Genetic and Environmental Influences on Religiousness: Findings for Retrospective and Current Religiousness Ratings

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ABSTRACT Estimates of the degree of genetic and environmental influences on religiousness have varied widely. This variation may, in part, be due to age differences in the samples under study. To investigate the heritability of religiousness and possible age changes in this estimate, both current and retrospective religiousness were assessed by self-report in a sample of adult male twins (169 MZ pairs and 104 DZ pairs, mean age of 33 years). Retrospective reports of religiousness showed little correlation difference between MZ ($r = .69$) and DZ ($r = .59$) twins. Reports of current religiousness, however, did show larger MZ ($r = .62$) than DZ ($r = .42$) similarity. Biometric analysis of the two religiousness ratings revealed that genetic factors were significantly weaker (12% vs. 44%) and shared environmental factors were significantly stronger (56% vs. 18%) in adolescence compared to adulthood. Analysis of internal and external religiousness subscales of the total score revealed similar results. These findings support the hypothesis that the heritability of religiousness increases from adolescence to adulthood.

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GENETIC AND ENVIRONMENTAL INFLUENCES ON RELIGIOUSNESS: FINDINGS FOR RETROSPECTIVE AND CURRENT RELIGIOUSNESS RATINGS

Though the study of religiousness has existed for quite some time, it is now experiencing a revival as an important psychological variable. Religiousness has been found to be negatively related to antisocial behavior (Mason & Windle, 2002) and positively related to prosocial behavior (Morgan, 1983). Both psychological (e.g. depression; McCullough & Larson, 1999; Smith, McCullough, & Poll, 2003) and physical (see Powell, Shahabi, & Thoresen, 2003) health have also been found to be positively associated with religiousness. The relationship between religiousness and personality has been another area of inquiry. Saucier and Goldberg (1998) found that religiousness was mostly orthogonal to the Big Five personality factors of Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness and concluded that religiousness was one of the best candidates for a new trait dimension. MacDonald (2000) also found that the Big Five factors of personality are different from factors of spirituality. These studies provide a basis for the study of religiousness as an important aspect of the person. Along with these lines of inquiry, religiousness has also been investigated from a behavior genetics perspective in order to estimate the degree to which variance in religiousness is due to genetic and environmental factors. The purpose of the present study was to examine genetic and environmental contributions to religiousness in an adult male twin sample.

Contemporary research supports the hypothesis that religiousness is moderately heritable. Studies of adult twins have found heritabilities in the .35 to .55 range, depending on the measure used to assess the phenotype. Bouchard, McGue, Lykken, and Tellegen (1999), studying adult twins who had been reared apart, found heritabilities of .43 for intrinsic religiousness and .39 for extrinsic religiousness (see Allport and Ross, 1967, for a discussion of these two types of religiousness). A heritability of .41 was found using the Minnesota Multiphasic Personality Inventory (MMPI) religious fundamentalism scale in an adult twin and adoptee sample (Beer, Arnold, & Loehlin, 1998). Bouchard et al. (2004), using a four-group design (adult monozygotic, MZ, and dizygotic, DZ, twins reared apart and together), reported a heritability of .54 on the MMPI Wiggins Religious Fundamentalism scale. Using frequency of attending

religious services as their phenotype, Truett et al. (1994) reported a heritability of .26 for males and .34 for females. Findings of substantial heritable influences on religiousness are not uniformly supported, however, since Truett, Eaves, Meyer, Heath, and Martin (1992) found no heritability in a sample of adult male Australian twins using church attendance to measure religiousness and a heritability of .16 when using the religiousness factor of the Wilson-Patterson Conservatism scale (though the estimates were slightly higher for females).

Age may be an important moderator of heritable influences on religiousness, with studies of younger samples suggesting lower heritability than the studies of adult samples already discussed. Winter, Kaprio, Viken, Karvonen, and Rose (1999) examined adolescent twins' (mean age of 16.2) MMPI religious fundamentalism scores and reported heritabilities of .11 for females and .22 for males. Boomsma, de Geus, van Baal, and Koopmans (1999) used three items to study religiousness: affiliation, religious upbringing, and degree of active participation in religious activities. They found that monozygotic (MZ) and dizygotic (DZ) twin pairs, with an average age of 17.8 years, were equally and highly correlated on the religious items in their survey. This suggested little heritable influence on the three items, with shared environmental factors being the major determinant of religiousness in this adolescent sample. Abrahamson, Baker, and Caspi (2002) found similar results in a sample of adoptees. In their sample of children aged 12 to 15, religious attitudes were influenced strongly by shared environmental effects and weakly, if at all, by genetic effects.

