**The Pursuit of Differences in Prosociality Among Identical Twins:
Religion Matters, Education Does Not**

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Abstract

Understanding the roots of human cooperation, or prosociality, is one of the key scientific challenges. Past research has revealed that individual differences in prosociality are positively associated with both level of education and religion. The present research asks whether education and religiosity might also help explain genetic and environmental influences on prosociality. Using a representative sample of US twins in a co-twin control study, we replicate the positive associations of prosociality, for both education and religiosity, and uncover new findings by examining differences within monozygotic twin pairs. For education, we find that the relation between prosocial behavior and level of education is not due to unique environmental influences. But for religiosity, we do find mediation by unique environmental influences. Among pairs of monozygotic twins we find that differences in levels of religiosity are associated with differences in levels of prosocial behavior. The more religious twin from a pair displays more prosocial behavior than the less religious twin. We conclude that religiosity is an important variable that helps to uncover unique environmental, non-genetic influences on prosociality.

What are the roots of prosociality? What determines whether people do good for others or the society at large? In modern societies, formal voluntary organizations have gained prominence in the provision of public goods along government programs. Donations of money and voluntary contributions of time and effort are crucial forms of commitment to noble causes and societal goals. Clearly, a broad conclusion about the roots of prosociality is that both the environment and genetics matter, and that environmental circumstances affect the expression of genetic influences. This conclusion holds for the understanding of various forms of prosocial traits and behavior (Polderman et al., 2015; Reimann, Schilke, & Cook, 2017; Turkheimer, 2000; Van Lange, Vinkhuyzen, & Posthuma, 2014). What is *not* clear, however, is *which environmental influences* matter, when genetics influences are controlled.

Understanding which environmental influences matter is all the more important as additive genetic effects on prosociality are minor compared to environmental effects. In two forms of prosocial behavior commonly found in western populations – donations of money to charity and time spent volunteering – more than two thirds of the variance are explained by unique environmental effects (See Table S2 in the Supplementary Materials). To examine this source of variance, we study differences between identical (or monozygotic) twins using a co-twin control design (Gesell, 1942). The benefit of this approach is that it allows us to examine unique environmental influences that may account for differences among identical twins, thus controlling for genetic and shared environmental effects. From this perspective, two “cultural” variables suggest themselves: Education and religiosity. Both variables are ubiquitously predictive of prosociality. Citizens with higher levels of education are more likely to engage in charitable giving (Bekkers & Wiepking, 2011) and volunteering (Musick & Wilson, 2008).

Likewise, more religious individuals are more likely to give and to volunteer (Koenig, McGue, Krueger, & Bouchard, 2007).

Moreover, education and religiosity are subject to *both* environmental and genetic influences. Research using classic twin designs demonstrates strong genetic influences on the level of education, typically around 50% or even higher (Polderman et al., 2015; Rietveld, 2013). A Genome Wide Association Study (GWAS) uncovered 74 Single Nucleotide Polymorphisms (SNPs) collectively explaining about 3% of the variance (Okbay et al., 2017). However, achievement in education is associated not only with intelligence and other traits that are genetically transmitted (Heckman, Stixrud, & Urzua, 2015), but also with variables such as parental support, teacher support, and community and peer influences that are likely to work through environmental effects (Downey, Von Hippel, & Broh, 2004). Likewise, there are genetic influences on religiosity, and these influences tend to become more pronounced after adolescence and young adulthood (D'Onofrio, Eaves, Murrelle, Maes, & Spilka, 1999; Koenig, McGue, Krueger, & Bouchard, 2005) but religiosity is also associated with environmental variables, such as partner influences, community influences, and national context (Kelley & De Graaf, 1997; Myers, 1996).

Unique environmental influences in MZ twins

The current study uses publicly available data on monozygotic twins from a US population survey (MIDUS, details below) in a *co-twin control study design* which allows us to examine the unique environmental influences of religion and education on prosocial behaviors. This approach to assessing unique environmental influences is based on the fact that at conception two MZ twins from the same pair share 100% of their genetic makeup with each other (Bruder, 2008). In

addition, MZ twins who are raised together share 100% of the common environmental influences. As a result, any differences between MZ twins from the same pair who were raised in the same environment must be due to unique environmental effects. The fixed effects model (Halaby, 2004) correlates deviation from the mean (i.e., differences with the siblings in the same pair) in one variable (e.g., prosociality) with deviations in other variables (e.g., measures of education and religion). We call our application of this model the *twin pair fixed effects model*, to denote that the characteristics common to the twin pair are fixed. This model is based on the logic of MZ twin discordance analysis (Pollin, Stabenau, & Tupin, 1965) or MZ twin differences (Caspi et al., 2004). We compare the results of these models with estimates from between effects models, which completely ignore the pair structure and allow genetic effects to influence the differences between twins, as in regular regression models applied to data obtained in random population samples. Our main results are derived from the data of MZ twins. While this analysis does not provide an estimate of the proportion of the total variance in prosocial behavior that is due to unique environmental effects, it does allow us to estimate to what extent the associations of prosocial behavior with measures of education and religiosity are due to unique environmental influences.

Results

Unique environmental effects of education and religion on prosocial behavior

A scatter plot of within-pair differences in the total amount donated and the frequency of church attendance among MZ twins (Figure 1) discordant for church attendance and the amount donated shows a strongly positive association ($r = .529$ ($n = 150$), $p < .000$). On average, the more

actively religious twin from an MZ pair donates about \$700 more per year than the less actively religious co-twin, with equal genetic endowments and shared environmental effects.

Figure 1. Scatterplot of intrapair differences in church attendance and the total amount donated to organizations among MZ twins discordant for church attendance and amount donated ($r = .529$, $n = 150$)

In contrast, the scatter plot among MZ twins who are discordant for education (Figure 2) shows that within-pair differences in the total amount donated and the level of education are

hardly associated ($r = .086$, ($n = 142$), $p = .310$). On average, the more highly educated twin from an MZ pair donates about \$130 more per year than the less highly educated co-twin, with equal genetic endowments and shared environmental effects. Thus, we conclude that the level of education is hardly associated with the amount donated when we effectively control for genetic endowments and shared environmental effects.

