the sociological quarterly
Official Journal of the Midwest Sociological Society

The Sociological Quarterly ISSN 0038-0253

GENETIC VARIATION IN VOLUNTEERISM

Joonmo Son*
National University of Singapore

John Wilson
Duke University

Research has shown that prosocial behaviors of various kinds are passed from generation to generation, but the role played by genetics in the transmission of volunteerism has been unexplored. Data from the Midlife in the United States (MIDUS) Twins and Siblings samples are used to estimate genetic heritability of hours volunteered per month. Although unique environmental factors of the kind sociologists have traditionally focused upon account for most of the variance, women do owe some of their disposition to perform volunteer work to their genes. There is no genetic effect for men.

One of the most intriguing discoveries in the recent research on volunteering is that it tends to run in families. The authors of one recent article referred to this phenomenon as "legacy volunteering" (Mustillo, Wilson, and Lynch 2004). Social scientists are inclined to attribute this pattern of behavior to socialization—parents who volunteer act as role models for their children or are more likely to teach their children altruistic values and prosocial attitudes. They are also more likely to recruit their children into volunteer work as soon as they are capable of it, and it is well known that people who volunteer in their pre-adult years are more likely to volunteer when they become adults. The possibility that there is a biological component to this intergenerational transmission of volunteer work has been largely overlooked. It could be that people *literally* inherit a disposition to perform volunteer work from their parents. It is in their genes. This article sets out to test this hypothesis using samples of twins and siblings to separate the influence of genes from the social environment in which children are raised and become adults. In this respect, it makes a novel contribution to the study of how people become volunteers.

THE INTERGENERATIONAL TRANSMISSION OF VOLUNTEERING

There is growing evidence that altruistic or prosocial behavior is passed from one generation to another. For example, Wilhelm et al. (2008) recently analyzed Panel Study of Income Dynamics (PSID) data to show that adults donate more money to charities if their parents do so. Prosocial behavior could be transmitted through social learning, principally by role modeling on the part of parents, parental approval of appropriate altruistic behaviors, or the teaching of prosocial values. It can also be transmitted indirectly, as when parents provide their children with the human and social capital

---

*Direct all correspondence to Joonmo Son, Department of Sociology, National University of Singapore, Faculty of Arts and Social Sciences, AS1 #04-24, 11 Arts Link, Singapore 117570; e-mail: socioson@nus.edu.sg

The Sociological Quarterly **51** (2010) 46–64 © 2010 Midwest Sociological Society

needed for volunteer work, when they encourage church attendance (which encourages volunteerism), or when they instill appropriate personality traits.

Using Dutch data, Bekkers (2007) shows that respondents whose parents volunteered are more likely to become volunteers themselves—although the strength of this correlation and the mechanism that links parent and offspring vary by type of volunteer work. He thus confirms what a number of other studies have previously found. For example, young Americans are more civically engaged if other family members, particularly parents, are also active: They belong to more groups, they are more involved in political campaigns, they are more likely to participate in boycotts and demonstrations, and they are more likely to volunteer (Keeter et al. 2002:31) Just over three-quarters of American teenagers surveyed in 2005 whose parents volunteered were also volunteers themselves compared with just under half of those whose parents were not volunteers (Grimm et al. 2005). In another study, Musick and Wilson (2008:228) found that adult respondents who reported that they remembered their mothers volunteering when they were young were twice as likely to be volunteers themselves (the influence of fathers was weaker but nevertheless significant). This role modeling is important because children are more likely to internalize values if they witness their parents actualizing them (Bengston and Roberts 1991).

Socialization is not the only mechanism by which parents pass along attitudes and behaviors to the next generation. Children also "inherit" their parents' social status. In an intriguing study of two generations of American women, Mustillo et al. (2004) showed that a mother's volunteer work positively influenced her daughter's initial volunteer hours, but the mother's social class increased the probability that her daughter's volunteer hours would increase over time. Through their own volunteer work, mothers get their daughters involved in volunteer work, but it is the human capital they bestow that best explains any increase in volunteer hours over time. A similar lesson, that both socialization and social class are involved in the transmission of volunteer work, is provided by Janoski and Wilson's (1995) analysis of two generations of respondents in the Youth-Parent Socialization Study showing that community-oriented volunteering (e.g., civic clubs) is passed via socialization, but self-oriented volunteering (e.g., veterans' groups) is passed via social class.

In light of this evidence, few scholars would dispute the tendency for volunteerism to be passed between generations and for social factors to play an important role in ensuring that this happens. The possibility that children inherit volunteerism from their parents through their genes has been almost entirely overlooked despite the fact that all of the analyses reported above leave much of the variation in transmission unexplained. This is partly because social scientists typically examine group differences in the rate of inheritance and invoke individual- or family-level factors to explain these differences. They focus on interfamily rather than intrafamily differences. Although the parent–child link is the focus of these studies, they cannot determine the role that genes play because all family members are treated alike as far as biology is concerned. To uncover the influence of genes, it is necessary to distinguish *within* families according to varying degree of biological inheritance—and this is the point of twin studies.

EVIDENCE FOR THE HERITABILITY OF VOLUNTEER WORK

In a recent issue of the *American Journal of Sociology* devoted to the relationship between biological and sociological factors, Schnittker (2008:S234) observed that "many outcomes of longstanding sociological interest are at least partly heritable." Volunteer work is part of a larger bundle of social activities, conventionally referred to as "social engagement," "social participation," or "social capital," that has attracted the attention of social scientists in many disciplines. There is a growing body of evidence that "social participation" or various ways in which people engage in their community such as attending church, participating in sports and other expressive activities, joining voluntary associations, and getting involved in local politics are influenced by genes as well as by factors in the social environment. For example, political participation (including voting in local and general elections) is to some degree genetically influenced (Alford, Funk, and Hibbing 2005; Hatemi et al. 2007; Fowler, Baker, and Dawes 2008). Religious affiliation, attitudes, and behaviors are also partially inherited (D'Onofrio et al. 1999; Eaves et al. 2008). In the field of expressive activities, Hur, McGue, and Iacono (1996) found heritability estimates for leisure time pursuits ranging from 6 percent for religious activities to 57 percent for intellectual activities, and Stubbe, Boomsma, and De Geus (2005) found that sports participation in adolescence has a genetic component as high as 85 percent at the age of 18.