Although comparisons across studies with differently aged samples suggest that genetic influences may grow in salience with age, the hypothesis of age moderation of heritable influences on religiousness had never been tested directly in a single sample. The present study provided such a test. Ratings of both childhood and adulthood religiousness were obtained from a sample of adult male twins and used to determine the degree to which the heritability of self-report of religiousness differs at two developmental stages. We also divided our religiousness scale into two subscales, one measuring internal facets of religiousness and one measuring external facets, to examine any differences in genetic influences that may exist between these two styles of religious behavior. Previous studies, like those discussed above, have shown that the heritability of religiousness was around

.3 to .5 for adult samples, but only .1 to .2 when younger samples were studied. The current study was able to estimate both of these heritabilities in the same sample. Our hypothesis was that genetic influences on religiousness would increase from retrospective to current religiousness ratings while shared environmental influences would decrease. The use of the same sample to simultaneously estimate childhood and adulthood religiousness should shed light on age changes in the heritability of religiousness and help to eliminate sample fluctuation in the explanation of differences in these heritabilities.

METHODS

Participants

Participants for this study were male twins born between the years of 1961 and 1964 in Minnesota. They are the youngest cohort of the Minnesota Twin Registry (MTR). Their average age at the time of completion of the measures was 33 years. Twin pairs were identified from Minnesota State Health Department birth records with over 90% located using public databases (e.g., phone directories). Surviving twin pairs were contacted by mail. Zygosity of the twin pairs was assessed with five questions pertaining to twin similarity. This method is 95% accurate when compared to assessing zygosity through blood samples (Lykken, Bouchard, McGue, & Tellegen, 1990). Both members from a total of 169 monozygotic (MZ) and 104 dizygotic (DZ) twin pairs had complete religiousness data and were used in the present analyses.

Materials

Religiousness scale. Our assessment of religiousness included a self-report of religious affiliation and nine items that measured the centrality of religion in the individual's life. A factor analysis of twins' current self-report responses to the nine items revealed one factor with an eigenvalue greater than one, with all items loading highly on this single factor. An overall religiousness score was computed by summing the nine item responses.[1] Table 1 gives the nine items along with means, factor loadings, and item-total scale correlation based on the twin self-reports of

1. Because the items summed to form the composite varied in scale, we checked to make sure no single item was having an undue influence on the total by standardizing the items prior to forming the composite. Because the standardized composite correlated very highly with the raw composite ($r = .997$ for current and .995 for retrospective ratings), the latter was used in all analyses reported here.

Table 1
Religiousness Scale Items and Mean, SD, Factor Loading, and Item-Total Correlation for Current Religiousness Ratings

Item	Response Range	Mean (*SD*)	Factor Loading	Item-Total *r*
1. Frequency of attending religious services	0–4	1.65 (1.20)	0.74	0.74
2. Frequency of seeking guidance, help, or forgiveness through prayer	0–3	1.52 (1.06)	0.59	0.74
3. Frequency of reading scripture or other religious material	0–4	1.39 (1.27)	0.85	0.79
4. Frequency of reviewing/ discussing religious teachings with family	0–4	1.28 (1.25)	0.82	0.78
5. Frequency of deciding moral "dos" and "don'ts" for religious reasons	0–3	1.36 (1.12)	0.65	0.74
6. Frequency of observing religious holidays	0–3	2.24 (1.01)	0.37	0.54
7. Membership in religious youth or study groups	0–1	0.17 (0.38)	0.72	0.63
8. Having friends with similar beliefs	0–4	2.20 (0.93)	0.36	0.40
9. Importance of religious faith in daily life	0–4	1.98 (1.23)	0.65	0.80