Figure 2. Scatterplot of intrapair differences in the level of education and the total amount donated to organizations among MZ twins ($r = .086$, $n = 142$)

*Table 1: Regressions of total amount donated and hours volunteered among monozygotic twins
(twin pair fixed effects models)*

	A. Total amount donated	B. Excluding donations to religion	C. Total hours volunteered	D. Excluding religious volunteering
Level of education	39.327	17.075	-1.195	-0.892
(SE)	(45.304)	(13.419)	(4.100)	(2.781)
Protestant	439.745*	44.126	-39.027*	-32.813*
(SE)	(208.457)	(61.746)	(18.866)	(12.798)
Other religion	394.436	-88.134	-60.217*	-55.931**
(SE)	(305.096)	(90.371)	(27.612)	(18.731)
Strength of religiosity	134.994	-36.817	25.167**	21.471**
(SE)	(106.122)	(31.434)	(9.605)	(6.515)
Church attendance	19.617***	2.378*	0.132	-0.065
(SE)	(3.553)	(1.052)	(0.322)	(0.218)
Constant	-232.314	-15.185	89.475**	63.190**
(SE)	(349.834)	(103.622)	(31.661)	(21.477)
n _i	680	680	680	680
R-Squared	0.164	0.039	0.043	0.058
n _j	340	340	340	340

* significant at 10%; ** significant at 5%; *** significant at 1%

This conclusion receives further support from the results of the twin pair fixed effects regression analyses. We find no significant relationship between the level of education and the amount donated and the number of hours volunteered (Table 1). The relationship with the frequency of church attendance with the amount donated, in contrast, is significant and sizeable: one additional church visit is associated with a \$20 increase in the amount donated per year. Protestants give \$440 more per year than their non-Protestant (i.e., Catholic or non-affiliated) twin siblings. More than 90% of that difference is due to donations to religious organizations. Excluding donations to religious organizations, we find no denominational differences in giving. Also we observe a much weaker positive relationship between church attendance and the amount donated, although more frequent church attendees still give more to charity – about \$2 per visit.

The weakly negative relationship with the level of education in the analysis of the number of hours volunteered (column C) is consistent with findings among New Zealand twins (Gibson, 2001). Consistent with previous research using another US dataset (Forbes & Zampelli, 2014), the analysis does show a strongly positive relationship of strength of religiosity with the number of hours volunteered. Protestants and those with another religion spend less time volunteering than the non-religious and Catholics. A one standard deviation increase in strength of religiosity is associated with a sizeable 25 hour increase in the number of hours volunteered per year. Similar estimates emerge from the analysis excluding religious volunteering (column D).

Table 2: Twin pair fixed effects reduced form regressions among MZ twins (Model 1) including additional controls (Model 2)

	A. Total amount donated		B. Excluding donations to religion		C. Total hours volunteered		D. Excluding religious volunteering	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Level of education	38.298	29.098	16.435	12.084	-1.210	-4.075	-0.926	-2.105
(SE)	(45.456)	(44.457)	(13.429)	(13.113)	(4.123)	(4.063)	(2.815)	(2.831)
Strength of religiosity	164.786	220.925*	-45.194	-26.807	20.280*	20.300*	16.890**	16.956**
(SE)	(103.269)	(101.869)	(30.509)	(30.047)	(9.368)	(9.309)	(6.396)	(6.487)
Church attendance	19.789***	18.205***	2.943**	2.376*	0.225	0.092	0.036	-0.019
(SE)	(3.366)	(3.298)	(0.994)	(0.973)	(0.305)	(0.301)	(0.208)	(0.210)
Social responsibility		106.861		18.401		5.779		3.118
(SE)		(71.779)		(21.172)		(6.560)		(4.571)
Prosocial role-identity		-91.207		-9.646		20.368***		7.879+
(SE)		(64.695)		(19.083)		(5.912)		(4.120)
Household income (\$k)		5.005***		1.124**		0.189+		0.081

(SE)		(1.184)		(0.349)		(0.108)		(0.075)
Assets (x \$1,000)		0.348		0.340**		0.062+		0.029
(SE)		(0.404)		(0.119)		(0.037)		(0.026)
Constant	72.274	353.636	-7.966	-18.074	57.835*	-63.905	35.618+	-11.970
(SE)	(319.304)	(470.588)	(94.333)	(138.805)	(28.964)	(43.005)	(19.776)	(29.968)
ni	680	680	680	680	680	680	680	680
R-Squared	0.152	0.218	0.031	0.108	0.025	0.087	0.028	0.051
nj	340	340	340	340	340	340	340	340

* significant at 10%; ** significant at 5%; *** significant at 1%

Additional analyses (Table 2) reveal that the associations are robust to exclusion of religious preference indicators and inclusion of indicators for social responsibility norms, prosocial self-identity and financial resources. The fact that a prosocial self-identity is strongly associated with the number of volunteer hours indicates that twins with a stronger prosocial self-identity are more active in volunteering. However, the inclusion of the additional variables does *not* reduce the coefficients for strength of religiosity nor the frequency of church attendance by much. This finding implies that prosocial self-identity does not explain why strength of religiosity is associated with volunteering. Neither does the measure of social responsibility norms explain the association with volunteering. Twins with higher household income and more valuable assets give more to charity than their siblings who are less well off financially. However, the association between financial resources and charitable giving does not explain why the higher educated give more, because twins with more education do not give more in the first place.

Discussion

We examined whether two classic “cultural” traits, religiosity and education, can account for unique environmental differences in prosociality among MZ twins. This new perspective suggests the importance of social influence with respect to prosociality. We find that education cannot account for these differences, but religiosity can. We suggest that religiosity is a strong environmental variable that can help explain differences among identical twins. A higher frequency of church attendance is associated with higher amounts donated, though to a lesser extent when contributions to religious organizations are excluded. An additional occasion of religious service attendance is associated with a \$20 increase in the amount donated to religion

and a \$2 increase in the amount donated to other causes. The strength of religiosity is positively associated with the number of hours volunteered for both religious and other organizations and the relationship is equally strong for both types of volunteering. We also observe denominational differences in charitable giving and volunteering due to unique environmental effects:

Protestants give more than Catholics (and the non-religious), primarily to religious causes.

The implications of the present findings for conventional theories on the association between religion and prosocial behavior are noteworthy. We tested two popular explanations for the association between religion and prosociality: social responsibility norms embedded in religious communities, and a prosocial self-identity (Wuthnow, 1991). In contrast to findings relying on random population samples (Bekkers & Schuyt, 2008) we find that the associations are not affected when we add controls for social responsibility norms and prosocial self-identity in our analyses. This implies that social norms and a prosocial self-identity do not explain unique environmental effects of religion on prosociality, and must be due to genetic and/or shared environmental effects.

So the puzzle remains: why do more religious twins give and volunteer more than their less religious siblings? One hypothesis is that religion affects prosociality through the formation of social networks of co-religionists (Wuthnow, 2002) through processes of selection and evocation (Buss, 1987). While the formation of social networks is likely to be rooted partly in genetic effects (Fowler, Dawes, & Christakis, 2009), social connections are also likely to explain some of the unique environmental effects of religiosity on prosociality. Image concerns (Tonin & Vlassopoulos, 2013) and direct and indirect reciprocity (Rand & Nowak, 2013) promote giving and volunteering in social networks, especially in public settings (Galen, 2012). A longitudinal

panel study mapping the formation and co-evolution of social networks, religiosity and opportunities for prosocial behavior is required to test this interpretation.