There is little reason to think that volunteer work is an exception to this general pattern not only because other kinds of social participation have some genetic component but also because altruistic behavior, of which volunteering is one form, seems to be partially genetic. Fowler et al. (2008:244) cite "a wide range of studies [that] have already shown a strong genetic basis for prosocial personality and behavior," and a recent review of the research on prosocial behavior concluded that "[h]umans are biologically predisposed to act prosocially" (Dovidio et al. 2006:312) To be sure, it is unlikely that there is a direct link between genes and prosocial behavior, but it is probable that genes encourage the expression of personality traits such as empathy (Graziano and Eisenberg 1997:809), and empathic people are more likely to volunteer (Musick and Wilson 2008:42–3). And in a research program extending over 20 years, Rushton (2004) has documented a sizable genetic component to variation in responses to a "Social Responsibility Questionnaire" that is, in turn, linked to voting in elections, joining voluntary associations, and helping others. The possibility that genes play some role in encouraging volunteer work is therefore an important next step in the investigation of the etiology of this form of social participation.

USING TWIN MODELS TO EXPLORE GENETIC VARIATION IN BEHAVIOR

One method for investigating possible genetic influences on volunteerism is to use samples of twins. Although family resemblances in volunteerism have been studied occasionally, twin studies mark a step further by making it possible to separate the effects of genes from both the common environment family members inevitably share and the unique social environment each family member is exposed to. The ability to discriminate genetic influences via twin pair comparisons stems from the fact that monozygotic (MZ) or "identical" twins develop from a single ovum (the fertilized egg splits), whereas dizygotic (DZ) or "fraternal" twins develop from two different ova fertilized by a different sperm. The MZ twins are genetically identical, but the DZ twins share only 50 percent of their segregating genes.

The method of using twins to determine the influence of genes on social attitudes or behaviors begins with a comparison of the co-twin correlations of MZ pairs and DZ pairs. If genetic influences are present, the MZ twin correlations will be significantly higher than the DZ twin correlations. However, correlation analysis is not sufficient to tease out genetic influences. Because the unit of analysis in twin studies is the family or, more specifically, the twin pair (and sometimes opposite-sex dizygotic [DZO] twins and pairs of siblings), analytical methods must be chosen that "explicitly model the non-independence, or relatedness present within the data" (Medland and Hatemi 2009:194). The most popular of these methods is some variant of maximum likelihood structural equation modeling. The goal is to partition the variance in the "trait" under study into that which is shared between family members and that which is unique to each individual family member.

Twin methods thus provide a new perspective on volunteerism studies. In conventional studies of volunteerism, the focus is on a sample of independent, randomly selected individuals with the aim of explaining differences in the mean hours volunteered of various groups in the sample, as when the volunteer hours of college graduates are compared with those with a more limited education. The twin method is different because the unit of the analysis is not the individual but the twin pair: "[I]nstead of considering covariance between two traits, X and Y, for individuals measured on both traits, we . . . consider the covariance between twins . . . for a single variable" (Plomin et al. 1997:296) The focus is on the variance in the population rather than the mean: That is, what contribution do genes make to the variance in volunteer hours within a given population?

Different analytical goals mean different analytical methods. In a regression analysis of volunteerism, the goal is to explain the difference between individuals in the number of hours volunteered, and success is typically measured by referring to the amount of variance explained by the variables in the model or to the role of particular independent variables in helping to contribute to this explanation. Unlike regression analysis, the purpose of structural equation modeling is to find the model that best fits the data by dropping parameters from the "full" model, comparing the fit of the unconstrained model in which parameters are freely estimated to the fit of the constrained model in which one or more of the parameters have been set to zero or fixed to a specific value. In the case of twin models, this involves comparing the unconstrained model where influences from genes, shared environment, and common environment are all allowed to vary with alternative models where one or more of these influences are given specified values. The shared environment would include factors such as family socioeconomic status and general parental treatment. The nonshared or unique environment includes life events specific to the individual, peer group influences, and errors of measurement.

THE ROLE OF GENDER IN TWIN STUDIES

Gender plays a significant role in twin studies because MZ twins are always the same sex, but DZ twins can be the same sex or the opposite sex. Because of the sex chromosome differences between males and females and because of the possibility that males and females might be exposed to different environments, it is customary when doing twin analysis using structural equation modeling (SEM) to compare only same-sex fraternal twins and identical twins, and we follow this procedure in this study. Comparing twins of the same gender brings with it an additional advantage, that of exploring possible differences in the influence of genes on men and women's behavior.

Gender differences in volunteerism are apparent in many surveys. For example, the Current Population Survey Supplement on Volunteering for 2006 shows 30.1 percent of women volunteering compared with 23.0 percent of men among Americans aged 16 years and over. Among those aged 25–34, the gap is 10 percentage points (Bureau of Labor Statistics 2006). Gender differences of this kind—different prevalence rates—are normally attributed to differences in socialization or sex-role obligations. Women receive more encouragement to do volunteer work, and their role as a mother imposes obligations on them that many men escape—hence the widening of the gap during the time when women are most likely to be taking care of school-aged children.

