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IZA DP No. 14734

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Nathan Kettlewell
University of Technology Sydney and IZA

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

The Heritability of Trust and Trustworthiness Depends on the Measure of Trust*

Using a large sample of 1,120 twins, we estimated the heritability of trust using four distinct measures of trust – domain-specific political trust, general self-reported trust, and incentivized behavioral trust and trustworthiness. Our results highlight the importance of measuring trust in a context because its heritability differs substantially across the four measures, from 0% to 37%. Moreover, we provide the first evidence on the heritability of political trust which we estimate to be 37%. Furthermore, like the heritability, the environmental correlates of trust also vary across the different measures with political trust having the largest set of environmental covariates. The perceptions of COVID-19 health and income risks are among the unique correlates of political trust, with participants who are more worried about financial and health consequences of COVID-19, trusting politicians less, stressing the importance of trust in political leaders during a health crisis.

JEL Classification: D91, Z13

Keywords: trust, heritability, genetics, twin study

Corresponding author:
Nathan Kettlewell
Economics Discipline Group
University of Technology Sydney
Sydney, NSW
Australia
E-mail: Nathan.Kettlewell@uts.edu.au

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1. Introduction

Trust and trustworthiness are the indispensable foundations of any well-functioning relationship and a society as a whole. Since not all agreements are enforceable via legal contracts, in practice, to function societies rely on trust and trustworthiness. Trustworthiness is among the main traits sought out in intimate relationships (Fletcher et al., 1999). Trust fosters economic development (Algan & Cahuc, 2013), and is the key metric in politics, marketing, education, and parenting. The long-term costs of foregone trust can be devastating. Approximately 35% of the life expectancy gap between black and white men in the 80s in the US was due to distrust in the medical profession after the disclosure of the unethical and deadly experiment in which black men in Alabama were denied appropriate medical treatment for syphilis (Alsan & Wanamaker, 2018). To this day, a half century later, black adults display more distrust in medical interventions recommended by the government. For example, they are the least willing racial group to get the COVID-19 vaccine (Deane et al., 2021). Needless to say, maintaining trust is costly — approximately 35% of US cost of labor is devoted to upholding trust and this cost has been growing during recent decades (Davidson et al., 2018).

The importance of trust has come into sharp focus recently as the world grapples with the COVID-19 pandemic (Devine et al., 2021; Goldfinch et al., 2021; Pagliaro et al., 2021). To effectively enforce lockdowns, safety mandates, and the smooth vaccine rollout, it is instrumental that citizens trust politicians who govern on their behalf. Unfortunately, public trust in politicians is at an all-time low. Over the past 60 years, about 60% of Americans stopped trusting that their government in Washington will to do what is right always or most of the time. Public trust tumbled from 77% of Americans trusting the government in 1964 to just 17% in 2019 (Pew Research Center, 2021) and similar patterns have been observed in many countries all over the world. The consequences are dire. On 18 July 2021, the leading medical advisor on the pandemic in the US, Dr Anthony Fauci, was quoted saying "We probably would still have polio in this country if we had the kind of false information that's being spread now … if we had that back decades ago, I would be certain that we'd still have polio in this country" (Tinker & Elassar, 2021). Politicians all over the world have been struggling to achieve the levels of political trust that would allow them to maintain health and order during the current pandemic.

While the societal importance of trust is evident, a firm understanding of its foundations remains elusive. For decades researchers in various disciplines used theoretical and empirical research to investigate the antecedents and consequences of various constructs of trust (Cook, 2001; Ho, 2021). With enormous amounts of money and time invested in building trusting relationships, a sensible question to ask is to what extent the tendency to trust others is predetermined by our genes and to what extent it is influenced by environmental factors. The existing evidence, using twin similarity designs, provides considerably mixed estimates that range from 3% to 66% of trust being explained by genes rather than influenced by external factors (see Table 1 that summarizes all studies to date).[1] Van Lange et al. (2014) use a variety of self-report measures for trust and conclude there is no evidence they are heritable. In contrast, Sturgis et al. (2010), using a similar battery of general trust survey questions, find that 66% of variation in trust is explained by additive genetic effects. It is not clear whether these differences across studies are driven by differences in the sample or methodology because all prior studies measured trust using only one method. Furthermore, it is unclear whether trust, like other human preferences such as risk attitudes (Weber et al., 2002) is domain-specific. Hence, the general trust questions may tell us little about trust in specific domains, for example about trust towards politicians.

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[1] An alternative to using twin similarity is to estimate heritability from mapped genome data for large samples. Only small sample studies have been conducted for (stated) trust, and they estimate heritability between 12-24% (Benjamin et al., 2012; Wootton et al., 2016).

Recent literature on trust paints a picture of a trait that is difficult to define, let alone measure (Sapienza et al., 2013). None of the existing trust heritability studies measured trust in politicians. From the six studies that investigated the heritability of trust, four used different general trust self-reported survey measures and two used behavioral measures based on incentivized decisions in an economic trust game (Berg et al., 1995). None of the studies used both. What makes interpreting their results challenging is that even survey and behavioral measures of trust are only very weakly correlated (Glaeser et al., 2000) and therefore seem to capture different aspects of trust, reinforcing the possibility that trust is domain specific.

In this paper, we first provide evidence that trust in politicians cannot be well approximated with the general survey or behavioral economics trust measures. Moreover, using a within-sample comparison, we provide evidence that the heritability of trust in politicians differs from the heritability of trust measured using survey and behavioral economics trust measures. Finally, the environmental covariates of trust also differ across different measures. Trust in politicians is correlated with the largest number of socioeconomic and demographic measures we collected with COVID-related income and health insecurity being one of the strongest correlates that are unique to trust in politicians. Our data suggest that the worry about pandemic outcomes is associated with a reduced trust in politicians but not trust in general.