The level of education, however, does not seem to nurture some prosocial behaviors. The absence of associations between the level of education and prosocial behaviors in our analyses bears similarity to findings in research on the association between schooling and health. Positive associations between schooling and health emerging in analyses confounded by genetic effects disappear in twin pair fixed effects models (Fujiwara & Kawachi, 2009). Our findings imply that relationships between the level of education and prosocial behavior are due to genetic or shared environmental effects. Achieving a higher level of education is not a life event that is uniquely correlated with a change in people's environment such that a higher level of giving and volunteering emerges.

We interpret associations in genetically informed tests such as the one we conduct here as 'quasi-causal' (Eney, Tsang, Delaney, Turkheimer, & Duncan, 2017). The association between religiosity and prosocial behavior could very well reflect a process of mutual reinforcement. Religion may encourage volunteering, and volunteering may encourage church attendance and religiosity, for instance when volunteers draw co-volunteers to their churches (Musick & Wilson, 2008). We suggest that longitudinal analyses of changes in religiosity and prosocial behavior be conducted to shed light on this possibility.

Through genome-wide association studies (GWAS), vast investments in the search for genetic effects on social outcomes have yielded evidence on specific polymorphisms, each explaining a small proportion of the variance (Okbay et al., 2017). The current study shows the feasibility of another strategy, demonstrating that twin pair fixed effects models can be used to study unique environmental effects of education and religion. Given that education and religion

explain large proportions of variance than specific SNPs, and their ubiquity as correlates of outcomes commonly studied in the social sciences, such as political participation, subjective wellbeing, and trust, twin pair fixed effects models are a promising design to examine unique environmental influences on these outcomes.

Materials and Methods

Participants in this study were respondents to the first wave of the MIDUS survey, funded by the MacArthur Foundation (Brim, 2007). The first survey (M1) was fielded in 1995/1996 among a sample of US twins in addition to a nationally representative sample, both selected through random digit dialing. A second survey (M2) was fielded in 2004-2006. The analyses reported here rely exclusively on the M1 data, because several key variables were not included in the M2 wave.

Twins were identified in the recruitment procedure for the initial survey through a screening question among 50,000 potential respondents within the MIDUS sampling frame: the English-speaking, non-institutionalized US population ages 25–74 with telephones. In 14.8% of the cases potential respondents reported the presence of a twin in the family, i.e. either the potential respondents themselves, their spouse/partner, sibling, child, or parent. After permission to contact the twins was obtained (in about 60% of the cases), the twins were invited to participate for whom phone numbers were obtained from the potential respondents. Only English-speaking respondents aged 25-74 living in the US who were physically and mentally able to complete the interview were allowed to participate. The strict eligibility criteria, missing phone numbers of (co-)twins and refusals to participate more than halved the resulting sample to 1,914 twins.

Zygoty was determined using self-reports of similarity in hair and eye color, complexion, confusion by peers, doctor's assessments and results of tests of zygoty. 25 respondents for whom zygoty could not be determined are excluded from the analyses.

Data on twins were used only for complete twin pairs; data from triplets, quadruplets etc. (n = 65) and data from incomplete pairs (n = 60) were excluded from the analyses. Ten

respondents classified as same sex (DZ) twins but self-reporting different sex were excluded. Also five twin pairs classified with different zygosity were excluded. The resulting sample of twins includes 340 MZ pairs ($n = 680$) and 294 DZ pairs ($n = 588$). Analyses reported in the paper are based on monozygotic (MZ) twin pairs only. Some of the analyses in the Supplemental Information also include same sex dizygotic (DZ) twins.

Data Availability

The MIDUS data that support the findings of this study can be downloaded from the ICPSR, at <http://www.icpsr.umich.edu/icpsrweb/ICPSR/series/203/studies/2760?archive=ICPSR&sortBy=7>. The code used to obtain the results is posted at <https://osf.io/ujhpm/>.

Measures

Descriptive statistics of the measures used in the current study are presented in Supplementary Information (Table S1). To mitigate the potential influence of outliers all dependent variables in the analyses were winsorized. Analyses of the non-winsorized variables reported in Table S12 and S13 of the Supplementary Online Materials yield qualitatively similar results.

Donations. Donations to organizations were measured with the following question: “On average, about how many dollars per month do you or your family living with you contribute to each of the following people or organizations? If you contribute food, clothing, or other goods, include their dollar value. (If none, enter "0".)” After this introduction, donations to three categories of organizations were measured: (1) to religious groups; (2) to political organizations or causes; (3) to any other organizations, causes, or charities (including donations made through monthly payroll deductions)? Amounts donated per month were multiplied by 12 to obtain the

total amount donated per year. The sum of these contributions is the variable for the total amount donated to organizations. A separate variable was created excluding donations to religion to see if the relationship between religion and philanthropy would also hold for donations to other causes. To reduce the influence of outliers, all amounts are winsorized, setting the 1% highest values to the value of the 99th percentile, \$7,380 for the total amount donated, \$2,400 for the amount donated to organizations other than religion.

Volunteering. The questions on volunteering asked about four types of formal volunteer work: ‘hospital, nursing home, or other health care-oriented work’, ‘school or other youth-related volunteer work’, ‘volunteer work for political organizations or causes’, and ‘volunteer work for any other organization, cause or charity’. While these questions did not explicitly identify religious organizations, respondents could report volunteering for religious organizations in the question about any ‘other’ organizations. A separate variable was created excluding potentially religious volunteering by computing the sum of hours volunteered in the first three types. To reduce the influence of outliers, numbers of hours volunteered are winsorized, setting the 1% highest values to the value of the 99th percentile, 660 hours for total hours volunteered and 480 hours for hours volunteered for health, education, and politics.

Level of education was reported by the respondents in twelve categories, ranging from 1 (no school/some grade school) to 12 (postdoctoral degree).

Religious affiliation was self-reported in response to a question ‘What is your religious preference?’ A very detailed set of response categories was offered; recoded here to four groups: protestant; catholic; other religious preference (including Jewish, Buddhist, Hindu, Muslim, and other preferences); the reference category was formed by non-religious respondents (indicating ‘no religious preference’, ‘agnostic’, or ‘atheist’).

Frequency of church attendance was measured in M1 with the question “How often do you usually attend religious or spiritual services?” and in M2 with the question “Within your religious or spiritual tradition, how often do you: attend religious or spiritual services?” Responses were recoded such that a frequency of church attendance per year was obtained (‘never’ = 0; ‘less than once per month’ = 5; ‘1-3 times per month’ = 20; ‘once a week’ = 50; ‘more than once a week’ = 75).

