

## **Education and Social Trust: Testing a Causal Hypothesis Using the Discordant Twin Design**

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*One of the clearest results in previous studies on social trust is the robust positive relationship with educational attainment. The most common interpretation is that education has a causal effect on social trust. The theoretical argument and empirical results in this article suggest a different interpretation. We argue that common preadult factors such as cognitive abilities and personality traits rooted in genes and early-life family environment may confound the relationship between educational attainment and social trust. We provide new evidence on this question by utilizing the quasi-experiment of twinning. By looking at the relationship between education and social trust within monozygotic (MZ) twin pairs, we are able to avoid potential confounders rooted in genetic factors and common environmental influences because the monozygotic twins share both. The results suggest that when controlling for such familial factors the estimated effects of education on social trust are close to zero and far from reaching statistical significance. Further analyses show that the relationship between education and social trust largely is driven by common genetic factors.*

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Social trust—the default expectation of the trustworthiness of unknown others (Rotter, 1980)—is of immense importance for individuals’ ability to maneuver today’s globalized societies characterized by risk and a concomitant need to operate “in conditions of uncertainty”

(Sztompka, 2006, p. 906).<sup>1</sup> Moreover, social trust has been suggested as a root cause of much of what is valued in today's societies. A large body of research has shown that high levels of social trust are associated with a wide range of positive outcomes for both individuals and societies at large: When people trust each other, democratic stability is promoted, society is more inclusive and open, economic development is furthered, and feelings of well-being and happiness flourishes (Putnam, 2000; Rothstein & Uslaner, 2006; Tokuda, Fujii, & Inoguchi, 2010).

Corresponding to its alleged importance, much research has been devoted to scrutinizing the sources of social trust. The list of factors proposed as potential causes is extensive (Nannestad, 2008). As an illustration, Delhey and Newton examine six types of explanations (in the guise of 35 variables) in their empirical analysis of aggregate-level social trust in 60 countries (Delhey & Newton, 2005) and six theories of social trust in a corresponding analysis at the individual level (Delhey & Newton, 2003). However, one of these factors stands out as particularly important for the development of social trust. The finding that education is a strong predictor of individual-level social trust is simply ubiquitous (Alesina & LaFerrara, 2000; Borgonovi, 2012; Glanville, Andersson, & Paxton, 2013; Helliwell & Putnam, 1999; Li, Pickles, & Savage, 2005; Marschall & Stolle, 2004; Putnam, 2000; Smith, 1997; Sønderskov & Dinesen, 2014; Uslaner, 2002). This is reflected in a recent meta-analysis synthesizing 154 evaluations from 28 studies across a number of countries, which confirms that education is a strong correlate of social trust (Huang, van den Brink, & Groot, 2009).

In previous research, it has almost unanimously been assumed that education exerts a causal impact on social trust (Huang, van den Brink, & Groot, 2011). There is, however, an alternative to this interpretation. In this study, we argue that various preadult factors may confound the relationship between educational attainment and social trust. More specifically, we expect factors such as intergenerational transmission of values and behavior, as well as personality traits and cognitive abilities, which have typically remained unobserved in previous analyses, to influence both educational attainment and social trust. As a consequence, this would lead the estimated effect of education on social trust to be biased—most likely upwards—because it captures both the influence of education as well as correlated unobserved factors.

In contrast to the related literature on the relationship between education and political participation (Kam & Palmer, 2008), the problem of confounding by unobserved factors has only received scant attention in previous research on social trust. Almost all of the previous studies of the relationship between education and social trust are based on observational cross-sectional data, analyzed in a standard regression framework, and thus rely on very strong and often untenable assumptions about the exogeneity of educational attainment. Hence, this approach can at best provide a partial solution to the potential problem of confounding since many of the possible confounders are unobservable, or at least very difficult to measure, and therefore impossible to control for. The ideal solution to the problem of identifying the causal impact of education is an experiment in which individuals are randomly assigned into different educational attainment (e.g., shorter vs. longer schooling). However, due to a lack of data on experimental manipulation of education linked to measures of social trust, researchers have had to rely on alternative means for estimating the effect of education on social trust.

One approach has been to use individual-level panel data, which allow for studying the relationship between education and social trust over time. Using a fixed-effects model that removes confounding from all stable individual-level characteristics (including those that are unobserved), Sturgis, Patulny, and Allum (2009) found significant effects of education on social trust in Britain, while Glanville et al. (2013) and Sønderskov and Dinesen (2014) found more limited effects bordering on statistical significance at conventional levels in the United States and Denmark, respectively. Using a lagged dependent-variable model, Li et al. (2005) found significant education effects in Britain,

<sup>1</sup> While the term “generalized social trust” is a more precise label for the type of trust studied here, we use the shorthand “social trust” in line with most of the literature.

although the original effect is reduced when introducing the lagged dependent variable in the model. This may suggest that some confounding by stable unmeasured factors occur.

Another approach to estimating causal effects of education on social trust is to use natural experiments in terms of policy reforms. Milligan, Moretti, and Oreopoulos (2004) applied this strategy by using changes in compulsory schooling laws as an instrument for policy reforms in their study of educational returns to social trust and other civic outcomes in the United States. They found a positive and largely unconfounded significant effect on social trust.

