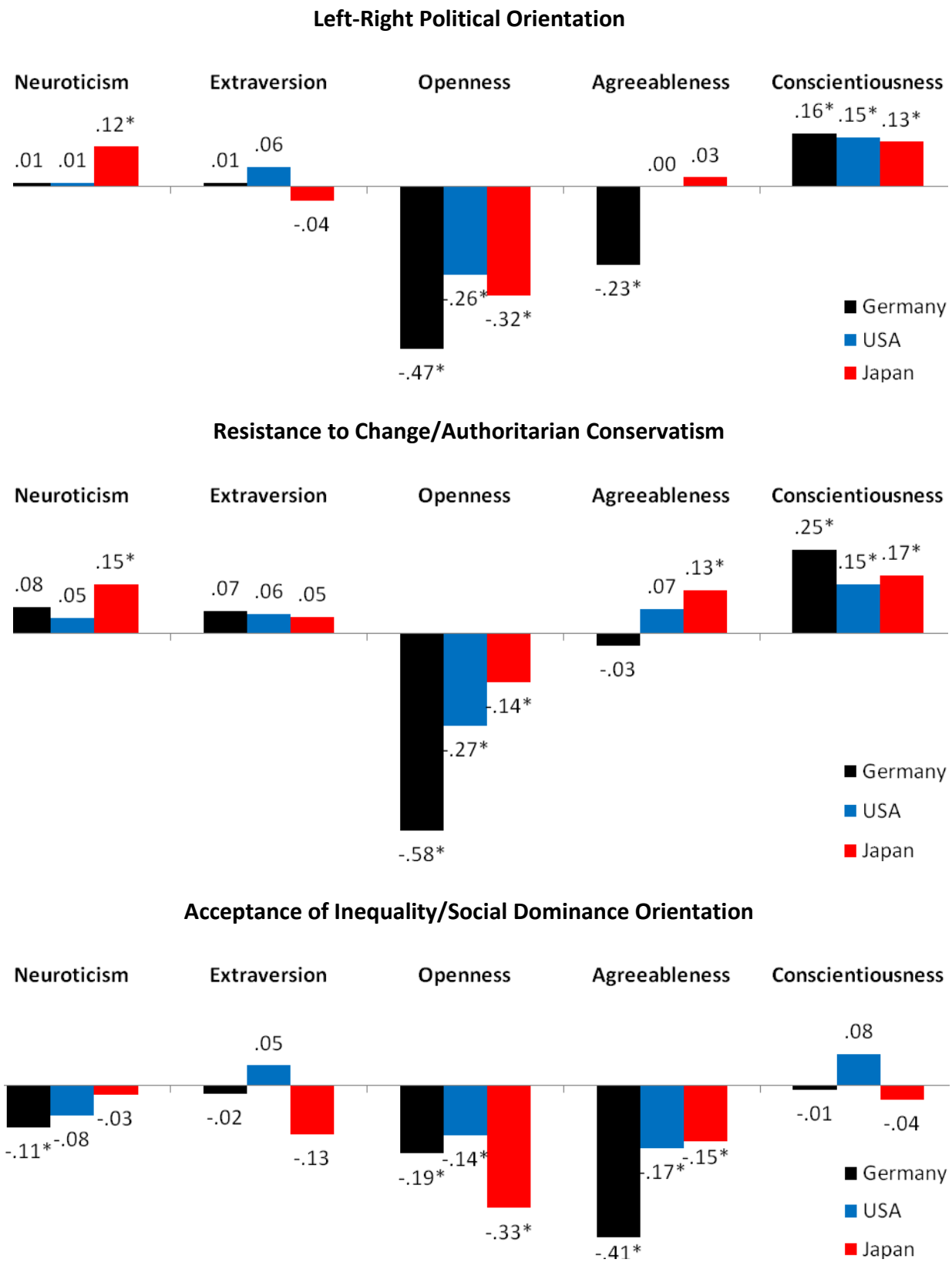

Figure 3. Correlations between core political orientations and personality traits corrected for measurement error; *$p < .01$.

Table 3. Cross-cultural Phenotypic, Genetic, and Environmental Correlations between Core Political Orientations and Personality Traits

	Correlations		
Links	Phenotypic	Genetic	Environmental
Left-Right PO and O	-.32***	-.56***	-.18***
Left-Right PO and C	.15***	.33***	-.04
RC/AC and O	-.31***	-.64***	-.15**
RC/AC and C	.17***	.36***	.08
AI/SDO and O	-.20***	-.40**	-.13*
AI/SDO and A	-.18***	-.38**	-.23***

Note. Correlations were based on bivariate twin model analyses and were corrected for measurement error; PO: political orientation; RC/AC: Resistance to Change/Authoritarian Conservatism; AI/SDO: Acceptance of Inequality/Social Dominance Orientation; O: Openness; C: Conscientiousness; A: Agreeableness; *$p < .05$; **$p < .01$; ***$p < .001$.