Strength of religiosity was measured with eight questions on a 0 (not at all) to 3 (very) scale: ‘how religious are you?’, ‘how spiritual are you?’, ‘how important is religion in your life?’, ‘how important is spirituality in your life?’, ‘how important is it for you--or would it be if you had children now--to send your children for religious or spiritual services or instruction?’, ‘how closely do you identify with being a member of your religious group?’, ‘how much do you prefer to be with other people who are the same religion as you?’ and ‘how important do you think it is for people of your religion to marry other people who are the same religion?’. Cronbach’s alpha coefficient of reliability for the scale was .90 in M1 and .91 in M2.

Social responsibility norms was a factor score composed of responses to the following question in M1 (the question was not repeated in M2). “Here is a list of hypothetical situations. Please rate how much obligation you would feel if they happened to you, using a 0 to 10 scale where 0 means ‘no obligation at all’ and 10 means ‘a very great obligation.’ If the situation does not apply to you, please think about how much obligation you would feel if you were in this situation.” From the variety of situations, those involving contributions to public benefit were selected as a measure of social responsibility norms: “To pay more for your health care so that everyone had access to health care”, “To volunteer time or money to social causes you support”,

“To collect contributions for heart or cancer research if asked to do so”, and “To vote for a law that would help others worse off than you but would increase your taxes”. The reliability is .80.

Prosocial self-identity is measured in M1 and M2 with the response on a 1 (disagree strongly) to 7 (agree strongly) response to the question “People would describe me as a giving person, willing to share my time with others.”

Household income is the sum of all sources of income (personal earnings income, social security retirement benefits, government assistance programs, pensions, investments, child support, or alimony) of household members (the respondent, spouse/partner and other household members) in the 12 months preceding the interview. Incomes exceeding \$300k (M1: 1.2%; M2: 1.4%) are capped. Small proportions of respondents (M1: 2.1%; M2: 4.4%) reported zero income. For sizeable minorities of respondents (M1: 10.7%; M2: 17.5%) total household income was missing due missing values on income components. The total amount was divided by 1,000 to obtain a measure in thousands of dollars.

Assets is the total net worth of the respondent and spouse or partner measured by the following question: “Suppose you (and your spouse or partner) cashed in all your checking and savings accounts, stocks and bonds, real estate, sold your home, your vehicles, and all your valuable possessions. Then suppose you put that money toward paying off your mortgage and all your other loans, debts, and credit cards. Would you have any money left over after paying your debts or would you still owe money?” with response options ‘would have money left over’, ‘would still owe money’, ‘debts would just about equal assets’; and a follow-up question “How much would that be (that you had left over, or would owe)? Again, please write down the correct letter from the list on the previous page. (Your best estimate is fine. If your debts would just about equal your assets, enter "B - \$0/none".)” Assets exceeding \$1m were capped; substantial

minorities of respondents (M1: 16.2%; M2: 20.8%) refused to answer this question or had missing values. Original amounts reported in hundreds of dollars were divided by 10 to obtain a measure in thousands of dollars.

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Supplementary Online Materials

An extensive set of additional analyses providing evidence for the validity of assumptions underlying the analyses presented above, responses to common criticisms and robustness checks is presented in the Supplementary Online Materials, available at <https://osf.io/ujhpm/> along with the code producing these results.

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Supplementary Online Materials

The tables and figures below provide empirical evidence supporting two assumptions of the analyses reported in the main text as well as a series of robustness checks.

Table S1: *Descriptive statistics and discordance among twins*

Table S2: *Correlations and sources of variance in education, religion and prosocial behaviors among MZ and same-sex DZ twins*

Figure S1. *Levels of prosocial behavior by the level of education*

Figure S2. *Levels of prosocial behavior by the frequency of church attendance*

Figure S3. *Scatterplot of intrapair differences in church attendance and the total amount donated to organizations among MZ twins*

Figure S4. *Scatterplot of intrapair differences in the level of education and the total amount donated to organizations among MZ twins*

Figure S5. *Scatterplot of intrapair differences in the level of education and church attendance among MZ twins discordant for education and church attendance*

Figure S6. *Scatterplot of intrapair differences in the level of education and strength of religiosity among MZ twins discordant for education and religiosity*

Table S3. *Between effects regressions of total amount donated among MZ twins*

Table S4. *Between effects regressions among MZ twins including mediators*

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Table S7. *Twin pair fixed effects regressions among MZ twins of religion on non-linear education variables*

Table S8. *Twin pair fixed effects regressions among MZ twins of total donations on education and religiosity indicators entered in separate models*

Table S9. *Twin pair fixed effects regressions among MZ twins of donations to causes other than religion on education and religiosity indicators entered in separate models*

Table S10. *Twin pair fixed effects regressions among MZ twins of hours volunteered on education and religiosity indicators entered in separate models*

Table S11. *Twin pair fixed effects regressions among MZ twins of hours volunteered in organizations other than religion on education and religiosity indicators*

Table S12. *Twin pair fixed effects regressions among MZ twins with non-winsorized dependent variables*

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Higher educated and more religious twins report more prosocial behavior

A first assumption that is important to the present analytical strategy is that bivariate relationships between prosocial behaviors, the level of education and religiosity are positive. As in previous research, we find positive relationships in the MIDUS data between the level of education, the frequency of church attendance and donating money to organizations and hours volunteered. Figure S1 presents data from both MZ and DZ twins: histograms of the dollar amounts spent on donations to organizations (panel A), and the number of hours spent volunteering (panel B). Twins with a PhD donate on average \$1,544 per year; almost six times the amount donated by twins who left school after eighth grade or in junior high school (\$267). The highest amounts are donated by twins holding a master's degree (\$1,876). The number of hours volunteered per year also increases with the level of education, with those holding a master's degree spending 99 hours, more than double the number of hours spent by twins who left school after eighth grade or in junior high school (43). We see roughly the same pattern in Figures S1C and S1D in which donations to religion and hours volunteered for religious organizations are excluded. Figures S2A and S2B plot the average amount donated to organizations and hours volunteered by the frequency of church attendance. Both are positively related to the frequency of church attendance. The amount donated increases almost tenfold from no church attendance (\$198) to more than weekly attendance (\$1,942). The number of hours volunteered increases more than fourfold (from 22 to 94). Figures S2C and S2D show that the differences in the amounts donated and hours volunteered for organizations other than religion are less dramatic, but still markedly positive. Results from regression analyses (see Table S3) confirm that higher educated individuals give higher amounts of financial donations and

volunteer more. Protestants and more frequent church attendees report higher donations and twins with a higher strength of religiosity report more volunteer hours.