While both the noted approaches represent a marked improvement over previous research, they are no panacea for solving the problem of confounding by unobservables. The panel-based models only take confounding by time-invariant unobservables into account and may thus still suffer from confounding by unobservable variables varying over time. A shortcoming of the instrumental variable approach is that the instruments are based on policy interventions that mainly influence the educational attainment of individuals at the lower end of the education distribution. The effect of extra schooling is likely different for this group than for the population at large, which implies that the resulting estimate reflects a local average treatment effect (LATE) that might not be informative about the average treatment effect (ATE) of education on social trust for the entire population (Lundborg, 2013).

In this study, we opt for a different strategy to address the problem of confounding of the relationship between education and social trust by unobserved factors. Following several studies on the economic returns to schooling (Ashenfelter & Krueger, 1994; Isacsson, 1999) and also a recent study on the effect of education on political participation (Dinesen et al., in press), we use the so-called discordant twin (or co-twin) design. The discordant twin design relies on the fact that monozygotic (MZ or identical) twins are genetically identical and have been reared in the same family environment. Consequently, by relating within-pair differences in schooling to within-pair differences in social trust among MZ twins, we are able to bypass confounding of factors stemming from unobserved genetic influences as well as a common rearing environment.

We test the relationship between education and social trust using a survey (from 2010) of 1,150 Swedish MZ twin pairs born between 1943 and 1958. In addition, by comparing the twin sample to the Swedish sample of the 2010–11 wave of the European Social Survey (ESS), we show that the twins are representative of the overall Swedish population regarding the levels of and relationship between educational attainment and social trust.

The results from a naive model not controlling for possible unobservable confounders corroborates earlier studies in finding a strong positive effect of education on social trust in both the twin sample and the nationally representative sample. However, based on the discordant twin model that accounts for confounding by common genes and early-life family environment, the estimated effect of education on social trust is reduced to close to zero and is far from statistically significant. This suggests that preadult factors (genetic influences and early-life processes) confound the relationship between educational attainment and social trust. To gain purchase on the sources of confounding, we use a Cholesky decomposition model to show that the relationship between education and social trust is largely accounted for by common genes rather than by environmental influences shared by the siblings in a twin-pair. We discuss the implications of our findings for future research on education and social trust in the concluding section.

### **The Relationship Between Education and Social Trust: A Causal or a Confounded Relationship?**

As noted in the introduction, a large number of studies have reported a robust, positive relationship between educational attainment and social trust. The assumption in most of these studies is that

this correlation reflects a causal impact of education on social trust. Several mechanisms underpinning the proposed causal effect have been suggested. First, the education system is an important socialization agent that may pave the way for a more cosmopolitan and optimistic worldview, which in turn entails a more positive outlook on other people in general (Bjørnskov, 2007; Borgonovi, 2012; Uslaner, 2002). Moreover, expectations of other people's trustworthiness involve risk assessments. In line with this, Huang et al. (2011) argued that the "advantages in economic and social resources may bring highly-educated people more confidence in handling the risks involved in trusting generalized others" (p. 292; see also Delhey & Newton, 2003). Relatedly, the effect of education on social trust may also run through a network mechanism. Due to homophily, higher educated individuals tend to associate with other highly educated persons and live in areas with higher average education levels. Helliwell and Putnam (1999) argued that this will lead to a climate of trust that is self-reinforcing since if "individuals know that higher education levels make others more likely to be trusting (and perhaps also more trustworthy), then they are in turn more likely to trust others" (p. 5).

However, an alternative that runs counter to this causal interpretation is that the relationship between education and social trust is spurious. In this scenario, early-life socialization and genetic makeup jointly—via a potentially large set of difficult-to-observe preadult factors—influence an individual's educational attainment and his or her propensity to trust others. To illustrate the rationale underlying this perspective, we review three of the influences we consider most likely to confound the relationship between education and social trust. More specifically, we look at generic parental transmission and molding of traits, as well as individual differences in psychological traits such as cognitive ability and personality.

First, there is evidence suggesting a substantial intergenerational transmission of both education (Haveman & Wolfe, 1995) and social trust (Dohmen, Falk, Huffman, & Sunde, 2012; Uslaner, 2002; but see Dinesen, 2012). Moreover, specific parental characteristics (e.g., occupation and income), as well as rearing practices, have also been shown to correlate with children's level of education and social trust (Dinesen, 2010; Entwistle, Alexander, & Olson, 2005; Haveman & Wolfe, 1995; Huang et al., 2011).

The parent-child correlations in educational attainment and social trust are likely rooted in both genetic and social transmission. As for social transmission, socialization researchers have pinpointed several pathways that could produce parent-child resemblance such as value transfer via imitation and learning, or transmission of social class and social identities to the offspring, which subsequently have downstream effects on social attitudes and behaviors (Jennings, Stoker, & Bowers, 2009). A number of studies based on adopted children and their adoptive and biological parents have also shown that both genetic and social factors contribute to intergenerational transmission in education, earnings, and other social and political behaviors (Björklund, Lindahl, & Plug, 2006; Cesarini, Johannesson, & Oskarsson, 2014). Irrespective of the specific mode of transmission, the important point in this context is that this intrafamilial transmission may likely confound the relationship between education and social trust. If parents transmit an inclination towards both pursuing a higher education and trusting others, then their offspring would manifest both traits—not as a result of education having a positive influence on social trust, but because both were transmitted by the parents.