Although gender differences in prevalence rates do not in themselves tell us much about the role of biological inheritance in volunteerism, they point to the possibility that individual differences among men and among women might result from gene action, that certain genes might have a greater impact on women than men or that the genes that encourage volunteerism in women are different from the genes that encourage volunteerism in men. To explore these issues, sex limitation models are used. The term "sex limitation" refers to any gender-specific effect of genetic influences. Testing sex limitation models using twins means comparing twin similarity across same-sex MZ, same-sex DZ, and DZO twins but applying the structural equation models separately to males and females. That is, genetic, shared environmental, and nonshared environmental effects are estimated independently for males and females. In this situation, comparing MZ and DZ twins shows whether there are differences in the *magnitude* of (the same) genetic influences between genders. Comparing DZ and DZO twins shows whether there is a difference in *kind*; that is, whether different genes are responsible for the outcome in male and females. Opposite-sex twins are needed to make this comparison because they share the same family environment but as members of the opposite sex. Either genetic or environmental influences on the behavior in question are different for males and females if the correlations between DZO pairs are smaller than those for same-sex DZ twins, in which case it might be that genetic effects are influencing only one sex.

THE TWIN EFFECT

Although the main focus on twin studies is upon twin pairs, there is always the possibility that some of the variation in the outcome variable is because of the special attention twins receive as family members. It is therefore necessary to have data on siblings in the family who are not twins. Like DZ twins, siblings share 50 percent of their genes. By comparing the similarities between DZ and nontwin siblings closely related in age, it is possible to determine the extent to which twin status has affected variation in the outcome variable. If being a twin, by itself, affects similarities in volunteering unrelated to genes, then the correlation in volunteer hours should be stronger for DZ twins than for nontwin pairs.

THE EQUAL ENVIRONMENT ASSUMPTION

Twin methods of analysis assume that the degree to which twins share the same environment (e.g., family) does not differ between MZ and DZ twins in such a way as to affect the estimation of inheritance of a given trait such as volunteering. One obvious concern is that this assumption is false because identical twins have been treated more alike or have been exposed to more similar environments than fraternal twins. If this concern is neglected, it is likely that genetic influences will be overestimated because the similarity between the MZ twins is actually because they were treated as more alike than were DZ twins. Prior research has confirmed that twins who are, or who are believed to be, identical are treated more similarly than fraternal twins, and they do tend to experience more similar environments such as spending more time together (Plomin et al. 1997:317). For a number of reasons, however, it is extremely doubtful that this difference in treatment will affect heritability estimates in the case of volunteering (for a summary of these reasons, see Alford et al. 2005:155; Medland and Hatemi 2009:198–9), but to ensure that this is not the case, we explored this issue with the MIDUS data. The conventional method for testing for any possible effects of being treated more alike is to see if twin differences in the outcome variable (e.g., volunteer hours) are correlated with measures of similarity in the environment (e.g., being dressed more alike). Low or insignificant correlations suggest that the similarities are not affecting the outcome variable. Following Kessler et al. (2004:133), we used three measures of childhood environment contained in the MIDUS survey to test the equal environment assumption: how often the twins played together, how often they were dressed identically, and how often they were placed in the same classroom in school. We found that MZ twins reported more similarity on these measures than DZ twins. However, these differences in environmental similarities were not related to the differences in volunteer similarities between MZ and DZ twins.

SAMPLE

A full description of how the twin pairs and nontwin sibling pairs were recruited for the MIDUS survey can be found in Kessler et al. (2004:128–29). Calls were made to about

TABLE 1. Mean Volunteering Hours

Twins	Mean (standard deviation/N)
MZ	
All identical twins	4.93 (9.16/275)
Male identical twins	5.25 (8.05/125)
Female identical twins	4.66 (10.00/150)
DZ	
All fraternal twins	4.99 (8.89/239)
Male fraternal twins	4.52 (6.53/92)
Female fraternal twins	5.29 (10.11/147)
DZO	
Mixed-sex twins	5.56 (11.20/159)
Nontwin siblings	**Mean (standard deviation/N)**
Male siblings	5.06 (6.51/87)
Female siblings	6.15 (9.78/134)
Mixed-sex siblings	6.06 (8.82/232)
Main MIDUS sample	5.33 (15.12/2,818)

MZ, monozygotic; DZ, dizygotic; DZO, opposite-sex dizygotic.

50,000 households asking respondents if they or any of their immediate family members were members of intact family pairs. The 14.8 percent of respondents who reported the presence of a twin in the family were then asked whether it would be acceptable for the research team to contact the twins to solicit their participation in the survey. The 60 percent of respondents who granted permission were referred to the MIDUS recruitment process. Only twins aged between 25 and 74 were selected.

To determine zygosity, "[a] classification rule was developed based on comparison with data from members of the Virginia Twin Registry (VTR) who were previously included in molecular genetic analyses. Eight self-report measures about whether the twins were identical or fraternal [e.g., eye and hair color and degree to which others were confused as to their identity during childhood] were included in both MIDUS and in the VTR. These variables were used to estimate a logistic regression equation in the VTR data to predict zygosity that used a classification of MZ and DZ based on molecular genetic analysis. The coefficients from this prediction were then used to generate predicted probabilities of being MZ versus DZ in the MIDUS data" (Kessler et al. 2004:129).

From the original sample of 998 twin pairs, we created a data set consisting of 941 pairs, the difference being because where families reported two or three twin pairs, we randomly selected only one of those pairs and because in 13 cases, zygosity could not be determined. The sample size is further reduced by missing data on volunteer hours. In the means reported in Table 1 and in the correlations reported in Table 2, we use data from twins where both of the pair report volunteer hours (673). In the SEM analysis, the number of twin pairs falls to 501 because we do not use DZO pairs, and 13 outlier cases were excluded.