Most of the variance in prosocial behavior is due to unique environmental effects

A second assumption is that there are unique environmental effects. Inspection of co-twin cross-tables shows considerable variance among twins from the same twin pair in the level of education, religiosity, and prosocial behavior (Table S1). The results imply that MZ twins are certainly not identical in terms of their prosocial behavior and its correlates. Among pairs of MZ twins, 45% report exactly the same level of education. In other words: 55% of MZ twins report a different level of education; they are discordant with respect to this characteristic. Among DZ twins the concordance level is 36%. The higher level of concordance among MZ twins than among DZ twins suggests the presence of genetic effects on educational achievement. Exactly half of MZ twins report the same religious affiliation; among DZ twins concordance reaches almost the same level (48%). While MZ twins are more alike than DZ twins in all of the characteristics investigated here, the minimal difference in religious affiliation suggests that genetic effects on this characteristic are small. We also computed discordance statistics for the other variables in the analyses. For ordinal variables with many potential values such as the strength of religiosity factor score or the amount donated we computed the proportion of twins from the same pair with a score in the same quintile as their sibling.

While precise estimates of the magnitude of unique environmental effects are difficult to obtain, biometric models reported in previous research strongly suggest that unique environmental effects on education, religion, and prosocial behaviors are indeed substantial (D'Onofrio, Eaves, Murrelle, Maes, & Spilka, 1999; Dawes, Settle, Loewen, McGue, & Iacono,

2015; Koenig, McGue, Krueger, & Bouchard, 2007; Polderman et al., 2015; Son & Wilson, 2010). Falconer's formula gives a crude approximation of the proportion of variance explained by additive genetic effects (a^2), shared environmental (c^2) and unique environmental effects (e^2). When applied to all twin data (MZ as well as DZ twins) in MIDUS we find unique environmental effects ranging from .30 to .87 and shared environmental effects ranging from .00 to .59 (Table S2). Additive genetic effects are far from unity for all of the characteristics investigated. Additive genetic effects account for 26% of the variance in the level of education, and 41% of the variance in the strength of religiosity. Most of the variance in prosocial behavior is due to unique environmental effects. These estimates are similar to a previous study using experimental methods in Sweden (Cesarini et al., 2009).

Thus, we conclude that there is strong support relevant to two assumptions of the analytical approach.

Table S1: Descriptive statistics and discordance among twins

	Means		Discordance	
	MZ	DZ	MZ	DZ
Female (0-1)	53.24	62.22	0.0	0.0
Age (25-75)	44.17	45.43	3.2	4.8
Protestant (0-1)	59.56	59.35	21.5	24.1
Catholic (0-1)	20.44	22.96	9.7	12.6
Other religion (0-1)	9.70	9.18	10.6	12.9
Frequency of church attendance per year (0-75)	25.38	27.11	58.2	68.7
Strength of religiosity (factor score / Q)	-.06	.07	60.3	69.0
Level of education (1-12)	6.80	6.38	53.5	63.3
Amount donated (\$, Q)	858.71	860.24	74.7	75.9
Amount donated (winsorized, Q)	825.09	817.69	55.6	59.2
Amount donated other than religion (\$, Q)	195.76	233.69	57.6	60.5
Amount donated other than religion (winsorized, Q)	181.20	191.76	48.2	51.4
Hours volunteered (Q)	58.09	58.65	55.6	55.1
Hours volunteered (winsorized, Q)	54.11	54.51	45.3	45.9
Hours volunteered other than religion (Q)	31.78	34.65	36.2	41.8
Hours volunteered other than religion (winsorized, Q)	29.24	29.01	27.6	35.4
Social responsibility (Q)	-.05	.05	67.9	72.4
Prosocial role-identity (1-7)	5.76	5.62	53.5	64.6
Household income (x \$ 1,000 / Q)	70.40	62.59	65.3	70.4
Assets (x \$ 1,000 / Q)	106.15	76.39	59.1	67.7

Table S2: Correlation and sources of variance in education, religion and prosocial behaviors among monozygotic and same-sex dizygotic twins

	Correlations		Variance components ^a		
	MZ	DZ	a^2	c^2	e^2
Level of education	.689	.558	.262	.427	.311
Protestant	.554	.504	.100	.454	.446
Catholic	.702	.645	.114	.588	.298
Other religion	.397	.229	.336	.061	.603
Strength of religiosity	.599	.393	.412	.187	.401
Frequency of church attendance	.475	.376	.198	.277	.525
Social responsibility	.287	.258	.058	.229	.713
Prosocial role-identity	.171	.061	.230	.000	.870
Household income	.341	.289	.104	.237	.659
Assets	.370	.254	.232	.138	.630
Total amount donated	.385	.286	.198	.187	.615
Amount donated other than religion	.259	.168	.182	.077	.741
Hours volunteered	.259	.178	.162	.097	.741
Hours volunteered other than religion	.256	.167	.178	.078	.744

^a Entries computed with Falconer's formulas, $a^2 = 2 (r_{MZ} - r_{DZ})$; $c^2 = 2 r_{DZ} - r_{MZ}$; and $e^2 = 1 - r_{MZ}$.

Figure S1. Levels of prosocial behavior by the level of education

C. Amount donated excluding religion

D. Hours volunteered excluding religion

Figure S2. Levels of prosocial behavior by the frequency of church attendance

C. Amount donated excluding religion

D. Hours volunteered excluding religion

The analysis among twins who are discordant with respect to church attendance reported in Figure 2 of the paper omits pairs reporting the same frequency of church attendance, because only the pairs reporting different frequencies of church attendance can contribute variance in the fixed effects model. Figure S1 shows that the correlation is smaller when including all twin pairs with a difference of 0, but still positive.

Figure S3. Scatterplot of intrapair differences in church attendance and the total amount donated to organizations among MZ twins ($r = .380$, $n = 340$)

Figure S4. Scatterplot of intrapair differences in the level of education and the total amount donated to organizations among MZ twins ($r = .062$, $n = 340$)

Figure S5. Scatterplot of intrapair differences in the level of education and church attendance among MZ twins discordant for education and church attendance ($r = .098$, $n = 109$, $p = .313$)

Figure S5 shows that more highly educated twins are not much more actively religious than less highly educated twins. The correlation among all MZ twins ($n = 340$) is $.053$ ($p = .333$).

Figure S6 shows that the strength of religiosity of more highly educated twins is equal to the religiosity of their less highly educated twin siblings. The correlation among all MZ twins ($n = 340$) is $.006$ ($p = .906$).