The observed relationship between education and social trust may also reflect psychological traits, partly innate and/or developed in the preadult years as the result of familial socialization. One obvious candidate is cognitive ability, a trait that has both genetic and environmental origins (Bouchard & McGue, 2003), and is highly stable over the life course (Lyons et al., 2009). The link between cognitive ability and educational achievement is well established (Entwistle et al., 2005), and a number of studies also show an association between cognitive ability and social trust. Importantly, these studies show that cognitive ability measured during childhood/adolescence, and thus before differentiation in the educational system takes place, predicts social trust much later in life (Oskarsson, Dawes,

Johannesson & Magnusson, 2012; Sturgis et al., 2010). This is a strong indication that cognitive ability is a likely confounder of the relationship between education and social trust.

Individual traits indexing patterns in thinking, feeling, and behavior, in *casu* personality traits, most likely also influence both educational choices and trust formation. Again, earlier research has shown that personality traits are influenced by both genes and environment and are generally shaped before adulthood (Bouchard & McGue, 2003; Costa & McCrae, 1988). As such, they are persistent dispositions that may influence both educational attainment and social trust and thus confound the relationship between the two variables. This can be illustrated by the most widely used model of personality, the so-called “Five Factor” or “Big Five” model, which describes human personality by five global traits (specifically, Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism; see McCrae & Costa, 1999). For example, The Big Five trait Openness to Experience—individuals scoring high on this trait are characterized by being curious and appreciative of novel and alternative ideas and people—has been shown to significantly influence educational success and lead to higher educational aspirations (Chamorro-Premuzic & Furnham, 2009; Entwisle et al., 2005). As for social trust, Ermisch, Gambetta, Laurie, Siedler, and Uhrig (2009) showed that Openness to Experience is positively related to self-reported trust in strangers. This is confirmed in a study by Dinesen, Nørgaard, and Klemmensen (2014), who reported that all Big Five traits, in particular Openness to Experience, Agreeableness, and Neuroticism, are significantly associated with social trust.<sup>2</sup> The results for the Big Five model are also confirmed for other (conceptualizations of) personality traits. For instance, personal control—the belief that one’s fate and well-being are primarily the result of one’s own making (Rotter, 1966)—is positively related to both educational attainment and social trust (Oskarsson et al., 2012; Stupinsky et al., 2007; Uslaner, 2002).

In sum, contrary to the general view that education influences social trust, the above review of potential confounders gives us reason to question the causal nature of this relationship. If early-life socialization and genetic factors influence both educational attainment and the formation of trust later in life via a variety of difficult-to-observe factors, the well-established correlation between education and social trust may be partly or wholly spurious. Thus, there is ample reason to look for research designs that can help us control for the influence of genetic makeup and the early-life environment.

### The Discordant Twin Design

In this article, we utilize the quasi-experiment of twinning for addressing the problem of confounding by unobserved factors. More precisely, we employ a so-called discordant twin design (McGue, Osler, & Christensen, 2010). The strength of the discordant twin design stems from the fact that monozygotic (MZ) twins are genetically identical and have been exposed to the same family environment (given their common upbringing). Thus, by relating within-twin pair differences in education to within-twin pair differences in social trust, we are able to estimate the relationship between education and social trust net of confounding factors rooted in common genes and the early-life rearing environment (e.g., cognitive abilities, personality traits, or upbringing); what we, for ease of exposition, may collectively label “family factors.” In effect, we use one twin in a pair as the co-twin’s credible (although not perfect) counterfactual (McGue et al., 2010). That is, the discordant twin design entails using a more highly educated co-twin of a less educated sibling to estimate what the latter would have looked like had he or she received more schooling.

Using the quasi-experiment of twinning is a well-established research design within economics. A number of studies have looked at within-twin pair differences in educational attainment and income

<sup>2</sup> Importantly, the association between agreeableness and social trust reported in Dinesen et al. (2014) persists also when excluding the items measuring the trust facet of agreeableness.

(Ashenfelter & Krueger, 1994; Isacson, 1999), as well as health outcomes (Lundborg, 2013), to obtain less biased estimates of the returns to schooling. The empirical framework employed in this article builds on this research tradition. To our knowledge, the discordant twin design has only been applied once within political science—to study the relationship between education and political engagement (Dinesen et al., in press).

To see how the discordant twin method may help us obtain more credible estimates of the relationship between education and social trust, consider, first, an individual  $i$  whose level of social trust  $Y_i$  is determined by:

$$Y_i = \beta X_i + F_i + \varepsilon_i, \quad (1)$$

where  $X_i$  denotes some indicator measuring educational attainment;  $F_i$  represents unobserved or unmeasured family factors potentially influencing both the propensity to trust and educational attainment; and  $\varepsilon_i$  is an unobserved random component. In the typical ordinary least square (OLS) setup based on cross-sectional observational data,  $F_i$  is excluded from Equation (1) or, alternatively, partly taken into account by crude proxies. However, since the family factors ( $F_i$ ) and educational attainment ( $X_i$ ) are likely to be correlated with one another, the estimated effect of education on social trust will be biased and inconsistent given that the family factors are not properly taken into account. More precisely, we would expect the correlations between the unobserved family factors and schooling and social trust, respectively, to be in the same direction. For example, a rearing environment that encourages the children to pursue higher education will likely also be conducive to higher levels of social trust. Thus, if not controlling properly for the family factors ( $F_i$ ), estimates of education on social trust will be upwardly biased.