Note. Means are for complete twin pairs only, while factor loadings and item-total *r*'s are reported for the entire sample. Data are based on the twin self-reports. The response scale for the items differed based on item content, but ranged from "never" to a high frequency description (e.g. "more than once a week," "daily," "always"). The item 7 response set was "yes" or "no".

current religiousness. The response scale differed, based on the item, but ranged from "never" to a high-frequency description (e.g. "more than once a week," "daily," "always"). All items, except for one that had only a "yes/no" response choice, had four or five response choices, along with a "don't know" option. Because of this "don't know" option, many individuals did not have a full set of nine items. If an individual was missing two or fewer items, the sample's mean score for that (those)

item(s) was substituted and used in computing the religiousness score. The internal consistency reliability (alpha) for the scale was .90 ($N = 571$). In addition to self-report of current religious behavior, twins answered the nine questions as they applied to themselves when they were growing up, their co-twins, both currently and when growing up, and their mothers and fathers, currently and when the twins were growing up. For all individuals, this allowed for both current ratings of religiousness and ratings of religiousness when the twin was young.

Although not supported by the factor analysis of the items, we decided to compute two subscales of religiousness based on their potential theoretical importance. Items were rationally assigned to the two subscales. The first assessed external aspects of religiousness (the four items of attending religious services, discussing religious teachings, observing religious holidays, and membership in youth/study groups) that might be most susceptible to environmental influence; the second reflected internal aspects of religiousness (the five items of seeking help through prayer, reading scripture, deciding moral actions, having a friend with similar beliefs, and importance of faith) that may be most susceptible to heritable influence. Subscales score were created using the same correction for missing data, except that only one item was allowed to be missing in a given subscale. For the four-item current internal scale, the internal consistency reliability (alpha) was .85 ($N = 679$), and for the five-item current external scale, it was .75 ($N = 679$). The correlation between the internal and external scale was .71 ($N = 653$) for retrospective ratings and .82 ($N = 653$) for current ratings.

Statistical Analysis

We modeled the MZ and DZ covariances with the program Mx (Neale, Boker, Xie, & Maes, 1999). Mx was used to decompose the variance of religiousness into portions associated with genetic influences (A), shared environmental influences (C), and nonshared environmental influences (E). Shared environment includes environmental influences that are shared by members of a twin pair and thus make twins similar within families. Nonshared environment includes influences that are unshared by members of a twin pair and so make the twins different from each other. The nonshared environmental component of variance also includes measurement error. Twin self-reports of current and retrospective religiousness were analyzed using a general bivariate model (Figure 1). This model allowed for separate genetic and environmental effects on current (subscript 2) and retrospective (subscript 1) religiousness, as well as correlations between underlying genetic and environmental effects. The same model was used to assess the internal and external religiousness subscales.

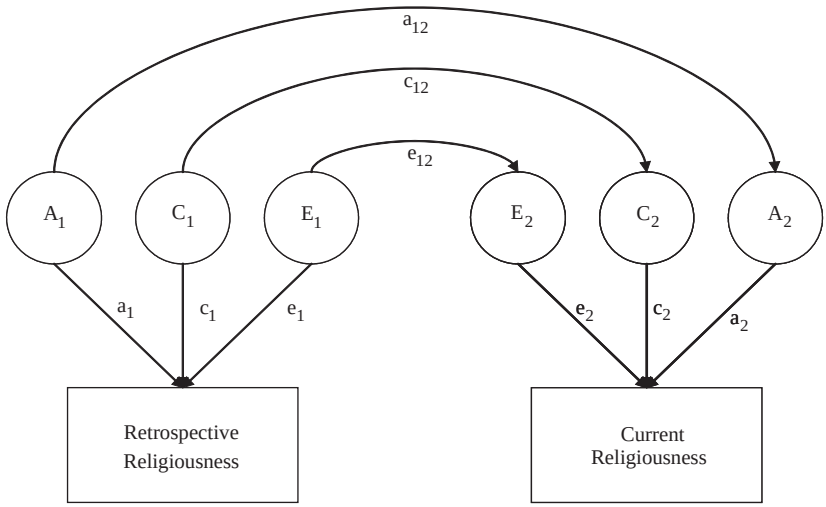

Figure 1
Bivariate model showing the relationship between current and retrospective religiousness over time. "A" represents genetic influences, "C" represents shared environmental influences, and "E" represents nonshared environmental influences.