TABLE 2. Pairwise Correlation of Volunteering Time by Zygosity, Siblings, and Gender

Twins and siblings	Correlation of volunteering time per month[a] between siblings
MZ	
All identical twins	.19**
Sig.	.001
N	275
95 percent CI	.08–.31
Male identical twins	.12
Sig.	.20
N	125
95 percent CI	−.06–.29
Female identical twins	.24**
Sig.	.003
N	150
95 percent CI	.08–.39
DZ	
All fraternal twins	−.02
Sig.	.78
N	239
95 percent CI	−.15–.11
Male fraternal twins	.04
Sig.	.67
N	92
95 percent CI	−.16–.25
Female fraternal twins	−.04
Sig.	.66
N	147
95 percent CI	−.20–.13
DZO	
Mixed-sex twins	.05
Sig.	.57
N	159
95 percent CI	−.11–.20
Nontwin siblings	
Male siblings	.08
Sig.	.48
N	87
95 percent CI	−.14–.28
Female siblings	.01
Sig.	.95
N	134
95 percent CI	−.16–.18
Mixed-sex siblings	.03
Sig.	.60
N	232
95 percent CI	−.10–.16

[a] Volunteering time is a continuous variable of hours per month spent for four types of formal volunteering activities as described in *Variables*.

$^{*}p < .05$, $^{**}p < .01$.

CI, confidence interval; MZ, monozygotic; DZ, dizygotic; DZO, opposite-sex dizygotic.

Nontwin siblings were recruited via postcards sent to MIDUS respondents inviting them to supply names and addresses of siblings they believed might be interested in participating in the study. From the resulting list of 1,372 siblings, 951 agreed to participate. These siblings were drawn from 529 families. We used only one pair of siblings from each family, resulting in 529 sibling pairs. We created these pairs by selecting those who were closest in age, reasoning that the smaller the age gap the more common environment and experiences they would share. As with the twin pairs, missing data on volunteer hours lowered the actual totals used in the analysis. Only the 453 sibling pairs where both report volunteer hours are used.

METHODS

We first compute the means for volunteer time reported by all twins and siblings in the sample who reported these data. We then compute cross-twin correlations in volunteer time and determine whether these correlations are different for MZ, DZ, and DZO twins and for sibling pairs. We then apply Additive genetic effects, Common environment, and unique Environment (ACE) modeling, a structural equation modeling technique specifically designed for use in twin studies, to the variance–covariance matrices using the MLM (Maximum Likelihood parameter estimates with standard errors and a Mean-adjusted chi-square test statistic) estimator because the outcome measure of volunteering hour is skewed to the left (60 percent of respondents report zero hours) and MLM is robust to nonnormality (Satorra and Bentler 2001; Crawford and Henry 2003). Prior to this stage of model fitting, we regressed out the influence of age and gender on volunteer hours because without correcting for it, the influence of genetics can be overestimated (Reynolds and Hewitt 1995; Ronald et al. 2005).

VARIABLES

Volunteer Hours

This variable is constructed by summing the hours per month doing volunteer work for organizations related to health, education and youth work, political organizations, and any other organization, cause, or charity (e.g., "On average, about how many hours per month do you spend doing formal volunteer work at a hospital, nursing home, or other health-care-oriented volunteer work?").

Education

The highest educational grade of the respondent: (1) some grade school to some high school; (2) general educational development (GED) or high school diploma; (3) some college (no bachelor's degree); or (4) bachelor's degree or more advanced degree. The mean educational level for twins was 2.7, indicating that their average education was close to "some college."

Age

Continuous variable between 25 and 74 with a mean age of 44.9.

RESULTS

Table 1 displays the mean number of hours volunteered per month together with standard deviations for each group analyzed in the study.

These mean differences are displayed not because we wish to explain them but to confirm that there are no major differences in the level of volunteer activity of any of the groups in the study that might bias the interpretation of the source of variation in volunteer hours within each group. The means for MZ and DZ twins are almost identical. Nontwin siblings contribute more hours, particularly sisters, but the difference is not statistically different from other groups. The table also displays the mean volunteer hours for respondents in the main MIDUS sample and, again, the differences are not statistically significant. Note that there are more female than male twins, especially in the case of fraternal twins. As it is well-known that volunteers are more likely to respond to surveys, this raises the possibility of bias caused by an overestimation of volunteers in the female twin population. But *t*-tests showed that the volunteer rates for male and fraternal twins were not significantly different, nor was the difference in the volunteer rate between male and female identical twins significant.

Preliminary evidence of possible genetic effects is provided by cross-twin correlations. Genes might be contributing to the variation in volunteer hours if the correlation between MZ twins is significantly stronger than the correlation between DZ twins.

As shown in Table 2, the time volunteered by identical twins is significantly correlated, but the time volunteered by same-sex fraternal twins is not. However, the correlation found in the identical twins is confined to females. Because there is no difference in the correlation between DZ twins and DZO twins (neither is significant), we can rule out the possibility that there are qualitative genetic differences between men and women. This casts doubt on any hypothesis that differences in volunteering might be because of different genes acting in males and females. Finally, if being a twin itself affected similarity for reasons unrelated to genes, there would have been a stronger correlation in the same-sex DZ pairs than in the nontwin sibling pairs. Since there is no significant correlation for either set of pairs, this possibility can also be ruled out.

Comparing correlations is a useful first step in partitioning variance in hours volunteered, but correct estimation of differences in genetic influences requires formal statistical procedures in which alternative models can be compared with different components of variance specified and goodness of fit statistics used to assess how well the various models fit the data.

We analyzed the males and females separately, comparing models with parameters separately estimated for each sex with those constraining parameters equal across sex or equal to zero creating various models to find the best fit to the data. The results are shown in Table 3.