Turning next to the discordant twin approach, we model the relationships between social trust and schooling for the two siblings in a monozygotic twin pair (Ashenfelter & Zimmerman, 1997; Lundborg, 2013). Using the same notation as in Equation (1), we assume that the true relationships between social trust and schooling for the two siblings in a monozygotic twin pair are:

$$Y_{1j} = \beta X_{1j} + F_j + \varepsilon_{1j}, \quad (2a)$$

$$Y_{2j} = \beta X_{2j} + F_j + \varepsilon_{2j}, \quad (2b)$$

where  $Y$  denotes social trust, and  $X$  is a measure of educational attainment of twin  $i$  ( $i = 1, 2$ ) in pair  $j$  ( $j = 1, 2, \dots, N$ ). The error term in each equation consists of an individual-specific component ( $\varepsilon_{ij}$ ) and a family-specific component ( $F_j$ ). The family-specific effects vary across, but not *within*, twin-pairs and capture the unobserved or unmeasured family factors discussed above.

The most straightforward way to control for the effects of family factors ( $F_j$ ) is to difference Equations (2a) and (2b) to obtain the between-twin-pair fixed-effects estimator:

$$Y_{1j} - Y_{2j} = \beta_{FE} (X_{1j} - X_{2j}) + (\varepsilon_{1j} - \varepsilon_{2j}), \quad (3)$$

where  $\beta_{FE}$  is the within-twin-pair estimate of the influence of education on social trust. In this specification, the estimate of  $\beta$  is based on the correlation between differences between siblings in a twin pair with respect to the independent variable of interest (here, educational attainment) and differences between members of a twin pair with respect to an outcome (here, social trust). By using difference scores, all family factors common to the siblings in a given twin pair ( $F_j$ ) are differenced out. That is, since monozygotic twins share common genes as well as the influence of a common rearing environment, an estimate of  $\beta_{FE}$  is no longer biased due to factors determined by these unobserved family factors.

Thus, the co-twin design relies on the assumption that differences in education are exogenous conditional on the fixed effects. An important question following this assumption is what may cause such differences in otherwise similar individuals. Lundborg (2013) provides several examples of exogenously given differences in educational attainment. Above all, more or less random events and experiences early in life may lead to differences in preferences and interests that, in turn, may result in differences in educational choices. For example, if the siblings in a twin pair end up with teachers of different quality, this may have downstream effects on the tendency to enter higher education later in life.

It is important to be clear about both the strengths and the weaknesses of the discordant twin design. On the one hand, the discordant twin design enables a very strong control for unobservable or hard-to-measure traits emanating from individual differences in genetic factors and early-life environment. This is important since, as discussed above, it is highly likely that such factors may account for part of the previously observed strong relationship between education and social trust. On the other hand, since the discordant twin design is based on observational data, it does not provide us with definitive causal estimates as the estimated impact of education on social trust may still be confounded by experiences unique to each twin in a pair. For instance, differential experiences with a teacher may influence both the individual's tendency to pursue higher education and his or her inclination to trust others, which would in turn lead the twin-based estimate of the relationship between education and social trust to be biased. We will return to this issue in the discussion.

### Data and Measures

The Swedish Twin Registry is the world's largest twin registry, and it routinely administers surveys to Swedish twins (Lichtenstein et al., 2006). This article uses data from a recent survey, called SALTY (Screening Across the Life-span Twin [Younger] cohort study). The SALTY study, initiated in 2007, was a collaborative effort between researchers in epidemiology, medicine, political science, and economics. The data collection was completed in the summer of 2010.

Beginning in the spring of 2009, 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 11,578 responses. Out of these, 11,261 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, the sample used in this study is comprised of 1,150 complete monozygotic twin pairs.

To compare the sample of twins with the population at large, we use data from the Swedish sample of the 2010–11 wave of the European Social Survey (ESS round 5). ESS contains a representative sample of the Swedish population. The survey design includes strict quality controls, such as random probability sampling, a minimum target response rate of 70% and rigorous translation protocols.<sup>3</sup>

In line with extant research on social trust, we employ the widely used survey question “Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?” scaled between 0 (“you can't be too careful”) and 10 (“most people can be trusted”) as our measure of social trust. This well-known indicator of social trust has been criticized on at least two grounds: that it measures trustworthiness rather than actual “behavioral” trust (Glaeser, Laibson, Scheinkman, & Soutter, 2000) and that it is underspecified in the sense that it is unclear for the respondent whom one is supposed to trust with respect to what (Hardin, 2002; Nannestad, 2008). With regard to the former criticism, the results by Glaeser et al. (2000) have been refuted on the

<sup>3</sup> The actual weighted average response rate across the 27 countries included in ESS 2010 was 57.4%. The response rate in the Swedish survey was 51.0%. Data and fieldwork documentation are available at [www.europeansocialsurvey.org/](http://www.europeansocialsurvey.org/).

grounds of the specific sample studied, specifically the homogeneity of participants and their mutual knowledge about each other, and the social trust measure has subsequently been shown to correlate with actual trusting behavior in more diverse and less information-rich samples (Sapienza, Toldra, & Zingales, 2007). This suggests that the standard survey question captures trust in anonymous others and thus corresponds with how social trust is conceptualized in this study.