In order to assess change in the architecture of genetic and environmental influences across the two ratings, two additional models were fit to the twin data: one equating A, C, and E between retrospective and current religiousness and one equating A and C only. For the internal and external religiousness scales, the full model was compared to the model fit for models constraining A and C to be equal. The fit of these reduced models was compared to the fit of the general no-constraint model using a χ^2 difference test and the Akaike Information Criterion (AIC; Akaike, 1987). The AIC is an index that balances model fit against model parsimony, with lower negative values of AIC reflecting better fit. If the constrained model fit the data better than an unconstrained model, we would conclude that the parameter estimates did not need to differ between the retrospective and current ratings.

RESULTS

Means

The overall means for retrospective and current religiousness ratings were 15.7 ($SD = 5.7$) and 13.9 ($SD = 7.2$), respectively. The mean religiousness scores did not vary significantly by zygosity for full

twin pairs. For retrospective religiousness, the average score for MZ twins was 15.9 ($SD = 5.6$), and the average score for DZ twins was 15.5 ($SD = 5.8$) [$t(632) = .773$, $p > .05$]. The average religiousness scores for the current adult ratings were 14.2 ($SD = 7.2$) for MZ twins and 13.5 ($SD = 7.2$) for DZ twins [$t(630) = 1.08$, $p > .05$]. The means did differ significantly across time, however, with retrospective religiousness ratings being significantly greater than current religiousness ratings [for MZ pairs, $t(373) = 5.14$, $p < .05$; for DZ pairs, $t(252) = 5.08$, $p < .05$]. Overall, there appeared to be both change and stability in religiousness, since the overall correlation was .52 between retrospective and current ratings. For MZ twin pairs, the retrospective-current correlation was .49, while for DZ pairs, it was .56.

A means analysis was also carried out to compare the twin pairs where data was gathered on both twins versus twin pairs where data was gathered on only one of the twins. Bias would be reflected by single-member twins having a significantly different mean than complete twin pairs. The analysis was completed on a combined sample of MZ and DZ twin pairs because the number of MZ twins from broken pairs was too small ($n = 8$) for separate analysis. The mean for retrospective religiousness when both members of a pair were assessed was 15.7 ($SD = 5.7$, $n = 634$), and the mean when only one member of the pair was assessed was 16.1 ($SD = 5.9$, $n = 38$). For current religiousness, the means were 13.9 ($SD = 7.2$, $n = 632$) and 14.9 ($SD = 7.4$, $n = 37$). The differences between the means for pairs when both twins were assessed and when only one twin was assessed were not significantly different [for retrospective ratings, $t(669) = -.416$, $p > .05$; for current ratings, $t(668) = -.714$, $p > .05$].

Interrater Reliability

A specific person's rating of himself agreed highly with the way the co-twin perceived him. Table 2 contains the interrater agreement intraclass correlations. The correlation between the self-rating of a twin and his co-twin's rating of him was .69 for retrospective reports and .86 for current ratings. These correlations differed little, depending on zygosity, though DZ agreement was slightly lower. The fact that a twin's rating of his co-twin agrees highly with the co-twin's rating of himself shows that the twins can reliably rate each other's religiousness.

Table 2
Interrater Agreement Interclass Correlations (and 95% Confidence Intervals) for Religiousness Ratings of Twin and Co-Twin When Rating Self/Co-Twin, Mother, and Father

Religiousness	MZ	DZ	All
Retrospective			
self-co-twin	.69 (.58–.77)	.67 (.52–.78)	.68 (.60–.75)
mother-mother	.50 (.25–.69)	.47 (.00–.77)	.49 (.28–.66)
father-father	.81 (.65–.90)	.74 (.37–.91)	.78 (.65–.87)
Current			
self-co-twin	.86 (.79–.91)	.77 (.58–.88)	.83 (.78–.88)
mother-mother	.71 (.59–.80)	.45 (.20–.64)	.62 (.51–.71)
father-father	.78 (.68–.85)	.70 (.50–.83)	.75 (.66–.82)

Note. The self-co-twin correlations reflect the similarity of the target's ratings of himself with the ratings of the target as perceived by his co-twin.