Finally, we tested the direction of causation between personality traits and political attitudes. In other words, we sought to determine whether it makes more sense to say that personality traits cause political attitudes, or that political attitudes cause personality traits. The cross-correlations between personality traits in one twin and political orientations in the co-twin provide critical information about the direction of an effect if the proportions of the total variation accounted for by genetic and environmental effects are different for those two variables (see Heath et al., 1993, for more details), which was the case in this study. Corrected for error variance, genetic effects (including nonadditive genetic influences) accounted for 65%, 52%, and 55% of the variance in Openness, Agreeableness, and Conscientiousness for the combined sample, while the remaining variance component was attributable to nonshared environmental effects. Those proportions of variation were different for the three measures of political orientations, shown in Figure 2.

In order to test direction of causation, we compared four models: (1) correlation (non-causal) models where all latent factors affecting personality traits were also affecting political attitudes; (2) models allowing for reciprocal causation; (3) unidirectional models where personality affects political attitudes; and (4) unidirectional models where political attitudes affect personality. The main results are illustrated in Figure 4. These results indicate that the associations for both left-right political orientation and RC/AC with personality traits (Openness and

Conscientiousness) can be best described as a correlation attributable to common genetic influences rather than a causal relationship. In case of AI/SDO, however, the model fitting analyses indicate a unidirectional causal relationship from personality traits (Openness and Agreeableness) to AI/SDO.

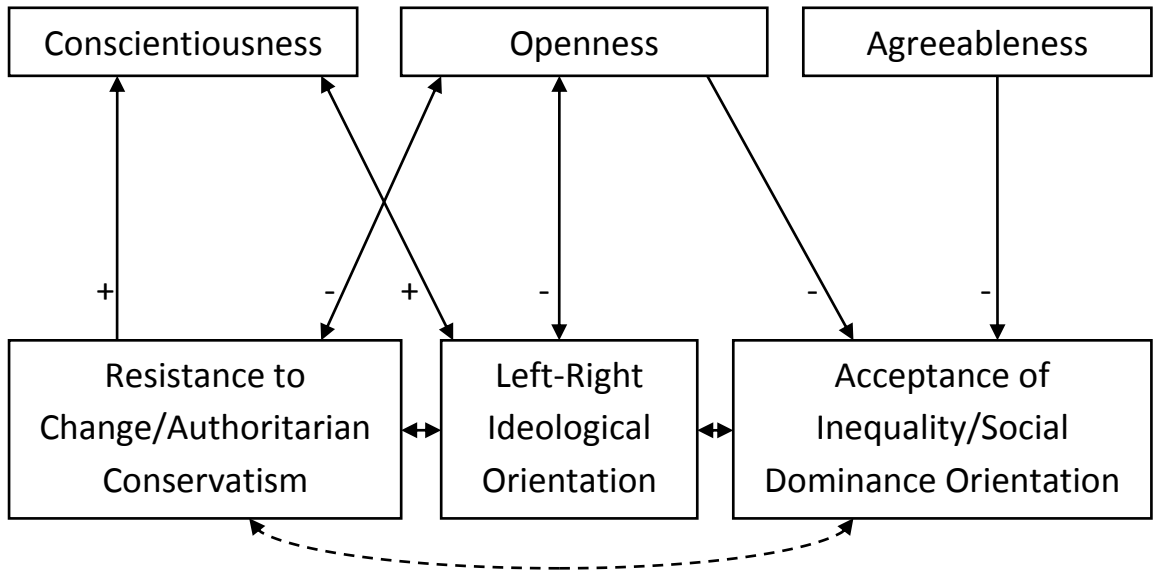

Figure 4. Correlations and direction of causation between personality traits (Openness, Agreeableness, and Conscientiousness) and core political orientations (Left-Right political orientation, Resistance to Change/Authoritarian Conservatism, and Acceptance of Inequality/Social Dominance Orientation) based on the direction-of-causation analyses using cross-cultural twin data.

Conclusions

The two-dimensional structure of political attitudes characterized by RC/AC and AI/SDO was found in all three cultures, suggesting that the two dimensions may be universal (although the correlations between them did vary across nations). Individual differences in all three measures of political orientations were shown to have both environmental and genetic causes. This was consistent with previous findings, but the magnitude of the genetic effects varied across cultures. As in other studies, political attitudes were associated with Openness, Conscientiousness, and Agreeableness. Genetic correlations indicated that these links could be due to common genetic factors. However, results from our direction-of-causation analyses cast doubt on the conventional wisdom that the flow of causation goes from personality traits to political attitudes. By and large, the results presented here provide support for the position that personality traits and political

attitudes are systematically related but distinct elements within a broad system of individual attributes.