As for the issue of the underspecification of the target of trust in the standard trust question, previous studies show that most people draw on more general frames of reference (i.e., unknown others) but also that a minority refer to more specific, known others (Sturgis & Smith, 2010; Uslander, 2002). More generally, Freitag and Bauer (2013) evaluated the equivalence of social trust across cultural contexts using Swiss data and data from the World Values Survey and concluded that respondents understood the wording of the social trust item as trust in strangers. All in all, then, while there is some variation in how people understand the trust question, it seems to be a fair assumption that it primarily captures trust in unknown others (our conceptualization of trust) and does so in an equivalent way for most respondents.<sup>4</sup>

We measure education as years of schooling. This was imputed from data on educational level and type of education. For the SALTY sample, this information was obtained from administrative data (from 2008) contained in the national registers, whereas self-reported educational attainment is used to calculate years of schooling for the ESS sample. To check the sensitivity of our results to the measure of education, we also estimate models of the effect of college attainment on social trust. In these analyses, college attainment is defined as 15 years of completed full-time schooling. Details on how years of schooling were assigned to the different levels and types of education for the two samples are presented in the online supporting information.

Table 1 reports descriptive statistics for the sample of MZ twins along with the corresponding figures for the ESS sample. The SALTY sample is very similar to the ESS sample with respect to social trust and years of schooling. The differences in mean values between the two samples are substantively small and do not reach conventional levels of significance.<sup>5</sup> Moreover, when restricting the ESS sample to respondents in the same age range as in the SALTY sample (52–67), the results for education and social trust are also very similar. A *t*-test at the 5% significance level reveals that the share of females in the SALTY sample is significantly larger compared to the representative ESS sample.<sup>6</sup>

Finally, for both education and social trust, there is substantial variation within twin pairs. Using completed years of schooling, 56% of the identical twins are assigned different number of years. In 78% of the pairs, the twins reported different levels of social trust.

## Results

### *Education and Social Trust: Co-Twin Results*

The results of the co-twin analysis are presented in Table 2. The analysis employing years of education as the measure of education is presented in the upper panel, and the analysis using college

<sup>4</sup> Partly at odds with the findings presented in Freitag and Bauer (2013), Delhey, Newton, and Welzel (2011) found—also using data from the World Values Survey—that the “radius of trust” (trust being more or less encompassing) varies considerably across countries. However, broadly consistent with our conceptualization of trust, their results indicated that for the overwhelming majority of Swedes, “trust in most people” connoted a wide radius of trust.

<sup>5</sup> It should also be noted that both the SALTY and the ESS samples are very similar to the overall Swedish population in terms of educational attainment. In 2014, the average years of schooling in the Swedish population was equal to 12.08 (information retrieved from [www.scb.se](http://www.scb.se)).

<sup>6</sup> If the effects of education on social trust would differ between males and females, the larger share of females in the SALTY sample may render any generalizations to the population at large problematic. Reassuringly, however, we find no signs of heterogeneous effects of education on social trust across sexes.



**Table 1.** Descriptive Statistics

Variable	ESS 2010 Full Sample	ESS Obs.	ESS 2010 Aged 52-67	ESS Obs.	MZ Twins	MZ Obs.
Education in years	11.955 [3.024]	1487	12.030 [2.978]	399	12.027 [2.592]	2292
College	0.252 [0.434]	1487	0.241 [0.428]	399	0.209 [0.407]	2292
Social trust	6.340 [1.979]	1490	6.296 [2.037]	398	6.574 [2.364]	2260
Age	48.603 [19.236]	1497	59.883 [4.629]	401	60.381 [4.646]	2300
Females	0.520 [0.500]	1497	0.524 [0.500]	401	0.594 [0.491]	2300

Note. Mean values (standard deviations in brackets).

**Table 2.** OLS and Fixed-Effects Estimates of the Effect of Education on Social Trust

Variable	ESS 2010 Full Sample OLS	ESS 2010 Aged 52-67 OLS	MZ Twins OLS	MZ Twins FE
Years of Schooling	0.142*** [0.017]	0.171*** [0.034]	0.186*** [0.021]	-0.012 [0.039]
Age	0.005* [0.003]	-0.019 [0.022]	-0.001 [0.013]	- -
Female	0.028 [0.100]	0.069 [0.198]	0.104 [0.115]	- -
College	0.954*** [0.116]	1.103*** [0.234]	1.004*** [0.121]	0.164 [0.209]
Age	0.002 [0.003]	-0.028 [0.022]	-0.010 [0.013]	- -
Female	0.013 [0.101]	0.075 [0.199]	0.102 [0.116]	- -
Twin-pair fixed effects	No	No	No	Yes
Observations	1480	396	2252	2252

Note. OLS and twin pair fixed-effects regressions; standard errors in brackets (clustered by twin pair in the OLS model based on the twin sample); \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

attainment is presented in the lower panel. Columns 1–3 in each panel contain naïve OLS estimates of the effect of education on social trust based on Equation (1), including controls for age and sex.<sup>7</sup> Consistent with earlier studies, the results in columns 1–3 indicate that there is a positive and significant effect of education on social trust when potentially confounding family factors are not taken into account. According to the estimates in the upper panel, each additional year of schooling increases the level of social trust by 0.14 units on the 0–10 scale in the ESS sample. When restricting the ESS sample to the same age cohorts as in the SALTY sample, the estimated effect marginally increases to 0.17. Importantly, column 3 shows that the estimated effect of years of schooling based on the SALTY sample is very similar to those obtained in the representative ESS sample. In particular, the expected increase in social trust from one additional year of schooling amounts to 0.19 in the sample of MZ twins.