Table 1: Summary of twin studies on the heritability of trust

Study	Trust measure	MZ pairs	DZ pairs	Mixed sex	Zygosity	Region	F/M	Age range	A%	C%	D%	E%
Cesarini et al. (2008)[1]	Fraction sent in standard trust game. Six levels for Swedish sample and 11 for US	258 (278)	71 (75)	No (no)	Questionnaire (self-report)	Swedish twin registry (Twins Days Festivals, OH, USA)	80/20	M=34 SD=7.5 (M=34 SD=15.5)	32 (16)			68 (84)
	Fraction sent back in standard trust game[2]								18 (17)	17 (12)		66 (71)
Hiraishi et al. (2008)	Self-reported responses to five items of generalized trust questionnaire (7-point scale)	491	138	No	Questionnaire, some by blood	Keio Twin Registry (Tokyo)	69/31	R=14-31 M=20.3 SD=4.1	31			69
Sturges et al. (2010)[3]	Self-reported responses to four items of social trust questionnaire (5-point scale)	113	138	Yes	Questionnaire (9 by DNA)	Australia	62/38	R=15-33	66			33
Van Lange et al. (2014)[4]	Self-reported responses to three items about trust in others (7-point scale)	186	191	Yes	DNA (88%) and questionnaire	Netherlands	55/45	R=17-70 M=45.3 SD=14.1			5	90
	Self-reported responses to three items about trust in self (7-point scale).								3		10	86
Wooton et al. (2016)[5]	Self-reported responses: 1. generalized trust (in general I think people can be trusted, yes/no) and 2. trust in friends (10 items, 5-point scale)	1293 (807)	2299 (1262)	Yes	Questionnaire and DNA markers	England and Wales	54/46 (59/41)	16 years	35 (14)		22 (36)	43 (50)
Reiman et al. (2017)[6]	Amount sent in standard trust game (up to $1 in 10c increments)	324	210	No	Questionnaire and some DNA testing	USA (Washington State Twin Registry)	100/0	M=44.52 SD=14.14	30			70
Kettlewell & Tymula	Self-reported responses to three items about trust	401	159	Yes	Questionnaire, blood, some DNA testing	Australia	83/17	R=18-66 M=44.67 SD=12.83	37			63

	in politicians (3-point scale)				
	Self-reported response to generalized trust question (11-point scale)	29			71
	Fraction sent in standard trust game		15		85
	Average fraction returned in standard trust game (strategy method)	23			77

Notes: For each study we report the genetic/environment decomposition estimates for the main results, according to our reading of the paper (often the model that performs best on model fit criteria). *MZ pairs*: the number of monozygotic twin pairs. *DZ pairs*: the number of dizygotic twin pairs. *Mixed sex*: whether the sample included twin pairs with different sex or not. *Zygosity*: how zygosity was determined for participants. *Region*: where the study was conducted. *F/M*: percentage of females/males in the sample. *Age range*: available statistics on age distribution of sample (R=range, M=mean, SD=standard deviation). *A%*: estimated percentage of variation due to additive genetic effects. *C%*: estimated percentage of variation due to common environment effects. *D%* estimated variation due to dominant genetic effects. *E%*: estimated percentage of variation due to unique environment effects. With a classic twin design, one of ACDE needs to be constrained to equal zero (usually this is D). [1]Study included two samples, one from the US and one from Sweden. Details for the Swedish study are in parentheses. Maximum amount that could be sent in Swedish sample was 50 SEK (approximately $7US). Maximum amount that could be sent in the US sample was 10 tokens, with a conversion rate of $0.65 per token. Age range is approximate (summary statistics only reported by zygosity). [2]ACE model was not unambiguously preferred. AE model is preferred for both samples on some criteria and has higher A (0.32/0.28). [3]This is for the latent variation between the four measures in their study. For the individual measures, A% ranges between 21-48. [4]Sample also includes extended family members (reflected in gender and age statistics). Including other relatives, the total sample size is n=1,012. Authors report that, had they used a classic twin design, broad heritability would be estimated at 16-17% due entirely to dominant genetic effects. [5]In parentheses is trust in friends, which uses a subsample of respondents. [6]Study conducted online. Authors also estimate hereditability for behavioral distrust and find no role for genes.

Methods

Ethics statement: Our protocols and procedures were approved by the University of Technology Sydney Human Research Ethics Committee (application numbers ETH19-4381 and ETH20-5410) and by Twins Research Australia.

Participants. 1,120 twins (18-66 years old; M=44.67, SD=12.83) recruited from Twins Research Australia, Australia's largest twin registry, participated in our study allowing us to create the largest twin dataset on behavioral trust and the first twin dataset on political trust.[2] Our sample comprises 401 monozygotic (MZ) and 159 dizygotic (DZ) twin pairs. The majority (83%) of twins are female, reflecting selection into the registry. Forty-two DZ pairs are mixed sex. We include these pairs in our baseline regressions and adjust for mean differences between sexes. Our sample is well-balanced. The only significant difference between MZ and DZ pairs is sex, with 14.2% of MZ twins being male compared to 24.5% for DZ twins. We control for this difference in our analysis, and present results for same-sex pairs only for comparison in the appendix. MZ and DZ twin pairs do not differ in other demographic and socioeconomic characteristics as well as trust measures (Table S2) which supports the equal environments assumption embedded in our analysis.

Domain-specific stated trust in politicians. We measure trust in politicians using responses to four statements which participants could rate as true, somewhat true, or false. The statements are: "Most politicians care more about staying in power than about the interests of the people", "Most politicians make a lot of money by misusing public office", "Most politicians do not care what happens to people like me", and "Most politicians do their job well most of the time" (Pop-Eleches & Pop-Eleches, 2012). For the first three questions true is coded as 0, somewhat true as 0.5, and false as 1 and for the last question the coding is reversed. The average of these

[2] Kettlewell & Tymula (2021) describe the recruitment and study design in detail.

four scores is our measure of trust in politicians. The internal consistency of the four scores is high (Cronbach's alpha = 0.78).

Survey general trust. Our stated trust measure is a single question from the Global Preferences Survey (Falk et al., 2018) which asks participants to rate how well the following statement describes them as a person "I assume that people have only the best intentions", on a scale from 0 "does not describe me at all" to 10 "describes me perfectly". We normalize this measure of trust into a fraction by dividing the indicated number by 10.

Behavioral trust. We measured behavioral trust using a standard trust game (Berg et al., 1995). Each participant first played as the 'sender' and then as the 'receiver'. As the sender, participants were given $11 AUD (approximately $8 USD) and told they could send any part (in $1 increments) of this amount to another randomly chosen and unknown to them participant in the study (who is not their twin). Any amount not sent, they would get to keep. The amount sent would be tripled and the receiver would then decide how much (if anything) to return to them. Trust is measured by the fraction of the endowment sent.[3]

Behavioral trustworthiness. We elicit trustworthiness using a strategy method (Brandts & Charness, 2011). As receivers, participants chose how much they would return to the sender for all 11 possible amounts sent (i.e. values from $1-$11). We quantify trustworthiness as the average fraction returned across all 11 scenarios.