TABLE 3. Model-Fitting Results for Volunteering Time in Male–Male and Female–Female Twin Pairs (Adjusted for the Effects of Age and Gender)

					Males			Females		
	SB chi-square[a]	df	CFI[b]	RMSEA[b]	a_m^2	c_m^2	e_m^2	a_f^2	c_f^2	e_f^2
1. ACE	1.817	13	1.000	.000	.11	.00	.89	.30	.00	.70
2. AE	3.333	17	.797	.042	.21[c]	.00[d]	.79[c]	.21[c]	.00[d]	.79[c]
3. Partial CE (male)	1.986	14	1.000	.000	.00[d]	.08	.92	.30	.00	.70
4. Partial CE(female)	2.860	14	.695	.057	.11	.00	.89	.00[d]	.19	.81
5. Full CE	3.075	15	.735	.051	.00[d]	.08	.92	.00[d]	.19	.81
6. E (male), AE (female)	2.512	16	1.000	.000	.00[d]	.00[d]	1.00	.30	.00[d]	.70

[a] SB scaled chi-square from the MLM estimator.

[b] CFI and RMSEA estimates are from the maximum likelihood estimator.

[c] Constrained to be equal in males and females.

[d] Constrained to value of zero.

SB, Satorra-Bentler; CFI, Comparative Fit Index; RMSEA, root mean square error of approximation.

Model 1 (ACE) has an acceptable model fit because Comparative Fit Index (CFI) was over .95 and root mean square error of approximation (RMSEA) was less than .05 (Bentler 1990), showing that genetic effects ("a") exist for both genders, although the effects seem to be about three times stronger for women than for men. The model shows no shared environment effects ("c"). Unique environmental factors ("e") exert the strongest influence on both genders. Model 2 (AE) was estimated with genetic effects and unique environmental effects set to be equal across gender groups and constraining common environmental factors to zero in both gender groups. The Satorra-Bentler (SB) scaled chi-square test did not indicate significant deterioration in the fit of the model; however, the other two indices of CFI and RMSEA indicated a worse model fit compared with the model 1. (We report CFI and RMSEA from the maximum likelihood [ML] estimator because the MLM estimator, by uniformly reporting perfect model fits for all the models, showed no deterioration in model fits.) Thus, the SB scaled chi-squared test statistic from the MLM estimator and CFI and RMSEA from the ML estimator should all be considered in selecting the best-fitting model. Model 3 (partial CE) imposed zero genetic effect for males, and all three model fit indices reported are satisfactory. Model 4 (partial CE) constrained genetic effect for females to be zero. However, as suggested by the CFI and RMSEA indices, the SB scaled chi-square test could not be performed because the SB scaled difference coefficient turned negative because of poor model fit. Model 5 (full CE) constrained genetic effects for both males and females to be zero. The model fit was also poor, and once again an SB chi-square test was not possible. It is likely that the assumption of nongenetic influence in females caused a serious problem in model fits in models 4 and 5. Last, model 6 sets both genetic and common environmental factors for males to be zero, while it constrains only the common environmental effect for females to be zero. All three model fit indices were satisfied by such constraints. In conclusion, the best-fitting model was model 6, having two more degrees of freedom than model 3 and excellent fit criteria as measured by CFI (1.00 indicates the model cannot be improved further) and RMSEA (.000, where anything less than .05 is considered acceptable). The structural equation model thus confirms what the correlation analyses implied, that female volunteering is more affected by variation in genetics than is male volunteering.

DISCUSSION

We began this study by pointing out that volunteerism, like other kinds of prosocial behavior, tends to get passed from one generation to another. We argued that there are a number of different pathways along which this influence can occur, principally socialization, social class, and genes. Using twin models, we conclude that there is a genetic component to this transmission, at least for women. The results thus conform to a broad pattern of findings from previous research on prosocial behavior and social participation. And it is certainly not the first time gender differences have been suggested by behavioral geneticists. In fact, we should not be too surprised at the idea of gender differences in the heritability of prosocial behavior when it is accepted that there are gender differences in the heritability of *anti*social behavior (Kendler and Prescott 2006:86) and when several studies cited earlier show that there is a genetic component to the attitudes and personality traits known to be predictive of volunteering. Nevertheless, this is the first study to show that volunteer work has a genetic component.

The correlations and the SEM estimates clearly show that zygosity contributes nothing to the variation in hours volunteered by males. As shared environment plays no role in creating these variations, the remaining component, unique environmental effects, is responsible for the variation observed. (Following a reviewer's recommendation, we should also be careful to note that the nonshared component includes measurement error, all within-person nonreliability in the measure of volunteer hours, and instances in which the same experience affects different siblings differently.) Women are different: Some of their tendency to inherit their parents' volunteerism is because they share their genes. Although the genetic component is lower than that provided by the nonshared environment, it is nevertheless sizable. Thus, although surveys show that men and women are not all that different in their levels of volunteerism, the pathways that lead them to volunteer work are likely to be different. Since none of the variation in either gender is because of environments they share (e.g., seeing their parents volunteer), the difference would appear to be because men are drawn into volunteer work by their adult social roles outside the family—perhaps as workers, club members, and the like—while for women these factors, although they still play the major role in influencing volunteerism, are somewhat less important in relation to biological tendencies inherited from their parents than they are for males.