These estimates provide the baseline against which to compare the within-pair estimates presented in column 4. When differencing out the influence of genes and early-life rearing environment,

<sup>7</sup> In the OLS models based on the SALTY twin sample, the standard errors are clustered on twin pairs to correct for interdependence within twin pairs.

the effect of years of schooling on social trust is close to zero and imprecisely estimated. Together with the positive and significant estimates from the OLS models in columns 1–3, the lack of effect in the fixed-effect model suggests that conventional estimates of the effect of education on social trust suffer from strong upward bias due to omission of confounding family factors.

In the lower panel of Table 2, we present corresponding results for the relationship between education and social trust using college completion as the indicator of educational attainment. Once again, it is clear that the OLS estimates based on the ESS sample in columns 1 and 2 are very close to the corresponding estimate for the SALT sample in column 3. The effect of college attainment is large in magnitude and statistically significant. According to the estimated coefficients in columns 1–3, a college degree will on average increase the level of social trust by approximately one unit on the 11-point scale. Similar to the results for years of schooling, the influence of college attainment on social trust decreases sharply when using the within-twin-pair estimator in column 4, thus indicating that the naïve OLS estimates of the influence of educational attainment on social trust are biased upward.

For several reasons, however, the fixed-effects estimates may be downward biased. First, a potential objection against the results reported in Table 2 concerns measurement error in the explanatory variable. Measurement errors in the explanatory variables are exacerbated when differencing, especially when differencing between identical twins (Griliches, 1979). As explained in the online supporting information, this will lead to attenuation bias (i.e., bias towards no effect) in the within-pair estimate of  $\beta$  from Equation (3) compared to the OLS estimate of  $\beta$  from Equation (1). Thus, any difference in the estimate of  $\beta$  from Equation (1) (omitting family factors from the equations) and Equation (3) may reflect controlling for common family factors, but also, in principle, measurement error (or both). In the online supporting information, we provide an extension of the empirical framework presented in the previous section that allows us to correct the within-twin-pair estimates for measurement error in the education variables. The results presented in Table A1 in the online supporting information show that correcting the schooling variables for common levels of measurement error does not affect the estimated effects of education on social trust in any substantive way. The reported within-pair estimates of the influence of educational attainment on social trust are all small in magnitude, often incorrectly signed, and never statistically significant irrespective of the assumed level of measurement error in the schooling variables. This suggests that the absence of effect of education on social trust in the twin-pair models does not reflect possible measurement error.

Second, the influence of outliers is exacerbated in fixed-effects models (Lundborg, 2013), which may also impinge on the estimated relationship between education and social trust. To check if outliers drive the results in the fixed-effect models, Figure A1 in the online supporting information plots the within twin-pair absolute difference in schooling against the within-twin-pair absolute difference in social trust. The graph reveals two outliers where large schooling differences are combined with much smaller differences in social trust. However, excluding these outliers and rerunning the fixed-effect models leaves the estimates more or less unchanged (see Table A2 in the online supporting information).

A final reason that the fixed-effect estimates may be downward biased concerns differences in parental treatment. If parents try to compensate for differences in ability or other traits important for schooling between the twins by giving the weaker sibling more time and attention, which may also influence their social trust, this may cause an underestimation of the relationship between education and social trust.<sup>8</sup> Unfortunately, we cannot control for this possible confounding factor due to lack of data on parental treatment during youth and adolescence. However, in a study of the educational

<sup>8</sup> However, differential parental treatment of siblings may also lead to an overestimation of the education effect on trust. For instance, if parents, instead of compensating for between-sibling differences, encourage the more able sibling to pursue higher education, this may lead to upward-biased fixed-effect estimates.

returns to health based on a sample of MZ twins from Minnesota, Lundborg (2013) shows that the amount of time parents devote to each sibling in a twin pair does not seem to confound the estimated effects of schooling on self-reported health.<sup>9</sup>

### Decomposing the Sources of Confounding: Bivariate Cholesky Results

The results thus far suggest that the positive relationship between education and social trust to a large extent derives from unobserved family factors. In the literature review, we outlined how both genetic factors and the early-life rearing environment may confound the empirical relationship between education and social trust through several possible influences including intergenerational transmission of values and behavior, cognitive ability, and personality traits. An important next step is therefore to pin down the relative importance of genetic and environmental sources of the confounding of the relationship between education and social trust.

Previous studies have shown that both social trust and educational attainment are partly heritable traits. Cesarini et al. (2008) reported that individual differences in behavior in a trust game could be attributed to genetic variation. Also, several studies have shown that 30–40% of the variation in survey responses to trust items akin to the one used in our study is accounted for by genes (Hiraishi, Yamagata, Shikishima, & Ando, 2008; Oskarsson et al., 2012; Sturgis et al., 2010).<sup>10</sup> As for schooling, a number of twin studies have found that 40–50% of the individual variation in education can be accounted for by genetic influences (Branigan, McCallum, & Freese, 2013). So far, however, no study has investigated the degree to which social trust and educational attainment share the same etiology, genetic or environmental.