Estimation of heritability. We employ a classic twin study design and exploit differences in genetic similarity between MZ and DZ twin pairs (Neale, 2009). MZ twins share the same set of genes whereas DZ twins, on average, share half their genes. We use two methods to establish the genetic influence on trust: simple correlations and the so-called ACE structural models.

[3] The participant survey also included other behavioral tasks with monetary outcomes (see Kettlewell & Tymula (2021) for details). We followed common practice by selecting one task at random to 'play out for real'.

Assuming that MZ and DZ twins have similar environments, a stronger correlation in trust between MZ pairs than between DZ pairs indicates that trust is partly genetic. We calculate the correlation in trust between twins, separately for MZ and DZ pairs, and then compare these correlations using standard asymptotic t-tests with clustered standard errors.[4] Next, by imposing additional assumptions on the correlations of the phenotype between the twin pairs, we further decompose the variance in participants' trust into additive genetic (A), common environment (C) and unique environment (E) components. Under the assumption that these components are additive and mutually exclusive, the covariance between MZ twins is given by $cov_{MZ} = \sigma_A + \sigma_C$ and between DZ twins is given by $cov_{DZ} = 0.5\sigma_A + \sigma_C$.[5] It is easy to solve for σ_A and σ_C, with σ_A being twice the difference in correlation between MZ and DZ pairs. As is typically done, we assume normality for the variance components and estimate a GLM model with random effects at the individual and twin pair levels, treating the phenotype as continuous.[6] We follow this approach using the model suggested in Rabe-Hesketh et al. (2008) and obtain estimates using the *acelong* package for Stata (Lang, 2017).

Environmental correlates: To understand what parts of the unique environment predict trust, we restrict the sample to MZ pairs and net out variation due to genes and common environment. We first regress own trust on twin pair's trust. We then obtain residuals as the difference between predicted and actual trust, removing the shared variation, which for MZ twins is the A and C components of variance. Last, we estimate the pairwise correlations between residualized trust (the E component of trust) and key demographics and experiences and

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[4] The main assumption underlying twin designs is that MZ and DZ twins share 'equal environments'. While strong, numerous studies in behavioral genetics find support for this assumption, or that violations only modestly affect estimates (see Barnes et al., 2014; Felson, 2014).

[5] Here we are additionally assuming dominant genetic (D) effects (genetic interaction effects) are zero since they cannot be identified without restricting other components.

[6] Appropriate constraints are imposed on the random effects so that the structural assumptions of the ACE model are met.

perceptions around the COVID-19 pandemic. Significance levels are adjusted for multiple hypotheses using the false discovery rate control approach described in Anderson (2008).

Results

Correlation across different measures of trust. Our correlation analysis reveals that trust in politicians is poorly approximated by other commonly used trust measures (Table S3). It is significantly but only weakly correlated with the survey general trust measure (corr. coef = 0.1986, $p<0.001$) and not significantly correlated with the behavioral measures of trust (corr. coef. = 0.0395, $p=0.221$) and trustworthiness (corr. coef. = 0.0084, $p=0.798$). This calls for a separate, domain-specific estimation of the heritability of political trust.

Heritability of trust across different trust measures. Simply comparing correlations in trust between MZ and DZ twin pairs is useful for establishing whether there is likely to be any heritability or common environmental influence. If correlations are higher for MZ than DZ twins, this suggests that heritability plays a role. If there is no correlation, this suggest that neither heritability nor common environment play a role. The correlations are also helpful for gauging the appropriateness of the structural ACE model we use later. For example, given that on average DZ twins share half of the genes and MZ share all, we should expect that the correlation between MZ is not more than twice the difference between MZ and DZ. Moreover, the correlation for MZ should be at least as large as for DZ (if not, this may indicate violation of equal environments).

We find that the extent to which genes and environment impact trust differs substantially across different measures of trust. Trust in politicians is significantly more correlated in MZ than DZ pairs (0.375 versus 0.163, $p=0.017$) suggesting that genetics plays a role in how much people trust politicians (Figure 1). This is reconfirmed in our structural model that estimates 37% of political trust is driven by genetic factors and the rest by unique environmental components (Figure 2).

General trust measured using a survey question is also more correlated between twins in MZ than DZ pairs (0.317 versus 0.041, p=0.003) (Figure 1) and 29% of trust is attributed to genetics and the rest to unique environmental factors (Figure 2).[7]

Behavioral measure of trust paints a substantially different picture. Statistically indistinguishable correlations of behavioral trust for the MZ and DZ pairs (0.151 versus 0.152, p=0.992) suggest a limited role for genes and some influence of common environment. Our structural model estimates that 17% of trust is determined by genetic factors, and the rest by unique environmental factors. However, this result is not robust as a CE model (which constrains the genetic impact to be zero) fits the data better according to both the Bayesian and Akaike Information Criteria (BIC and AIC) statistics (Table S4). Overall, this suggests no genetic role for behavioral trust, while around 15% of variation is explained by common environment.

Heritability of trustworthiness. The correlations of trustworthiness are higher for MZ twin pairs (0.214) than for DZ twin pairs (0.168). Although, the difference in correlations is not statistically significant (p=0.631), our structural model estimates 23% of the variation in trustworthiness to be genetic and 77% to be due to unique environmental factors.

[7] The correlation coefficient for MZ twins is more than twice as big as that of DZ twins which could be interpreted as evidence for multiplicative genetic effects, However, using a t-test test, we cannot statistically reject that the correlation is twice as large or smaller (p = 0.151). This justifies our use of models with additive genetic effects.