The twins' ratings of their parents correlated approximately .50 for the mothers' religiousness and .70 for the fathers' (Table 2). Both the current and retrospective correlations were of the same magnitude for each parent. Again, twin zygosity had little effect on the similarity of parent ratings, though DZ agreement did tend to be slightly lower than MZ agreement. The twins agreed somewhat less on the ratings for their mother compared to their father, but correlations were still of moderate magnitude. These results again showed that the twins could reliably rate the religiousness of other individuals. Because the DZ agreement was not lower than the MZ agreement, the ability of the twins to agree on another individual's religiousness did not depend on the zygosity of the pair.

Each twin seemed to see his parents as having similar levels of religiousness. The correlations between ratings of mothers' and fathers' religiousness were, for retrospective ratings, .79, and for current ratings, .77, showing that the mother and father were viewed similarly by the twins. These high correlations suggest high assortative mating for religiousness. Each parent's religiousness was also viewed as being stable over time. The correlation between retrospective and current ratings was .92 for mothers and .94 for fathers.

Interestingly, twins saw themselves as being more similar to their parents when rating both retrospectively. This data is shown in Table 3. When rating retrospectively, the twin-mom and twin-dad correla-

tions were around .75. For current ratings, however, the correlations were around .35. Since parents' religiousness was seen to change very little over time, the difference in these correlations primarily reflects change in the twins' religiousness as they aged.

Twin Similarity

As seen in Table 3, the twin correlations for religiousness were high and varied by zygosity. When rating retrospectively, the MZ correlation for religiousness was .69, and the DZ correlation was .59. The difference between these correlations was not significant ($Z = 1.35$, $p > .05$). When rating current religiousness, however, the MZ and DZ correlations were .62 and .42, respectively, and were significantly different ($Z = 2.18$, $p < .05$). It appeared that the MZ twins maintained their similarity over time, while the DZ twins became more dissimilar. These correlations suggest low genetic and high environmental influences when the twins were young but a larger genetic influence as the twins age.

A general bivariate model, shown in Figure 1, was fit to the data to formalize the heritability estimates for the data set. We wanted to assess the genetic effects on religiousness over time and to see to what extent the genetic effect when young accounted for the genetic effect when the twins were older. First, a full ACE model was fit to the data, allowing all parameters to be free. The estimates and confidence intervals for this model can be found in Table 4. Model fit statistics showed that the model fit the data well (χ^2 (11) = 12.5, $p = .33$, AIC = -9.5). The estimates showed that common environment was the largest influence in the childhood data, while genetic influences were the largest in adulthood. Nonshared environmental influences, which included error variance, remained about the same

Table 3
Twin and Parent-Offspring Correlations (95% CI) for Retrospective and Current Religiousness Interclass Correlations

Religiousness	MZ	DZ	Mom-Twin	Dad-Twin
Retrospective	0.69 (.60–.76)	0.59 (.45–.70)	0.74 (.66–.80)	0.76 (.68–.82)
Current	0.62 (.52–.71)	0.42 (.25–.57)	0.36 (.24–.47)	0.35 (.22–.46)

Table 4
Standardized Variance Component Estimates and Model-Based Correlation Estimates (95% CI) for Retrospective and Current Religiousness

	Parameter Estimates		
	A (95% CI)	C (95% CI)	E (95% CI)
Variance Estimate			
Retrospective	0.12 (.00–.40)	0.56 (.29–.71)	0.32 (.25–.40)
Current	0.44 (.12–.66)	0.18 (.01–.47)	0.38 (.30–.47)
Correlation	0.59 (.51–.66)	0.84 (.80–.87)	0.31 (.20–.41)

Note. A = genetic effects. C = shared environmental effects. E = nonshared environmental effects. The correlation entries give the correlations in genetic, shared environment, and non-shared environment effects across the two ratings.

over time. The genetic correlation was .59, the shared environmental correlation was .84, and the nonshared environmental correlation was .31.