Before describing future possibilities for genetic research in the area of volunteerism, it is important to clarify a number of issues. First, twin studies measure statistical differences within populations. They do not allow us to draw any conclusions about what percentage of any one individual's behavior is genetically determined. We will comment on the need for individual-level studies below. Second, comparing twin pairs to derive estimates of heritability says nothing about the identity of the genes that might be responsible or their number. Working as a volunteer is not specifically inherited, as we might say of a person's height. We do not inherit behaviors so much as predispositions that influence our sensitivity to and selection of opportunities for social action. This is simply a way of stating what is already obvious: that not all people respond to the opportunity to volunteer in the same way. A corollary of this general rule is that the estimates of heritability reported in this study can only *suggest* that genetic influences might differentially affect men and women (Reynolds and Hewitt 1995:198). Third, the SEM analyses do not explain differences in mean volunteer hours for men and women. They estimate the contributions of genetic differences to the variation in volunteer hours *within* males and females. Fourth, the MZ twin correlations on volunteer hours are far short of unity, even for females. Such differences between identical twins clearly indicate the significance of unique environmental factors and errors of measurement. Identical twins can behave quite differently when it comes to volunteer work despite their identical genes and their shared environment. Finally, more complex models of genetic effects must deal with the possibility that the "environment"—treated as nongenetic in simpler models—itself has a genetic component. For example, we know that being asked to volunteer is an important incentive. If there are genetically determined sex differences in the likelihood of being asked (e.g., as a result of extroversion) *and* there are genetic differences in the likelihood of agreeing to volunteer, the genetic effect is compounded.

FURTHER RESEARCH USING TWIN MODELS

In this article we have reported only univariate results, but an important step for the future is to consider the etiology of volunteerism through multivariate studies. Multivariate analysis allows us to progress beyond the question of whether genetic factors are influencing variation in volunteerism to explore questions of how this influence may come about. In behavioral genetics, these questions take two principal forms. The first is, what is the mechanism that links biology and action? Behavioral geneticists argue that genes influence social behavior only indirectly. They assume that genes act through some intermediary factor, the most obvious of which would be self-concept such as self-esteem, a sense of mastery, or any other subjective predisposition linked to the propensity to volunteer.

Twin studies can be adapted to explore these possibilities by means of "cross-twin, cross-trait" comparisons. For any two traits (e.g., self-concept and volunteer hours), we ask if the genetic factor that influences one trait is the same as the genetic factor that influences the other. To even pose this question, both "traits" must be inherited, and they must be correlated with each other. Thus, for example, the self-concept of Twin 1 would be correlated with the volunteer hours of Twin 2 and the cross-correlations of the MZ twins compared with the cross-correlations of the DZ twins. The purpose is to see if the correlation between self-concept in Twin 1 and volunteering in Twin 2 is stronger in the case of MZ twins than DZ twins. A SEM analysis would then reveal what proportion of the association between the two traits (e.g., education and volunteer hours) is accounted for by genes and environment.

Personality traits provide one set of possible linking mechanisms because they are known to have a heritability component (including those measured in MIDUS [Rossi 2001:282; Johnson and Krueger 2004]), and some researchers have shown that personality traits are linked to volunteerism, either directly (Atkins, Hart, and Donnelly 2005) or indirectly, through a value such as generativity (Musick and Wilson 2008:39–53). We investigated the possibility that personality traits were mediating the influence of genes on volunteering for both men and women. However, although we were able to confirm that personality traits as measured in MIDUS are to some degree inherited, they were not linked to volunteer hours. It should be noted that personality traits were not directly linked to volunteer hours in the main MIDUS sample either (Rossi 2001:296), and in a different analysis, Bekkers (2007) also failed to find any connection between personality traits and volunteerism. In view of this disagreement over the link between personality and volunteerism, it is clearly necessary to devote more research to this topic before personality traits can be identified as a mechanism linking genes and volunteer work.

Generativity is another possible linking mechanism. It measures people's sense of responsibility toward the next generation. Rossi (2001:296) found that generativity was positively associated with volunteer hours in the main MIDUS sample, so we explored this possibility in the sample of twins. Generativity was indeed positively related to volunteer hours in the twin sample, but the correlation between volunteering and generativity was no stronger in the MZ twins than it was in the DZ twins ("cross-trait, cross-twin correlations"), indicating that generativity was not serving as a mediator of the influence of genes on volunteering (nor was there any difference in the correlations when we compared male and female MZ and DZ twins separately).

Another possible mediator is having a helping identity. Many social psychologists believe that people who make a habit of helping others have developed a strong helping identity and that once this self-concept has been formed, people are readier to respond to invitations to volunteer. Using MIDUS data, Matsuba, Hart, and Atkins (2007) show that a helping identity (e.g., "How much thought and effort do you put into your contribution to the welfare and well-being of others these days?") is indeed positively linked to volunteer hours, and we therefore used this construct to test for mediating effects in the case of twins. However, we found no link between having a helping identity and volunteer hours among the twins.

Less subjective measures can also function as mediators. For example, years of schooling have been among the most reliable predictors of volunteerism, a fact we confirmed in our own analysis of the main MIDUS sample, and there is a genetic influence on educational achievement (Plomin 1994:100), which we also confirmed in our analysis of the twin sample. But to our surprise, education was *not* related to volunteer hours among the twins and therefore does not mediate the relation between genes and volunteering. The first thing to note in this connection is that the correlation between educational attainment and volunteer hours in the main MIDUS sample is quite weak ($r = .08$, $p < 001$). The twins are little different from the members of the main sample in either the number of hours they volunteer or in their educational attainment, and therefore we should expect this weak association to carry over to the twins. It should also be noted that we found an *inconsistent* relation between education and volunteer time among the twins rather than no relation at all: That is, education was related to volunteering in one twin of the pair but not the other in the case of both identical and fraternal twins. Perhaps a larger sample of twins would yield the expected educational influence more consistently.