Figure 1: Twin pair trust correlations

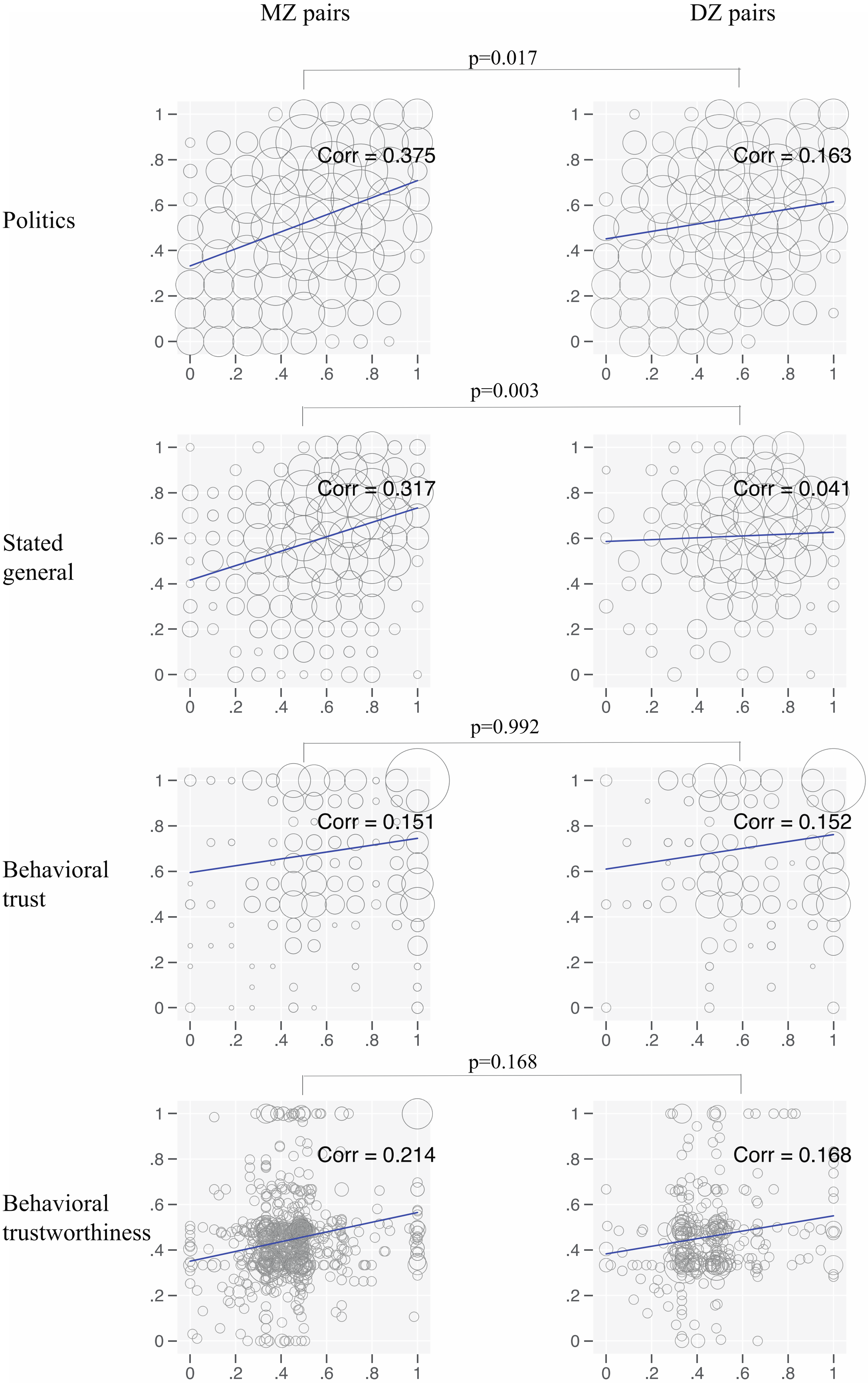
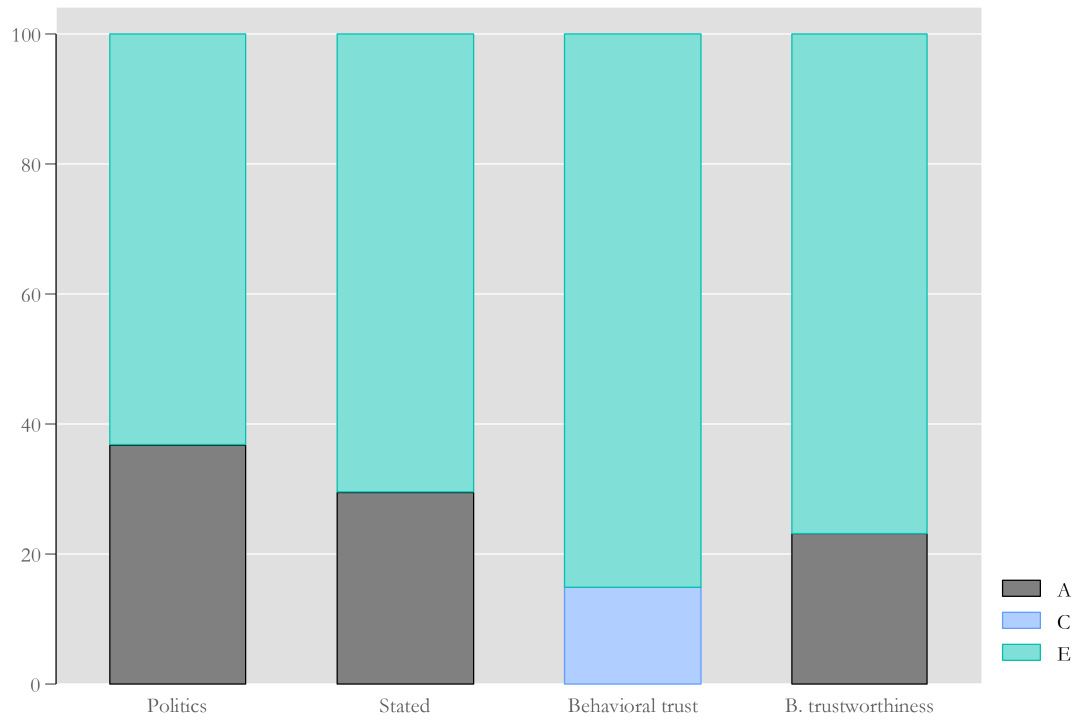


Figure 2: Proportion of variance explained by additive genes and environment.



Notes: Stacked bars correspond to the proportion of variation explained for each trust phenotype by additive genetic effects (A), common environment (C) and unique environment (E) using the model of best fit (lowest BIC and AIC out of ACE, AE and CE specifications). ACE and AE estimates obtained using the acelong program for Stata (version 14.2). CE estimates obtained using Stata's meglm command. ***A*** estimates (percent) and 95% confidence intervals are: Trust politics, 36.77 [30.99, 42.96]; trust stated, 29.39 [23.19, 36.47]; and trustworthiness behavioral, 23.17 [16.70, 31.21]. Confidence intervals are obtained using the delta method with a probit transformation, as described in Rabe-Hesketh et al. (2008). Full estimation results are in the Supplementary Material (Table S4).

Robustness checks. In the supplement (Table S4), we show that our conclusions are robust to restricting either the genetic (CE model) or the common environmental (AE model) effects to be equal to zero, except for behavioral trust (as discussed above). According to the BIC and AIC, the ACE and AE models are best for political and stated trust (with C estimated to be practically zero in the ACE version). For behavioral trust, the CE model, with no genetic component, best explains the data. In Table S7, we present results using ordinal GLM regressions with probit link functions and obtain similar estimates.