A straightforward way to test this is to use bivariate twin models in order to decompose the covariance between social trust and educational attainment. Here, we will only briefly introduce the intuition behind the decomposition using the twin design. A more formal introduction to the biometric models used in this article and the underlying assumptions can be found in Medland and Hatemi (2009).

The classical univariate twin model assumes that the variance in observed behavior (here social trust and educational attainment) can be partitioned into three latent factors: additive genetic factors (*A*), environmental factors that are shared or common to co-twins, such as being reared in the same family (*C*), and unique environmental factors (*E*). This is the so-called *ACE*-model. The variance decomposition uses information about both monozygotic (*MZ*) and dizygotic (*DZ*) twins, and the underlying logic is straightforward. The correlation for a trait (e.g., social trust or educational attainment) among *MZ* twins, who share 100% of their genes, are compared to the correlation among *DZ* twins, who share on average half of their segregating genes, in order to estimate to what extent the trait is accounted for by additive genetic factors (*A*), shared (or common) environment (*C*), and non-shared environment (*E*). *MZ* correlations less than unity reflect the influence of unshared environment (*E*). Greater concordance among *MZ* twins compared to *DZ* twins reflects genetic influence (*A*). Finally, a *DZ* correlation greater than half of the corresponding *MZ* correlation reflects the influence of shared environment factors (*C*).

This logic can be extended to the bivariate (or multivariate) case using so-called Cholesky decomposition. We employ bivariate Cholesky decomposition in order to estimate the amount of

<sup>9</sup> As a potential challenge to this interpretation, a recent meta-analysis showed that the relative importance of genetic and environmental influences on individual differences in health outcomes and social attitudes differ substantially (Polderman et al., 2015). Hence, Lundborg's results regarding the absence of confounding of the relationship between education and health outcomes by differential parental treatment may not transfer to the relationship between education and social trust.

<sup>10</sup> For an exception, see Van Lange, Vinkhuyzen, and Posthuma (2014), who found that social trust is not influenced by genetic factors in a sample of Dutch twins.

**Table 3.** Estimates from Univariate and Bivariate Variance Decompositions

	A	C	E
<i>Univariate Models</i>			
Social trust	37 [33, 42]	0 [0, 10]	63 [58, 67]
Years of schooling	39 [31, 49]	30 [21, 38]	31 [28, 34]
College attainment	36 [17, 56]	44 [26, 60]	20 [15, 26]
<i>Bivariate Models</i>			
Years of schooling and social trust	80 [44, 117]	22 [-9, 52]	-1 [-13, 10]
College attainment and social trust	60 [15, 109]	32 [-8, 70]	8 [-8, 14]

*Note.* Results from univariate (upper panel) and bivariate (lower panel) variance decompositions. Ninety-five percent confidence intervals in brackets. The entries in the lower panel display the share of the bivariate phenotypic correlation due to genetic (A), common environmental (C), and unique environmental (E) factors. Due to rounding the A, C, and E estimates may not sum to 100%.

*covariation* between two traits (e.g., educational attainment and social trust) that can be accounted for by genetic (*A*) and environmental (*C* and *E*) sources. The Cholesky decomposition is based on the cross-twin cross-trait correlations: the correlation between one trait (e.g., education) in the first twin and the other trait (e.g., social trust) in the second twin. The interpretation of these cross-twin cross-trait correlations carries over from the univariate case. For example, a higher correlation for MZ than DZ twins indicates that genetic factors influence both traits and therefore account for part of the covariation between them.

The results from the univariate models and the Cholesky decomposition of the relationship between education and social trust are presented in Table 3.<sup>11</sup> The estimates suggest that social trust and education are moderately heritable traits. According to the estimates, around 40% of the variation in social trust, years of schooling, and college completion can be accounted for by additive genetic influences, which is roughly similar to the results reported in previous studies based on samples of Swedish twins partly overlapping with the current sample used in this study (Oskarsson et al., 2012; Rietveld et al., 2013). However, the three traits differ in terms of environmental influences. Whereas individual differences in social trust are not attributable to shared environmental influences, such factors account for sizeable shares of the variation in educational attainment.

Turning to the bivariate models, we focus on the share of the covariation between education and social trust accounted for by genetic (*A*) or environmental factors (*C* and *E*), as this analysis directly assesses the sources of the confounding of the relationship. The estimates in column 1 show that the share of the phenotypic correlation attributable to genetic factors is statistically significant and amounts to 80% (years of schooling and social trust) and 60% (college graduation and social trust). The estimates of *C* for the two models are nontrivial, suggesting that the share of the covariance accounted for by common environmental factors is 22 and 32%, respectively. However, both in the case of years of education and college attainment, the share of covariation with social trust accounted for by the common (shared) environment is statistically insignificant and substantially smaller than the corresponding estimate of the influence of genetic factors. Moreover, the estimates in column 3 indicate that the share of the correlation attributable to nonshared environmental factors (*E*) is

<sup>11</sup> Structural equation modeling is used to estimate the relative contributions of genetic and environmental factors. The models are estimated using maximum likelihood on raw data in the software Mx (Neale, Boker, Xie, & Maes, 2004). In total, 1,126 complete MZ and 1,216 complete same-sex DZ twin pairs are used in the analyses. Sex and age are included as covariates influencing the mean values of education, college, and social trust.

statistically insignificant and substantively negligible in both models. All in all, the results in Table 3 suggest that the bivariate relationship between social trust and education is mainly accounted for by a set of common genetic factors and thus point to these genetic factors as being the primary source of the confounding of the “naïve” relationship between the two.