Another possible mechanism or mediating factor is church attendance. Some studies have suggested that variations in church attendance are to some degree inherited (Plomin 1994:88), and in the main MIDUS sample frequency of church attendance does predict volunteer hours (Rossi 2001:298). However, we did not find any correlation between churchgoing and volunteer hours among the twins. MIDUS does not discriminate volunteering in connection with a religious organization from other types of volunteer work, and this might account for the absence of any association in the smaller sample of twins.

The second question with which multivariate analysis can deal is, does the expression of the gene depend upon the environment? This line of investigation is of special interest to social scientists because it promises to open up the ways in which biological predispositions can be triggered or suppressed by the social environment. In short, genes do not make a person behave in a certain way: They influence the extent to which their behavior is contingent on the environment. The possibilities opened up by this line of investigation have been outlined by Shanahan and Hofer (2005) in an article describing four ways in which genes and environment can interact. Contextual triggering occurs when the social environment triggers or encourages gene expression, as when people experience a life event rich in opportunities to volunteer, such as a mother enrolling her children in school. Compensation is in some ways the opposite end of the continuum: Here the social context makes up for genetic deficiencies. In this case, regardless of their genetic endowments, subjects would be no different in their volunteer behavior unless they were exposed to a specific contextual stimulus, such as being recruited. Where the social context is important as a source of social control, the interaction takes the form of gene expression being either inhibited or encouraged by societal norms and group pressure, as when, for example, the expression of an altruism gene is discouraged by residing in deprived and disorganized neighborhoods. Enhancement is the form that the gene–environment interaction takes when the social context facilitates gene expression, as among people raised in a religious household or who attend church frequently.

In the study of volunteerism there is one obvious candidate for an environmental factor that might interact with genes, and that is education because a genetic disposition to volunteer might be "triggered" by educational experiences. It is known, for example, that college graduates are more likely to have been asked to volunteer than high school graduates (Musick and Wilson 2008:292). However, as noted above, we failed to find a consistent relation between education and volunteer hours in the twin sample. The same could be said for church attendance, which we noted above might enhance the expression of a genetic disposition. Frequent churchgoers are more likely to be asked to volunteer than those who never attend church (Musick and Wilson 2008:292). Genes might have a weaker (or stronger) effect on people who rarely go to church because social support for and norms enjoining volunteer work are weaker than for regular churchgoers. Conversely, because frequent churchgoers feel more social pressure or receive more encouragement to volunteer, this might help overcome any genetic predisposition not to help. We explored this possibility in our analyses, but as stated above, there was no consistent correlation between church attendance and volunteer hours in the twin sample.

In conclusion, studies of heritability are important because they give social scientists more accurate estimates of the average effect of "social" causes and a more complete understanding of why the same cause affects different people differently. Future research into the possible genetic roots of volunteerism should focus on using larger samples of twins to increase the likelihood that significant gene–environment interactions can be investigated. It should also incorporate where available twins who have been reared apart to allow for both within-family and between-family variations in social circumstances and socialization. It could also focus on what people do as volunteers. For example, studies have shown that men and women differ in the kinds of volunteer jobs they elect to perform or are assigned to (Rotolo and Wilson 2007). Perhaps these choices are also partially determined by genes. Finally, it should use population-based studies as a springboard for studies using individual-level genetic data, which must be considered the gold standard for the investigation of the genetics of social behavior. A recent example is a twin study suggesting that there is a genetic component to the variation in political participation (Fowler et al. 2008) followed by a study showing that individuals with a polymorphism of the monoamine oxidase A gene are significantly more likely to have voted in the 2004 American presidential election (Fowler and Dawes 2008).

From a practical point of view, in a world where there is always a shortage of volunteer labor, this study reemphasizes the importance of looking at the influence of the family on the decision to volunteer and suggests to recruiters that, at least in the case of women, it is probably effective to harness the mobilization efforts of parents when looking for new volunteer workers. It could well be the case that volunteerism literally runs in the family. And, to be sure, it is worth reiterating that there are many other factors that influence the decision to volunteer, many of which can be manipulated to make the choice an easier one.

ACKNOWLEDGMENTS

We would like to thank Drs. Bengt and Linda Muthén and Professor Keith Whitfield for their help in designing this study.

REFERENCES

Alford, John, Carolyn Funk, and John Hibbing. 2005. "Are Political Orientations Genetically Transmitted?" *American Political Science Review* 99:153–67.

Atkins, Robert, Daniel Hart, and Thomas Donnelly. 2005. "The Association of Childhood Personality Type with Volunteering during Adolescence." *Merrill-Palmer Quarterly* 51:145–62.

Bekkers, Rene. 2007. "Intergenerational Transmission of Volunteering." *Acta Sociologica* 50:99–114.

Bengston, Vern and R. E. L. Roberts. 1991. "Intergenerational Solidarity in Aging Families." *Journal of Marriage and the Family* 53:856–70.

Bentler, Peter M. 1990. "Comparative Fit Indices in Structural Models." *Psychological Bulletin* 107:238–46.

Bureau of Labor Statistics. 2006. *Volunteering in the United States*. Washington, DC: United States Department of Labor.

Crawford, J. R. and J. D. Henry. 2003. "The Depression Anxiety Stress Scales: Normative Data and Latent Structure in a Large Non-Clinical Sample." *British Journal of Clinical Psychology* 42:111–31.

D'Onofrio, Brian, Lindon Eaves, Lenn Murrelle, Hermine Maes, and Bernard Spilka. 1999. "Understanding Biological and Social Influences on Religious Affiliation, Attitudes and Behaviors: A Behavior Genetic Perspective." *Journal of Personality* 67:953–84.

Dovidio, John, Jayne Allyn Piliavin, David Schroeder, and Louis Penner. 2006. *The Social Psychology of Prosocial Behavior*. Mahwah, NJ: Lawrence Erlbaum.