We report results for same-sex pairs only in Tables S5-S6. One reason for this exercise is that the equal environments assumption may be more tenable without mixed sex pairs. A second reason is that genes and environment may be differently important for males and females. However, since there are relatively few male-male pairs in our sample (57 MZ, 18 DZ), we lack adequate statistical power to differentiate these estimates and therefore interpret differences as suggestive. For political and stated general trust, we estimate for females that 35% and 29% of variation is due to genes respectively, and the rest to unique environment, similar to our main results. Our estimates are almost identical for males (36% and 29%). For behavioral trust, we estimate no genetic variation and 13% to common environment for females according to our best fitting model. Interestingly, for males the best fitting model is an AE specification that attributes 28% of variation to genes. A surprising finding is that for behavioral trustworthiness, the CE model with no genetic component best explains the data, with 21 and 34% of variation due to common environment for females and males respectively. We view the 23% of variation attributed to genes in our main results as an upper bound given the sensitivity of these estimates, along with the lack of any statistically significant difference in correlations between MZ and DZ pairs in the full-sample.

Environmental correlates: Since unique environment explains most of the variation in all trust measures (63 – 85%), we investigated what parts of the environment predict trust. Table 3 reports the pairwise correlations between trust (net of twin's trust) and key covariates for MZ twins. There is surprisingly little overlap in the correlates across different measures of trust. None of the correlations are significant for behavioral trust or trustworthiness. People who are older, in better health and married or in de facto relationships, exhibit higher political and stated general trust while higher income and financial security increases with political trust only.

Additionally, particularly interesting is the unique role of COVID-19 on political trust, with negative correlations with worry, risk beliefs and having experienced job loss, ranging from -0.10 to -0.18.

Table 2: Correlations between residualized trust and covariates

Variable	Politics		Stated		Behavioral		Trustworthiness	
	Corr	q-val	Corr	q-val	Corr	q-val	Corr	q-val
Age	**0.113**	**0.001**	*0.065*	*0.098*	0.012	1.000	0.052	1.000
Male	0.028	0.364	-0.047	0.210	0.029	1.000	0.014	1.000
Aus born	-0.011	0.619	0.032	0.352	0.035	1.000	-0.022	1.000
Live city	0.021	0.560	-0.029	0.438	-0.025	1.000	-0.012	1.000
Married/defacto	**0.099**	**0.003**	**0.137**	**0.001**	0.046	1.000	0.014	1.000
Household size	-0.019	0.560	*0.078*	*0.098*	0.064	0.504	-0.006	1.000
Num. dep. children	0.013	0.619	0.075	0.055	0.063	0.504	0.002	1.000
University	**0.113**	**0.001**	-0.003	0.836	-0.032	1.000	-0.048	1.000
Employed	0.004	0.672	-0.034	0.438	-0.021	1.000	0.017	1.000
Retired	0.006	0.672	0.020	0.652	0.008	1.000	0.022	1.000
Income	**0.119**	**0.003**	0.027	0.511	0.086	0.341	0.049	1.000
Financial security	**0.186**	**0.001**	0.063	0.176	-0.009	1.000	0.017	1.000
LT health condition	**-0.171**	**0.001**	**-0.104**	**0.044**	-0.043	1.000	-0.013	1.000
Covid worry	**-0.100**	**0.005**	-0.045	0.325	-0.020	1.000	-0.001	1.000
Covid risk	**-0.106**	**0.004**	0.001	0.836	-0.004	1.000	0.019	1.000
Covid mortality	**-0.175**	**0.001**	-0.082	0.148	0.005	1.000	0.068	1.000
Covid job loss	**-0.133**	**0.001**	-0.013	0.750	0.013	1.000	-0.003	1.000
Covid reduced income	0.012	0.619	-0.045	0.325	0.087	0.341	0.053	1.000
Covid work home	0.044	0.227	0.028	0.438	-0.018	1.000	0.031	1.000
Covid reduced hours	-0.032	0.364	-0.062	0.176	-0.016	1.000	-0.011	1.000
Covid friends	-0.038	0.267	0.023	0.511	0.023	1.000	-0.032	1.000

Notes: Estimates from non-missing values from a full sample of 802 monozygotic twins (See Table S1 for observation counts). Correlation cells show the pairwise correlation between the covariate and the residualized trust measure (residual obtained after estimating a linear regression controlling for twin pair's trust). FDR q-values as described in Anderson (2008) are used to test for statistical significance (adjusted for multiple hypotheses) after obtaining standard errors via non-parametric bootstrap with 1,000 replications clustered at the twin pair level. P-values without adjustment for multiple hypothesis testing are in Table S8. Estimates in bold are significant at the 5% level and estimates in italics at 10%.

Discussion

The importance of trust came to light over the past two years as the world grapples with the COVID-19 pandemic. According to the 2021 World Happiness Report, countries with higher levels of social trust have lover COVID-19 death rates, are more resilient and are generally happier (Helliwell et al., 2021). Economists at the American Economics Association's annual conference in January 2021, concluded that "*higher levels of trust and social responsibility were associated with less scepticism of media reporting on COVID-19 and greater willingness to accept stringent lockdown measures"* (The Economist, 2021). The pandemic emphasized that trust in country's leaders is essential to efficiently manage and recover from a crisis.

By measuring, for the first time, the domain-specific trust in politicians using monozygotic and dizygotic twins, we can uncover its genetic and environmental determinants. We estimate that about 37% of political trust is genetic and the remaining 63% is determined by environment that is unique to a twin. Strikingly, the environment common to twins plays essentially no role, suggesting that the degree of trust placed in politicians does not depend on our family upbringing. Overall, people with higher financial security and those who finished university have higher trust in politicians. Political trust, unlike general trust measures, is also highly correlated with beliefs about current events. People who are more worried about health and economic losses due to COVID-19 distrust politicians more. This finding emphasizes the importance of trust in political leaders in times of crisis.