Key Issues for Future Research

The research on political orientations provides strong evidence that there is a genetic component to social attitude formation. However, the processes and pathways between genes and attitudes are not yet fully understood. In particular, it will be important to examine how genetic (or neurophysiological) and environmental (e.g., social and cultural) influences may correlate and interact. For example, is a given genetic predisposition more likely to be found in certain kinds of political environments? Does the effect of a given political environment vary depending on an individual's genetic make-up? The investigation of gene-environment correlations and interactions in conjunction with the study of psycho-physiological pathways between genetic factors and behavior are the most promising and exciting areas of research for future studies. A more macro approach could also yield important insights; for example, one could examine how genetic factors influence political culture and vice versa. All of these sorts of studies will require collaborative interdisciplinary teams of scientists drawn from fields such as of psychology, sociology, political science, genetics, and neuroscience.

Though our multinational study is informative about cross-cultural universality (e.g., a two-dimensional structure of political attitudes) and cultural differences (e.g., different levels of correlation between those two core dimensions), future international studies should endeavor to use the same measuring instruments across cultures. Also, additional nations need to be included in order to provide a more complete picture of the sources of variation in political attitudes. This will require collaborative international teams of scientists to rigorously apply sophisticated methodologies to analyze complex genetically informative data at both the individual and national levels.

As noted, previous research provides a rationale for viewing personality traits as a link between genetic factors and social attitudes. Longitudinal studies have primarily supported this conception (Perry & Sibley, 2012; Sibley & Duckitt, 2013), whereas behavioral genetic studies, including this one, cast doubt on it (Verhulst et al., 2012). Future studies on this issue should be both longitudinal and genetically informative to provide a more complete picture of the phenomena in question. Ideally, these studies should include subjects who are at the age at which personality trait structure and political attitudes begin to take shape. Moreover, a variety of methods should be used to control for potential artifacts of measurement such as random error or

socially desirable responding. Also, intelligence and motivational variables such as interests and goals (which appear to have a genetic basis that is partly independent of the genetic sources of personality traits; Bleidorn et al., 2010; Kandler, Bleidorn, Riemann, Angleitner, & Spinath, 2011) should be brought into the analysis.

The core aspects of political orientations considered here may reflect basic factors that drive more specific values and attitudes (e.g., toward homosexuals, foreigners, the death penalty, or environmental protection). More research should be done on the hierarchical structure of political attitudes, and on the genetic architecture of that structure.

This short review has focused on political attitudes. A great deal of research has been done on other attitude domains as well (e.g., D'Onofrio et al., 1999; Olson et al., 2001). All the issues we raise here – in particular the need for cross-cultural data, the value of direction-of-causation research, and the role of correlations and interactions between genetic and environmental influences – should also be considered in future research in those other areas. Though we have learned a lot about the genetic foundation of individual differences in attitudes during the last four decades, much remains to be learned on the specific underlying processes and pathways between gene activity and attitude formation.

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Further Readings

**See References*

Biographies

Christian Kandler is a scientific assistant and lecturer in personality psychology and psychological assessment in the Department of Psychology at Bielefeld University. For his dissertation (October 2007- July 2010), he investigated the genetic and environmental sources of personality structure and development as well as artificial sources of personality measurement. In his postdoctoral work his interests expanded to include the examination of the genetic and environmental sources of the structure and development of individual determinants of behavior conceptually distinct from but related to personality traits (e.g., major life goals, interests, socio-political attitudes, and religiousness) in order to capture a broader picture of the genetic architecture of an individuals' trait and motivational spectrum. In addition to publications in international scientific journals (e.g., *Journal of Personality and Social Psychology*, *Developmental Psychology*, and *Current Directions in Psychological Science*) and monographs in German, Kandler has given many lectures and talks on the topic of behavioral genetics, personality structure, and personality development in various academic settings, including several international conferences.
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Chizuru Shikishima received her PhD in education from Keio University and is currently an associate professor in the Department of Psychology, Faculty of Liberal Arts, Teikyo University, Tokyo. Her research focuses on factors underlying individual differences in human social traits, intelligence, and family background. Her work relies on the twin method of behavioral genetics and data from large-scale longitudinal studies. Specifically, she intends to identify sources of

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Webpage: http://www.uni-bielefeld.de/psychologie/personen/ae04/riemann.html

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