Figure S6. Scatterplot of intrapair differences in the level of education and strength of religiosity among MZ twins discordant for education and religiosity ($r = .021$, $n = 107$, $p = .832$)

Table S3: Regressions of total amount donated among monozygotic twins (between effects models)

	Total amount donated	Excluding donations to religion	Total hours volunteered	Excluding religious volunteering
Level of education	162.527***	48.275***	9.816***	6.217***
(SE)	(27.338)	(7.335)	(2.289)	(1.582)
Protestant	482.391**	68.311+	4.110	-0.800
(SE)	(145.762)	(39.110)	(12.204)	(8.435)
Other religion	158.279	39.810	-35.117	-15.610
(SE)	(255.722)	(68.615)	(21.411)	(14.799)
Strength of religiosity	35.969	-16.625	14.778+	10.950+
(SE)	(96.474)	(25.886)	(8.077)	(5.583)
Church attendance	21.007***	0.419	0.250	-0.129
(SE)	(3.679)	(0.987)	(0.308)	(0.213)
Constant	-1,113.916***	-203.316**	-17.148	-7.127
(SE)	(230.866)	(61.945)	(19.329)	(13.360)
n _i	680	680	680	680
R-Squared	0.305	0.128	0.098	0.055
n _j	340	340	340	340

* significant at 10%, ** significant at 5%, *** significant at 1%

The between regression model estimates whether twins with a higher score on the level of education or religiosity report more prosocial behavior. The estimates show that this is the case.

Table S4 shows that social responsibility norms are strongly predictive of the number of volunteer hours in the between effects model among MZ twins, while this was not the case in the fixed effects model. Other noteworthy differences between the between-effects estimates in Table S4 and the fixed effects estimates in Table S2 appear in the relationship between the level of education and the amount donated as well as the number of volunteer hours. These relationships are strong and retain significance in the between-effects specification when additional variables are included in Model 2, but they are much weaker in model 2 than in model 1. In the fixed-effects models, however, the relationships are not changing much. This pattern suggests that the mediation by household income and the value of assets in the analysis of donations and the mediation by prosocial role-identity and social responsibility in the number of volunteer hours is due to genetic effects on these variables and to genetic effects on other variables not measured here, but not due to unique environmental factors.

Table S4: Between effects reduced form regression coefficients of donations and volunteering (Model 1) among MZ twins including mediators (Model 2)

	Donations		Excluding donations to religion		Volunteer hours		Excluding religious volunteering	
Level of education	165.880***	99.270**	49.975***	31.327**	9.609***	7.386**	6.157***	4.709**
(SE)	(31.971)	(32.690)	(9.829)	(10.245)	(2.290)	(2.420)	(1.577)	(1.663)
Strength of religiosity	109.815	243.193*	-32.964	-7.277	11.832	4.019	9.442+	3.441
(SE)	(107.590)	(109.316)	(33.076)	(34.261)	(7.707)	(8.093)	(5.307)	(5.561)
Church attendance	22.021***	17.576***	0.809	0.015	0.422	0.505+	-0.060	0.025
(SE)	(4.116)	(4.006)	(1.265)	(1.255)	(0.295)	(0.297)	(0.203)	(0.204)
Social responsibility		-86.031		21.629		16.331*		12.858**
(SE)		(85.603)		(26.829)		(6.337)		(4.355)
Prosocial role-identity		3.445		-32.503		15.686*		10.061*
(SE)		(87.333)		(27.372)		(6.465)		(4.443)
Household income (\$k)		5.039***		1.320**		0.145		0.120+

(SE)		(1.422)		(0.446)		(0.105)		(0.072)
Assets (x \$1,000)		1.599***		0.375**		0.006		-0.014
(SE)		(0.406)		(0.127)		(0.030)		(0.021)
Constant	-821.764***	-797.494	-166.637*	49.597	-21.245	-	-10.565	-71.340*
(SE)	(233.488)	(581.986)	(71.781)	(182.404)	(16.725)	115.042** (43.085)	(11.517)	(29.608)
ni	680	680	680	680	680	680	680	680
R-Square	0.243	0.328	0.084	0.155	0.088	0.135	0.052	0.105
nj	340	340	340	340	340	340	340	340

* significant at 10%; ** significant at 5%; *** significant at 1%

Model specification robustness checks

Linearity of education. In the main analyses we have estimated linear specifications because the average amounts donated and hours volunteered (Figure S1) show almost linear associations with the level of education. We conducted additional analyses checking whether schooling may have non-linear associations with prosocial behavior (Table S5), as seems to be the case for health outcomes (Lundborg, 2013). We find no substantial deviations from linearity. The analysis in the first column shows that twins who graduated from college – the reference category in the analysis – seem to give higher amounts than their siblings who left education after high school, but the differences are not statistically significant. The analysis in the second column shows that twins who graduated from college give somewhat higher amounts to causes other than religion than their siblings who entered college but did not graduate, but again the differences are not sizeable. For the number of volunteer hours the trends are negative and fairly linear: twins who graduated from college tend to volunteer fewer hours than their siblings with shorter careers in education. However, as in the main analyses, none of the differences are substantial, nor significant.

Table S5: Twin pair fixed effects regressions among MZ twins of prosocial behaviors including non-linear education variables (reference category: college or higher)

	Total amount donated	Excluding religion	Total hours volunteered	Excluding religion
Grade school	-183.787	-147.036	20.237	34.622
(SE)	(445.539)	(132.060)	(40.431)	(27.372)
High school	-411.122	-118.714	9.844	13.447
(SE)	(282.352)	(83.691)	(25.623)	(17.347)
Some college	-346.882	-124.070+	8.070	9.588
(SE)	(239.670)	(71.040)	(21.749)	(14.724)
Protestant	451.696*	50.221	-39.591*	-33.694**
(SE)	(208.971)	(61.940)	(18.964)	(12.838)
Other religion	407.857	-81.666	-60.755*	-56.630**
(SE)	(305.231)	(90.472)	(27.699)	(18.752)
Strength of religiosity	134.471	-37.102	25.209**	21.503**
(SE)	(106.105)	(31.450)	(9.629)	(6.519)
Church attendance	19.786***	2.450*	0.128	-0.066
(SE)	(3.546)	(1.051)	(0.322)	(0.218)
Constant	280.696	182.994*	74.780***	48.166**
(SE)	(241.860)	(71.689)	(21.948)	(14.859)
n _i	680	680	680	680
R-Square	0.169	0.043	0.043	0.062
n _j	340	340	340	340

* significant at 10%; ** significant at 5%; *** significant at 1%

Table S6: Twin pair fixed effects regressions among MZ twins of log-transformed variables for amounts donated and hours volunteered