It is remarkable that our conclusions would be diametrically different had we based our study only on the general trust measures (stated or behavioral), as in previous trust heritability studies (Cesarini et al., 2008; Hiraishi et al., 2008; Reimann et al., 2017; Sturgis et al., 2010; van Lange et al., 2014; Wootton et al., 2016). Political trust turns out to be only weakly correlated with responses to the general survey trust question and not correlated at all with behavioral trust measures, meaning that we essentially cannot predict the degree to which people trust political leaders from how trusting they are in general. This may explain why the existing studies (Table 1) that measured trust using a variety of different techniques (each possibly capturing something different about human nature (Sapienza et al., 2013)) reached very different conclusions about the degree of trust heritability. By using the twin study design with four different trust-related measurements in each twin, we are able to confirm that the degree to which trust depends on genes, common and unique environments, varies across different measures of trust. What is common for all the trust measures is that they are all mostly (63 – 85%) determined by a person's unique environment. However, the fact that there is essentially no overlap in their environmental and socioeconomic correlates across different measures, further reaffirms that the way they are formed differs and we should be cautious using different trust measures interchangeably. This also raises challenges for research seeking to identify 'trust genes' (Benjamin et al., 2012; Nishina et al., 2015; Wootton et al., 2016) as it is not clear that a significant gene for a particular measure of trust will carry over to other domains and measures.

The behavioral measures of trust seem to provide a particularly different set of results. First, the environment common to twins, such as the characteristics of the household they grew up in, seems to matter only for behavioral trust measures. Second, behavioral measures stand out because of the lack of any genetic influence. In contrast, 29-37% of the variation in political and stated general trust is due to genes. This is surprising and somewhat problematic since the behavioral trust measures and general trust survey question are both supposed to measure a person's general tendency to trust. Surprisingly, they are not only weakly correlated but also seem to be biometrically different concepts, with different socioeconomic and environmental correlates. So a natural question is: which measure is better? We do not have a definitive answer (Sapienza et al., 2013). On the one hand, the survey measure is more general and has more observable correlates. On the other hand, behavioral measures based on incentivized decisions are indicative of how people really behave when asked to trust a stranger. In the context of our results, one possible interpretation is that while genes play little role in actual trusting behavior, they do play a role in how we *think* we would behave in hypothetical situations (i.e., our beliefs about ourselves). Another possibility is that the behavioral trust measures, just like political trust, are specific to the monetary domain (that is trusting people with your money).

We contribute to a still relatively small literature that uses twin variation to estimate heritability of trust attitudes and behavior (Cesarini et al., 2008; Hiraishi et al., 2008; Reimann et al., 2017; Sturgis et al., 2010; van Lange et al., 2014; Wootton et al., 2016). This literature has provided a variety of different heritability estimates of trust and our estimates could be seen as slightly lower, especially for the behavioral trust measures, where we estimate no genetic role. There is a variety of reasons (other than measurement and domain-specificity discussed above) that could explain differences across the studies. For example, ours is the first study of behaviorally measured trust conducted outside Europe and the US and the institutional and cultural differences across countries could explain part of the difference. There are also other methodological differences between our and previous studies. For example, to elicit behavioral trust measures we used higher monetary amounts than previous studies (Reimann et al., 2017). It is possible that when payments are not large enough, participants treat questions as hypothetical, which could explain why Reimann et al. (2017) who use lower stakes find heritability estimates closer to our general (and hypothetical) survey trust question than to our behavioral measure. Our finding that the common environment is important for behavioral trust is also different and worth highlighting. It suggests that the shared environment is perhaps more important in Australian households. As for the stated general trust measure, we are the first ones to use an instrument that was extensively validated and used in an influential global preference survey (Falk et al., 2018; *Global Preferences Survey*, 2021). This means that we may be measuring trust more precisely than previous studies. We chose this instrument given the extensive validation efforts underlying the GPS (Falk et al., 2016) and the ongoing influence of the GPS on social science research.[8]

Finally, one could wonder whether the fact that we conducted our study during the pandemic affected our estimates (although Australia has experienced relatively few cases of COVID-19 in the period when data were collected[9]). It is possible that during this period, trust is especially influenced by environmental factors compared to other times. While we do not know whether this is the case, we certainly measured the determinants of trust during an extraordinary period, when one could argue trust is as socially relevant as ever.

[8] https://www.briq-institute.org/global-preferences/publications

[9] When we began collecting data on 5 September 2020 there had been cumulatively 26,136 confirmed cases of COVID-19 and 737 deaths, and when we closed the survey on 1 March 2021 there had been 28,970 cases (around 0.1% of the population) and 907 deaths. In comparison, the US had experienced 28,363,488 cases (around 8.5% of the population) and 515,214 deaths while Europe had experienced 38,712,652 cases (around 5% of the population) and 873,354 deaths (World Health Organisation, 2021).

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Supplementary Material

Table S1: Variable definitions

Variable	Definition	MZ obs.	DZ obs.
Trust politics	"Most politicians care more about staying in power than about the interests of the people", "Most politicians make a lot of money by misusing public office", "Most politicians do not care what happens to people like me", and "Most politicians do their job well most of the time" For the first three questions true is coded as 0, somewhat true as 0.5, and false as 1 and for the last question the coding is reversed. The average of these four scores is our measure of trust in politicians.	802	318
Trust stated general	Answer to: "I assume that people have the best intentions". How well does this statement describe you on a scale of 0 to 10? Divided by 10.	802	318
Trust behavioral	Fraction sent in trust game (amount sent / $11)	802	318
Trustworthiness behavioral	Average amount returned across trust receiver scenarios in trust game	802	318
		802	318
Age	Age at last birthday	802	318
Male	= 1 if male	802	318
Australia born	= 1 if born in Australia	802	318
Lives in a city	= 1 if currently live in a major city (Sydney, Melbourne, Brisbane, Adelaide, Perth, Canberra)	795	317
Married/defacto	= 1 if married or in a defacto relationship	800	314
Household size	How many people live in your household	799	315
Num. dep. children	Number of dependent children	766	310
University degree	= 1 if highest level of education obtained is a university degree	802	318
Employed	= 1 if worked any time in the last 7 days or if had a job but did not work in the last 7 days due to holidays, sickness or any other reason	802	318
Retired	= 1 if currently retired from the workforce	802	318
Income (weekly)	Average usual weekly own income in the last month using midpoint value for the following categories: $1-$149, $150-$299, $300-$399, $400-$499, $500-$649, $650-$799, $800-$999, $1,000-$1,249, $1,250-$1,499, $1,500-$1,749, $1,750-$1,999, $2,000-$2,999, $3,000 or more (coded as $3000). Negative or nil coded as missing.	692	275
Financial security	Given your current needs and financial responsibility, would you say that you and your family are: = 1 if Poor, = 2 if Just getting along, = 3 if Comfortable, = 4 if Very comfortable, = 5 if Prosperous.	802	318