Eaves, Lindon, Peter Hatemi, Elizabeth Prom-Womley, and Lenn Murrelle. 2008. "Social and Genetic Influences on Adolescent Religious Attitudes and Practices." *Social Forces* 86:1621–46.

Fowler, James, Laura Baker, and Christopher Dawes. 2008. "Genetic Variation in Political Participation." *American Political Science Review* 102:233–48.

Fowler, James and Christopher Dawes. 2008. "Two Genes Predict Voter Turnout." *The Journal of Politics* 70:579–95.

Graziano, William and Nancy Eisenberg. 1997. "Agreeableness: A Dimension of Personality." Pp. 795–824 in *Handbook of Personality Psychology*, edited by Robert Hogan, John Johnson, and Stephen Briggs. New York: Academic Press.

Grimm, Robert, Nathan Dietz, Kimberly Spring, Kelly Arey, and John Foster-Bey. 2005. "Building Active Citizens." *The Role of Social Institutions in Teen Volunteering*. Washington, DC: Corporation for National and Community Service.

Hatemi, Peter, Sarah Medland, Katherine Morley, Andrew Heath, and Nicholas Martin. 2007. "The Genetics of Voting: An Australian Twin Study." *Behavioral Genetics* 37:435–48.

Hur, Y.-M., M. McGue, and W. G. Iacono. 1996. "Genetic and Shared Environmental Influences of Leisure-Time Interests in Male Adolescents." *Personality and Individual Differences* 21:791–801.

Janoski, Thomas and John Wilson. 1995. "Pathways to Voluntarism: Family Socialization and Status Transmission Models." *Social Forces* 74:271–92.

Johnson, Wendy and Robert Krueger. 2004. "Genetic and Environmental Structure of Adjectives Describing the Domains of the Big Give Model of Personality: A Nationwide US Twin Study." *Journal of Research in Personality* 38:448–72.

Keeter, Scott, Cliff Zukin, Molly Andolina, and Krista Jenkins. 2002. *The Civic and Political Health of the Nation: A Generational Portrait*. Washington, DC: The Center for Information and Research on Civic Learning and Engagement.

Kendler, Kenneth and Carol Prescott. 2006. *Genes, Environment and Psychopathology*. New York: Guilford Press.

Kessler, Ronald, Stephen Gilman, Laura Thornton, and Kenneth Kendler. 2004. "Health, Well-Being, and Social Responsibility in the MIDUS Twin and Sibling Subsamples." Pp. 124–52 in *How Healthy Are We? A National Study of Well-Being at Mid-Life*, edited by Orville Brim, Carol Ryff, and Ronald Kessler. Chicago, IL: University of Chicago Press.

Matsuba, M. Kyle, Daniel Hart, and Robert Atkins. 2007. "Psychological and Social-Structural Influences on Commitment to Volunteering." *Journal of Research in Personality* 41:889–907.

Medland, Sarah and Peter Hatemi. 2009. "Political Science, Biometric Theory and Twin Studies: A Methodological Introduction." *Political Analysis* 17:191–214.

Musick, Marc and John Wilson. 2008. *Volunteers: A Social Profile*. Indianapolis: Indiana University Press.

Mustillo, Sarah, John Wilson, and Scott Lynch. 2004. "Legacy Volunteering: A Test of Two Theories of Intergenerational Transmission." *Journal of Marriage and Family* 66:530–41.

Plomin, Robert. 1994. *Genetics and Experience*. Thousand Oaks, CA: Sage Publications.

Plomin, Robert, John de Fries, Gerald McClearn, and Michael Rutter. 1997. *Behavioral Genetics*. New York: W. H. Freeman.

Reynolds, Chandra and John Hewitt. 1995. “Issues in the Behavior Genetic Investigation of Gender Differences.” Pp. 189–99 in *Behavior Genetic Approaches in Behavioral Medicine*, edited by J. Rick Turner, Lon R. Cardon, and John K. Hewitt. New York: Plenum Press.

Ronald, Angelic, Francesca Happe, Claire Hughes, and Robert Plomin. 2005. “Nice and Nasty Theory of Mind in Preschool Children: Nature and Nurture.” *Social Development* 14:664–84.

Rossi, Alice. 2001. “Development Roots of Adult Social Responsibility.” Pp. 227–320 in *Caring and Doing for Others*, edited by Alice Rossi. Chicago, IL: University of Chicago Press.

Rotolo, Thomas and John Wilson. 2007. “Sex Segregation in Volunteer Work.” *Sociological Quarterly* 48:559–85.

Rushton, J. Phillippe. 2004. “Genetic and Environmental Contributions to Pro-Social Attitudes: A Twin Study of Social Responsibility.” *Proceedings of the Royal Society* 271:2583–5.

Satorra, A. and P. M. Bentler. 2001. “A Scaled Difference in Chi-Square Test Statistic for Moment Structure Analysis.” *Psychometrica* 66:507–14.

Schnittker, Jason. 2008. “Happiness and Success: Genes, Families, and the Psychological Effects of Socioeconomic Position and Social Support.” *American Journal of Sociology* 114(Supplement):S233–59.

Shanahan, Michael and Scott Hofer. 2005. “Social Context in Gene–Environment Interactions: Retrospect and Prospect.” *Journals of Gerontology* 60B:65–76.

Stubbe, Janine, Dorret Boomsma, and Eco De Geus. 2005. “Sports Participation during Adolescence: A Shift from Environmental to Genetic Factors.” *Medicine and Science in Sports and Exercise* 37:563–70.

Wilhelm, Mark, Eleanor Brown, Patrick Rooney, and Richard Steinberg. 2008. “The Intergenerational Transmission of Generosity.” *Journal of Public Economics* 92:2146–56.