	Donations		Excluding donations to religion		Volunteer hours		Excluding religious volunteering	
Level of education	0.105	0.124	0.110	0.125	0.081	0.054	0.086	0.076
(SE)	(0.108)	(0.106)	(0.100)	(0.100)	(0.078)	(0.077)	(0.064)	(0.063)
Protestant	0.469	0.469	0.660	0.674	-0.442	-0.416	-0.428	-0.420
(SE)	(0.505)	(0.490)	(0.468)	(0.460)	(0.363)	(0.356)	(0.297)	(0.293)
Other religion	-0.884	0.416	-1.023	-0.081	-0.264	0.168	-0.711	-0.396
(SE)	(0.743)	(0.804)	(0.688)	(0.756)	(0.534)	(0.585)	(0.437)	(0.481)
Strength of religiosity	0.245	0.356	-0.144	-0.068	0.079	0.005	0.245+	0.212
(SE)	(0.252)	(0.249)	(0.234)	(0.234)	(0.181)	(0.181)	(0.148)	(0.149)
Church attendance (ln)	0.667***	0.603***	0.062	0.016	0.387***	0.395***	0.157+	0.157+
(SE)	(0.148)	(0.144)	(0.137)	(0.136)	(0.106)	(0.105)	(0.087)	(0.086)
Social responsibility		0.340*		0.249		0.304*		0.283**
(SE)		(0.171)		(0.161)		(0.124)		(0.102)

Prosocial role-identity		-0.293+		-0.207		0.233*		0.053
(SE)		(0.156)		(0.147)		(0.114)		(0.093)
Household income (ln)		0.588***		0.377**		0.036		0.068
(SE)		(0.146)		(0.137)		(0.106)		(0.087)
Assets (ln)		0.034		0.096		0.150*		0.095+
(SE)		(0.094)		(0.089)		(0.069)		(0.056)
Constant	1.448+	0.924	1.157	0.699	0.578	-1.306	0.474	-0.329
(SE)	(0.868)	(1.302)	(0.804)	(1.223)	(0.624)	(0.947)	(0.510)	(0.778)
<hr/>								
n _i	680	680	680	680	680	680	680	680
R-Square	0.142	0.204	0.035	0.079	0.065	0.111	0.049	0.087
n _j	340	340	340	340	340	340	340	340

* significant at 10%; ** significant at 5%; *** significant at 1%

The log-log specification allows for an interpretation of relative changes, e.g. the .67 coefficient for the logged value of church attendance in model 1 indicates that a 10% increase in church attendance is associated with a 6.7% increase in amounts donated.

Linearity of prosociality. Re-analysis of the models reported in Table S2 using log-transformed values of the dependent variables (Table S6) does not reveal non-linear patterns for charitable giving and volunteering. The relationship of the level of education with hours volunteered is positive in this specification, but not significant. Other noteworthy differences between the results in Table S6 and Table S2 are that social responsibility shows stronger relationships with the log-transformed amounts donated and hours volunteered than with their non-transformed values, that the value of assets has a weaker relationship with amounts donated and hours volunteered, and church attendance has a more pronounced relationship with hours volunteered at the expense of strength of religiosity.

Table S7. *Twin pair fixed fixed effects regressions among MZ twins of religion on non-linear education variables (reference category: college or higher)*

	Church attendance		Strength of religiosity	
Grade school		19.765		-1.147
(SE)		(28.760)		(0.934)
High school		20.000		-1.156
(SE)		(27.923)		(0.907)
Some college		21.000		-1.114
(SE)		(28.147)		(0.914)
Level of education	0.813		0.002	
(SE)	(0.831)		(0.027)	
Constant	19.844***	5.067	-0.074	1.087
	(5.700)	(28.000)	(0.186)	(0.910)
ni	680	680	680	680
R-Square	0.003	0.002	0.000	0.006
nj	340	340	340	340

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

The results reported in Table S7 show that twins from the same pair with different levels of education have similar levels of church attendance and religiosity: none of the education indicators is related to church attendance or religiosity.

Table S8. *Twin pair fixed effects regressions among MZ twins of total donations on education and religiosity indicators entered in separate models*

	1	2	3	4	5	6
Grade school	-117.694	-178.834				
(SE)	(481.110)	(443.230)				
High school	-368.862	-405.480				
(SE)	(301.480)	(277.568)				
Some college	-277.220	-343.269				
(SE)	(257.581)	(237.409)				
Protestant		451.778*	437.132*			
(SE)		(208.968)	(208.359)			
Other religion		410.306	398.335			
(SE)		(305.261)	(304.951)			
Strength of religiosity		131.491	132.499			
(SE)		(106.112)	(106.045)			
Church attendance		19.869***	19.813***			22.452***
(SE)		(3.546)	(3.545)			(2.968)
Level of education					54.735	
(SE)					(49.056)	
Constant	1,042.164***	274.206	31.210		452.813	255.364**
(SE)	(192.410)	(238.616)	(173.802)		(336.605)	(85.866)
n _i	680	680	680		680	680
R-Square	0.006	0.169	0.162		0.004	0.144
n _j	340	340	340		340	340

Standard errors in parentheses; *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table S9. *Twin pair fixed effects regressions among MZ twins of donations to causes other than religion on education and religiosity indicators entered in separate models*

	1	2	3	4	5	6
Grade school	-139.336	-146.266				
(SE)	(132.728)	(131.371)				
High school	-112.814	-117.843				
(SE)	(83.172)	(82.270)				
Some college	-117.960+	-123.503+				
(SE)	(71.061)	(70.367)				
Protestant		50.270	42.992	53.142		
(SE)		(61.937)	(61.796)	(62.053)		
Other religion		-80.938	-86.441	-139.018		
(SE)		(90.478)	(90.444)	(88.197)		
Strength of religiosity		-37.967	-37.900	-1.298		
(SE)		(31.451)	(31.451)	(27.477)		
Church attendance		2.474*	2.463*			2.307**
(SE)		(1.051)	(1.051)			(0.878)
Level of education					18.735	
(SE)					(13.540)	
Constant	264.799***	181.541*	99.229+	162.965***	53.777	122.672***
(SE)	(53.082)	(70.724)	(51.547)	(44.073)	(92.905)	(25.390)
n _i	680	680	680	680	680	680
R-Square	0.008	0.043	0.034	0.018	0.006	0.020
n _j	340	340	340	340	340	340

Standard errors in parentheses; *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table S10. *Twin pair fixed effects regressions among MZ twins of hours volunteered on education and religiosity indicators entered in separate models*

	1	2	3	4	5	6
Grade school	15.850	20.729				
(SE)	(40.797)	(40.221)				
High school	7.766	10.411				
(SE)	(25.565)	(25.188)				
Some college	6.670	8.425				
(SE)	(21.842)	(21.544)				
Protestant		-39.616*	-38.948*	-38.428*		
(SE)		(18.963)	(18.839)	(18.769)		
Other religion		-60.832*	-60.335*	-63.029*		
(SE)		(27.701)	(27.572)	(26.676)		
Strength of religiosity		25.284**	25.243**	27.119**		
(SE)		(9.629)	(9.588)	(8.311)		
Church attendance		0.126	0.126			0.532*
(SE)		(0.322)	(0.320)			(0.270)
Level of education					-0.985	
(SE)					(4.157)	
Constant	48.456**	74.545***	81.464***	84.730***	60.807*	40.600***
(SE)	(16.316)	(21.653)	(15.714)	(13.330)	(28.522)	(7.807)
n _i	680	680	680	680	680	680
R-Square	0.001	0.043	0.042	0.042	0.000	0.011
n _j	340	340	340	340	340	340