Long-term health condition	= 1 if has a long-term health condition, impairment or disability that has lasted more than 6 months	800	318
Covid worry	Worry or concern about contracting COVID-19 on a scale of 1 to 10	798	318
Covid risk	Probability participant believes they will get COVID-19 in the next 3 months	796	315
Covid mortality	If you do get COVID-19, what is the percent chance you will die from it?	795	317
Covid job loss	= 1 if experienced job loss due to COVID-19	802	318
Covid reduced income	= 1 if experienced reduction in income due to COVID-19	802	318
Covid work home	= 1 if experienced working from home due to COVID-19	802	318
Covid reduced hours	= 1 if experienced a reduction in working hours due to COVID-19	802	318
Covid friends	How many relatives or close friends have tested positive for COVID-19	799	318

Table S2: Descriptive statistics

Variable	Mean MZ	Mean DZ	Difference	P-value
Trust politics	0.532	0.54	0.007	0.686
Trust stated general	0.609	0.611	0.001	0.93
Trust behavioral	0.7	0.719	0.019	0.333
Trustworthiness behavioral	0.446	0.46	0.014	0.323
Age	44.034	46.289	2.256	0.058
Male	0.142	0.245	0.103	0.002
Australia born	0.869	0.903	0.033	0.245
Lives in a city	0.648	0.659	0.012	0.759
Married/defacto	0.653	0.688	0.035	0.304
Household size	4.513	4.438	-0.075	0.577
Num. dep. children	1.89	2.016	0.126	0.289
University degree	0.589	0.597	0.009	0.816
Employed	0.859	0.836	-0.023	0.409
Retired	0.08	0.085	0.005	0.822
Income (weekly)	1256.9	1321.909	65.009	0.246
Financial security	3.158	3.176	0.018	0.748
Long-term health condition	0.218	0.189	-0.029	0.316
Covid worry	2.816	2.805	-0.011	0.956
Covid risk	10.918	9.57	-1.348	0.177
Covid mortality	14.044	13.51	-0.533	0.719
Covid job loss	0.066	0.063	-0.003	0.848
Covid reduced income	0.125	0.135	0.011	0.660
Covid work home	0.354	0.346	-0.008	0.806
Covid reduced hours	0.137	0.132	-0.005	0.831
Covid friends	1.881	1.733	-0.148	0.371

Notes: Calculated from non-missing values from a full sample of 802 monozygotic twins and 318 dizygotic twins. See Table S1 for variable definitions and detailed observation counts. Clustered (twin pair level) standard errors are used to calculate p-values.

Table S3: Correlation coefficients between trust measures

	Trust politics	Trust stated general	Trust behavioral
Trust stated general	0.1986 (0.000)		
Trust behavioral	0.0395 (0.221)	0.1347 (0.000)	
Trustworthiness behavioral	0.0084 (0.798)	0.0866 (0.014)	0.3593 (0.000)

Notes: N=1,120. P-values in parenthesis based on clustered (twin pair level) asymptotic standard errors.

Table S4: Structural twin model regression results (ACE proportions).

A%	C%	E%	AIC	BIC	LL
		Trust politics			
36.77	0.00	63.23	54.64	74.72	-23.32
[30.99, 42.96]	[0.00, 100]	[60.16, 66.19]			
36.77		63.23	54.64	74.72	-23.32
[31.02, 42.93]		[60.17, 66.19]			
	31.81	68.19	60.02	80.10	-26.01
	[24.64, 39.75]	[60.25 75.36]			
		Trust stated general			
29.39	0.00	70.61	-214.15	-194.07	111.08
[23.19, 36.47]	[0.00, 100]	[67.87, 73.20]			
29.39		70.61	-214.15	-194.07	111.08
[23.25, 36.39]		[67.88, 73.19]			
	24.79	75.21	-208.42	-188.33	108.21
	[17.56, 33.35]	[66.65, 82.44]			
		Trust behavioral			
16.53	0.00	83.47	241.64	261.73	-116.82
[10.11, 25.87]	[0.00, 100]	[81.63, 85.15]			
16.53		83.47	241.64	261.73	-116.82
[10.05, 25.99]		[81.62, 85.16]			
	14.87	85.13	241.05	261.14	-116.53
	[8.10, 24.65]	[75.35, 91.90]			
		Trustworthiness behavioral			
23.17	0.00	76.83	-609.66	-589.58	308.83
[16.70, 31.21]	[0.00, 100]	[74.45, 79.05]			
23.17		76.83	-609.66	-589.58	308.83
[16.59, 31.38]		[74.43, 79.07]			
	19.93	80.07	-609.23	-589.14	308.61
	[12.81, 29.02]	[70.98, 87.19]			

Notes: n = 1,120 twins (401 MZ pairs, 159 DZ airs). Models in the first row include A, C, and E components. Models in the second (third) row restrict C (A) component to be equal to zero. ACE and AE estimates obtained using the acelong program for Stata (version 14.2). CE estimates obtained using Stata's meglm command. Confidence intervals (in square brackets) are obtained using the delta method with a probit transformation, as described in Rabe-Hesketh et al. (2008). *AIC* is the Akaike Information Criterion, *BIC* is the Bayesian Information Criterion and *LL* is the log-likelihood.

Table S5: Structural twin model regression results (ACE proportions): female-female twin pairs

A%	C%	E%	AIC	BIC	LL
		Trust politics			
35.36	0.00	64.64	29.56	43.92	-11.78
[28.90, 42.41]	[0.00, 100]	[61.32, 67.82]			
35.35		64.65	29.56	43.92	-11.78
[28.92 42.37]		[61.33, 67.83]			
	30.47	69.53	36.29	50.65	-15.15
	[22.45, 39.56]	[60.44, 77.55]			
		Trust stated general			
29.21	0.00	70.79	-158.33	-143.97	82.16
[22.45, 37.03]	[0.00, 100]	[67.79, 73.62]			
29.21		70.79	-158.33	-143.97	82.16
[22.53, 36.93]		[67.80, 73.60]			
	26.30	73.70	-155.86	-141.50	80.93
	[18.27, 35.83]	[64.17, 81.73]			
		Trust behavioral			
13.26	0.00	86.74	159.04	173.41	-76.52
[6.60, 24.86]	[0.00, 100]	[85.05, 88.27]			
13.26		86.74	159.04	173.41	-76.52
[6.59, 24.88]		[85.05, 88.27]			
	12.42	87.58	158.68	173.04	-76.34
	[5.36, 24.27	[75.73, 94.64]			
		Trustworthiness behavioral			
22.33	0.00	77.67	-505.75	-491.39	255.87
[15.32, 31.35]	[0.00, 100]	[75.12, 80.03]			
22.32		77.68	-505.75	-491.39	255.87
[15.22, 31.51]		[75.11, 80.05]			
	20.78	79.22	-507.24	-492.88	256.62
	[12.89, 30.97]	[69.03, 87.11]			

Notes: n = 886 twins (344 MZ pairs, 99 DZ airs). See Table S4 for further details.