### Discussion and Conclusion

One of the clearest findings reported by previous studies on social trust is the strong relationship with educational attainment. The explicit or implicit assumption in the vast majority of studies is that education has a causal effect on social trust. The results in this article suggest a different interpretation of the well-established correlation between education and social trust.

Using a within-twin-pair approach, which avoids confounding by genes and early-life rearing environment, we find a relationship between education and social trust that is close to zero and far from reaching statistical significance, both when using years of schooling and attainment of a college degree as measures of education. These results strongly suggest that the relationship between education and social trust reported in studies based on observational cross-sectional data suffers from an upward bias due to omission of preadult sources of confounding. Moreover, using a Cholesky decomposition model, we demonstrated that these sources of confounding are primarily genetic factors.

We have argued that the discordant twin design is a fruitful strategy for examining the relationship between education and social trust (and, in principle, other attitudinal outcomes) since it controls for confounding factors rooted in genes as well as early-life (family) environment. However, it is important to note that using discordant MZ twins has its own limitations as a method for assessing confounding of the relationship between education and social trust. We have already addressed two such limitations in the article: measurement error in the education variable and the representativeness of the twin sample of the population at large. Fortunately, neither appears to be a major concern in our study: Measurement error in the education variable does not impinge on our findings, and, based on a comparison with a nationally representative sample, there are strong reasons to believe that our results are representative of the general population in Sweden.

However, at least one limitation remains. While the discordant twin model controls for all unobserved factors common to siblings within a twin-pair, by definition there still remain within-pair differences in unshared environmental factors that may affect both educational attainment and the propensity to trust others, thus leading to inflated estimates of the effects of education. For example, using a sample of Swedish twins partly overlapping the one used in our study, Sandewall, Cesarini, and Johannesson (2014) showed that within-twin pair differences in cognitive ability, as measured by IQ test scores at age 18, are positively and significantly related to within-pair differences in schooling among MZ twin pairs in which both siblings had at least 12 years of schooling. This implies that twin-based estimates of the effect of education on any outcome that we expect to be (positively) related to cognitive ability (such as social trust) may be upward biased if cognitive ability is not controlled for. However, it is important to note that this limitation of the discordant twin design is a problem only insofar that we did find a positive and significant impact of education on social trust in the first place. Thus, the confounding influence due to the omission of unobserved factors rooted in experiences not shared by the twins should, in principle, lead us to expect even smaller effects of education on social trust than the ones reported in this study.

Does the lack of significant effects of schooling in our discordant twin models mean that we should abandon the idea that education, one of the most prominent explanations of social trust, can influence social trust? Even though the results presented in this article are clear, we still believe that an affirmative answer to this question is somewhat premature. As always, our results should be replicated using independent samples before any firm conclusions regarding the causal status of the

relationship between education and social trust can be established. Moreover, no single approach is without its limits, so it is sensible to tackle this research question from different angles. Studies using other identification strategies, for example, as mentioned earlier, individual-level panel data and instrumental variable designs based on natural experiments (for example, policy reforms [Meghir & Palme, 2005] or college admission thresholds [Öckert, 2010]) should therefore also be considered.

It may also be the case that the social returns to schooling are heterogeneous and hinge on the national institutional context. This is suggested by studies finding an effect of education on social trust in Great Britain (Sturgis et al., 2009), and to a lesser extent Denmark (Sønderskov & Dinesen, 2014) and the United States (Glanville et al., 2013), based on other identification strategies. Similarly, heterogeneous effects have also been found in the related literature on the relationship between education and political participation (Chevalier & Doyle, 2012), including in studies using the same co-twin methodology as employed in this study (Dinesen et al., in press). Future studies would thus preferably use data from several national contexts to gain insight into the comparative effects of education on social trust across nations (Borgonovi, 2012).

Finally, most studies on the relationship between schooling and social trust, including the present one, has focused on the influence of the quantity or length of education. However, the quality or content of education may be at least as important for civic outcomes (Green et al., 2011). Future research should therefore elaborate further on this distinction in order to understand how educational attainment influences social trust.

In conclusion, we argue that the lack of within-pair effects of schooling on social trust in our sample of Swedish twins is an important finding, and we hope that the results presented in this article will spur further research into the nature of the relationship between education and social trust as well as other civic attitudes and behaviors.

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### Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Coding of Years of Schooling

Correcting the Co-Twin Estimates for Measurement Error

**Table A1.** Within-Pair Estimates of the Effect of Years of Schooling/College Attainment and Family Effect Bias on Social Trust with Correction for Measurement Error

Outliers

**Figure A1.** Outliers: Absolute Differences in Schooling and Social Trust

**Table A2.** OLS and Fixed-Effects Estimates Excluding Outliers