Standard errors in parentheses; *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table S11. *Twin pair fixed effects regressions among MZ twins of hours volunteered in organizations other than religion on education and religiosity indicators*

	1	2	3	4	5	6
Grade school	30.795	34.997				
(SE)	(27.849)	(27.229)				
High school	11.521	13.879				
(SE)	(17.451)	(17.052)				
Some college	8.131	9.858				
(SE)	(14.910)	(14.585)				
Protestant		-33.717**	-32.754*	-33.038**		
(SE)		(12.837)	(12.779)	(12.731)		
Other religion		-56.727**	-56.020**	-54.546**		
(SE)		(18.753)	(18.704)	(18.095)		
Strength of religiosity		21.603**	21.528**	20.502***		
(SE)		(6.519)	(6.504)	(5.637)		
Church attendance		-0.069	-0.069			0.293
(SE)		(0.218)	(0.217)			(0.185)
Level of education					-0.861	
(SE)					(2.842)	
Constant	20.995+	48.035**	57.215***	55.429***	35.095+	21.813***
(SE)	(11.138)	(14.659)	(10.660)	(9.042)	(19.499)	(5.349)
n _i	680	680	680	680	680	680
R-Square	0.001	0.043	0.042	0.042	0.000	0.011
n _j	340	340	340	340	340	340

Standard errors in parentheses; *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Two common criticisms of the twin fixed effects model (Bound & Solon, 1999; Galama, Lleras-Muney, & Van Kippersluis, 2018; Madsen & Osler, 2009) are:

1. Measurement error reduces the power of the statistical analysis such that coefficients that may be lose significance. This suggestion implies that significance levels of the estimated coefficients are greatly reduced not because the point estimates are smaller in fixed effects models, but because the standard errors of the estimates increase. Comparison of the estimates in Table S3 with the estimates in Table 1 shows that this argument cannot explain our findings. While the standard errors of the coefficients in the fixed effects models are indeed larger than in between effects models for some variables (e.g. for level of education). A case in point is the standard error for the level of education. In the fixed effects model of the total amount donated, the standard error (45.304) is 65% larger than in the between effects model (27.338). However, the main reason why the coefficient for the level of education becomes non-significant in the fixed effects model is simply that the coefficient is greatly reduced, by more than 75%, from 162.257 in the between effects model to 39.327 in the fixed effects model. If only the standard error had increased, the coefficient would still be significant. This does not only hold for the coefficient for the level of education in the regression of amounts donated, but also for hours volunteered. In contrast, the coefficients for the strength of religiosity in the between effects model of hours volunteered are much larger in the fixed effects model (32.960) than in the between effects model (14.778). At the same time, we see the familiar pattern of somewhat larger standard errors in the fixed effects model (11.818) than in the between effects model (8.077). We also see this pattern in the standard errors for the frequency of church

attendance and Protestant affiliation, while the coefficients are quite similar in the fixed effects and between effects models.

2. Estimates from fixed effects models do not reflect causal effects. We agree with this criticism. Differences in education and religion among twins in midlife may be associated with differences in birthweight and even with differences in prenatal circumstances. Our question, however, is not whether education or religion have certain effects, but whether these variables help to understand unique environmental effects.

Table S12. *Twin pair fixed effects regressions among MZ twins with non-winsorized dependent variables*

	A. Total amount donated	B. Excluding donations to religion	C. Total hours volunteered	D. Excluding religious volunteering
Level of education	55.946	30.702	-2.603	-2.239
(SE)	(54.545)	(20.244)	(5.497)	(3.546)
Protestant	414.960+	52.496	-44.414+	-44.238**
(SE)	(250.979)	(93.148)	(25.293)	(16.315)
Other religion	442.398	-130.060	-70.698+	-72.842**
(SE)	(367.331)	(136.331)	(37.018)	(23.879)
Strength of religiosity	144.050	-45.617	30.871*	32.412***
(SE)	(127.770)	(47.420)	(12.876)	(8.306)
Church attendance	22.826***	3.190*	-0.124	-0.310
(SE)	(4.278)	(1.588)	(0.431)	(0.278)
Constant	-382.515	-115.354	114.111**	90.222**
(SE)	(421.195)	(156.322)	(42.446)	(27.380)
n _i	680	680	680	680
R-Squared	0.147	0.034	0.029	0.066
n _j	340	340	340	340

* significant at 10%; ** significant at 5%; *** significant at 1%

Table S13: Twin pair fixed effects reduced form regressions among MZ twins (Model 1) including additional controls (Model 2) with non-winsorized dependent variables

	A. Total amount donated		B. Excluding donations to religion		C. Total hours volunteered		D. Excluding religious volunteering	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Level of education	55.270	39.954	29.835	26.640	-2.629	-5.850	-2.275	-3.734
(SE)	(54.599)	(52.753)	(20.244)	(19.879)	(5.515)	(5.485)	(3.593)	(3.616)
Strength of religiosity	178.409	257.581*	-57.826	-27.036	25.116*	26.434*	26.464**	27.295**
(SE)	(124.041)	(120.879)	(45.991)	(45.551)	(12.530)	(12.569)	(8.162)	(8.285)
Church attendance	22.687***	20.393***	3.971**	3.190*	-0.009	-0.193	-0.185	-0.273
(SE)	(4.043)	(3.913)	(1.499)	(1.475)	(0.408)	(0.407)	(0.266)	(0.268)
Social responsibility		132.294		16.424		-0.591		-1.216
(SE)		(85.174)		(32.097)		(8.857)		(5.838)
Prosocial role-identity		-98.640		-42.278		24.132**		10.992*
(SE)		(76.768)		(28.929)		(7.983)		(5.262)

Household income (\$k)		5.992***		1.801***		0.239		0.103
(SE)		(1.405)		(0.530)		(0.146)		(0.096)
Assets (x \$1,000)		1.012*		0.366*		0.067		0.036
(SE)		(0.479)		(0.181)		(0.050)		(0.033)
Constant	-82.264	166.957	-111.373	26.555	77.707*	-67.760	53.519*	-12.901
(SE)	(383.531)	(558.406)	(142.203)	(210.427)	(38.742)	(58.065)	(25.238)	(38.272)
ni	680	680	680	680	680	680	680	680
R-Squared	0.140	0.225	0.028	0.095	0.016	0.060	0.034	0.056
nj	340	340	340	340	340	340	340	340

* significant at 10%; ** significant at 5%; *** significant at 1%

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