Table S6: Structural twin model regression results (ACE proportions): male-male twin pairs

A%	C%	E%	AIC	BIC	LL
		Trust politics			
36.06	0.00	63.94	21.25	30.29	-7.63
[21.58, 53.60]	[0.00, 100]	[55.52, 71.59]			
36.06		63.94	21.25	30.29	-7.63
[21.57, 53.62]		[55.52, 71.59]			
	29.39	70.61	22.98	32.01	-8.49
	[12.41, 52.81]	[47.19, 87.59]			
		Trust stated general			
34.85	0.00	65.15	-42.99	-33.96	24.50
[20.51, 52.59]	[0.00, 100]	[56.98, 72.51]			
34.86		65.14	-42.99	-33.96	24.50
[20.76, 52.22]		[57.02, 72.47]			
	30.53	69.47	-41.76	-32.73	23.88
	[13.42, 53.52]	[46.48, 86.58]			
		Trust behavioral			
27.50	0.00	72.50	43.95	52.98	-18.97
[13.15, 48.73]	[0.00, 100]	[65.14, 78.81]			
27.50		72.50	43.95	52.98	-18.97
[13.29, 48.42]		[65.18, 78.78]			
	24.68	75.32	44.27	53.30	-19.14
	[8.51, 50.10]	[49.90, 91.49]			
		Trustworthiness behavioral			
32.39	0.00	67.61	-75.51	-66.48	40.76
[18.16, 50.86]	[0.00, 100]	[59.77, 74.56]			
32.40		67.60	-75.51	-66.48	40.76
[18.46, 50.35]		[59.82, 74.52]			
	33.79	66.21	-77.13	-68.10	41.57
	[16.41, 55.62]	[44.38, 83.59]			

Notes: n = 150 twins (57 MZ pairs, 18 DZ airs). See Table S4 for further details.

Table S7: Structural twin model regression results (ACE proportions): ordinal probit regression

A%	C%	E%	AIC	BIC	LL
		Trust politics			
38.42	0.00	61.58	4611.99	4662.20	-2296.00
[30.55, 46.94]	[0.00, 100]				
38.42		61.58	4611.99	4662.20	-2296.00
[30.62, 46.86]					
	33.47	66.53	4616.59	4666.80	-2298.29
	[26.08, 41.57]				
		Trust stated general			
29.68	0.00	70.32	4809.62	4869.87	-2392.81
[21.66, 39.17]	[0.00, 100]				
29.68		70.32	4809.62	4869.87	-2392.81
[21.78, 39.02]					
	24.55	75.45	4816.15	4876.40	-2396.08
	[17.13, 33.42]				
		Trust behavioral			
21.48	0.00	78.52	4406.23	4476.53	-2189.12
[13.02, 33.33]	[0.00, 100]				
21.49		78.51	4406.23	4476.53	-2189.12
[12.85, 33.69]					
	18.93	81.07	4403.94	4469.22	-2188.97
	[11.00, 29.66]				

Notes: n = 1,120 twins (401 MZ pairs, 159 DZ airs). See Table S4 for further details.

Table S8: Correlations between residualized trust and covariates

Variable	Politics		Stated		Behavioral		Trustworthiness	
	Corr	p-val	Corr	p-val	Corr	p-val	Corr	p-val
Age	**0.113**	**0.000**	**0.065**	**0.025**	0.012	0.713	*0.052*	*0.089*
Male	0.028	0.324	-0.047	0.104	0.029	0.436	0.014	0.690
Aus born	-0.011	0.689	0.032	0.260	0.035	0.250	-0.022	0.452
Live city	0.021	0.544	-0.029	0.380	-0.025	0.441	-0.012	0.718
Married/defacto	**0.099**	**0.001**	**0.137**	**0.000**	0.046	0.192	0.014	0.709
Household size	-0.019	0.574	**0.078**	**0.020**	*0.064*	*0.060*	-0.006	0.861
Num. dep. children	0.013	0.709	**0.075**	**0.008**	*0.063*	*0.070*	0.002	0.948
University	**0.113**	**0.000**	-0.003	0.926	-0.032	0.325	-0.048	0.145
Employed	0.004	0.894	-0.034	0.349	-0.021	0.524	0.017	0.613
Retired	0.006	0.832	0.020	0.592	0.008	0.785	0.022	0.501
Income	**0.119**	**0.001**	0.027	0.450	**0.086**	**0.024**	0.049	0.171
Financial security	**0.186**	**0.000**	*0.063*	*0.073*	-0.009	0.791	0.017	0.627
LT health condition	**-0.171**	**0.000**	**-0.104**	**0.004**	-0.043	0.202	-0.013	0.708
Covid worry	**-0.100**	**0.003**	-0.045	0.205	-0.020	0.567	-0.001	0.985
Covid risk	**-0.106**	**0.002**	0.001	0.990	-0.004	0.915	0.019	0.629
Covid mortality	**-0.175**	**0.000**	**-0.082**	**0.048**	0.005	0.868	*0.068*	*0.076*
Covid job loss	**-0.133**	**0.000**	-0.013	0.730	0.013	0.681	-0.003	0.932
Covid reduced income	0.012	0.726	-0.045	0.224	*0.087*	*0.012*	0.053	0.138
Covid work home	0.044	0.185	0.028	0.368	-0.018	0.625	0.031	0.356
Covid reduced hours	-0.032	0.339	*-0.062*	*0.074*	-0.016	0.653	-0.011	0.751
Covid friends	-0.038	0.230	0.023	0.479	0.023	0.537	-0.032	0.336

Notes: Estimates from non-missing values from a full sample of 802 monozygotic twins (See Table S1 for observation counts). Correlation cells show the pairwise correlation between the covariate and the residualized trust measure (residual obtained after estimating a linear regression controlling for twin pair's trust). P-values calculated after obtaining standard errors via non-parametric bootstrap with 1,000 replications clustered at the twin pair level. Estimates in bold are significant at the 5% level and estimates in italics at 10%.