To test the hypothesis that the genetic and environmental estimates remained constant across the two ratings, models were fit constraining the raw estimates of genetic, shared, environmental and nonshared environmental variance and the raw estimates of genetic and shared environmental variance to be equal over time. Constraining all three estimates would provide a model where none of the genetic or environmental estimates differed from retrospective to current religiousness ratings. This model fit worse than the original no-constraint model, with a χ^2 change, on 3 degrees of freedom, of 58.96 ($p < .001$), and AIC of 43.44. Constraining the genetic and shared environmental estimates to be equal over time and allowing only the nonshared environmental estimate to vary provide another test of the genetic and environmental change over time. The change in χ^2 change between the original model and this model was 8.77 on 2 degrees of freedom ($p < .05$), and the AIC was -4.73. Since neither of the constrained models fit the data better than the unconstrained model, the full model was accepted as the best fit for the data, allowing estimates for genetic and environmental influences to change from retrospective childhood ratings to current adulthood ratings.

The general bivariate model was also fit to the external and internal religiousness subscales, with estimates given in Table 5. The

Table 5
Standardized Variance Component Estimates and Model-Based Correlation Estimates (95% CI) for Retrospective and Current Internal and External Religiousness Subscales

	Parameter Estimates		
	A (95% CI)	C (95% CI)	E (95% CI)
Internal			
Variance Estimate			
Retrospective	0.20 (.00–.54)	0.44 (.12–.66)	0.36 (.38–.46)
Current	0.34 (.00–.63)	0.24 (.00–.54)	0.42 (.33–.53)
Correlation	0.75 (− 1.0–1.0)	0.56 (− 1.0–1.0)	0.42 (.29–.54)
External			
Variance Estimate			
Retrospective	0.08 (.00–.33)	0.53 (.30–.65)	0.39 (.31–.47)
Current	0.39 (.07–.63)	0.18 (.00–.47)	0.43 (.34–.53)
Correlation	0.62 (− 1.0–1.0)	1.0 (− .59–1.0)	0.13 (− .01–.27)

bivariate models fit the data well (internal, χ^2 (11) = 11.27, $p = .42$, AIC = − 10.73; external, χ^2 (11) = 20.54, $p = .04$, AIC = − 1.46). For both subscales, the heritability of the retrospective ratings was smaller than the heritability for the current ratings. Also, while the magnitude of nonshared environmental influences was similar across the two time points for both external and internal religiousness, shared environmental influences decreased across time. Though the confidence intervals for the internal and external religiousness heritabilities overlapped, retrospective ratings of external religiousness were less heritable than the retrospective ratings of internal religiousness. For internal religiousness, constraining genetic and environmental parameters to be equal over time resulted in a nonsignificant change in χ^2 of 2.8 on 2 df ($p > .05$) and a lower AIC of − 11.73, which showed that constraining the genetic and environmental variance components to be equal across time was reasonable for ratings of internal religiousness. For the external religiousness model, the constrained model did not fit the data better than the full model (χ^2 change of 9.17 on 2 df, $p < .05$, and a AIC of 3.71), and the full model with different heritability estimates across time was kept as the best fitting model.

DISCUSSION

Although the data were collected contemporaneously, the results were consistent with the hypothesis that genetic influences on religiousness increase with age. The heritability of religiousness was larger in adulthood than in childhood and consistent with findings from previous studies that also report greater heritability of religiousness in adulthood than adolescence, albeit on different samples. We also found that there was considerable overlap between the genetic and shared environmental influences on religiousness across the two ratings. Genes that influenced religiousness when the twins were growing up also played a part in adult ratings. Shared environment was also highly correlated over time, which was expected since shared environment is generally taken to include the effects of the familial rearing environment, including parental and sibling influences. Nonshared environmental influences were less related over time, showing that nonshared environmental influences in adulthood are largely different from those for children.

The current ratings for the two subscales of religiousness, internal and external, were also both heritable, while the retrospective ratings were less heritable, especially for the external subscale. In fact, the heritability and shared environmental estimates for internal religiousness could be equated across the two ratings without significant loss in model fit, but they could not be equated for external ratings. These findings suggest that the increase in heritability in overall religiousness may reflect the increasing importance of individual dispositional factors and the decreasing importance of external forces.

There were a number of limitations to this study. First, the results may not be generalizable to the larger U.S. population. The sample was all male, and different influences may be important for female religiousness. Kirk et al. (1999) report differences between men and women for church attendance, with women attending more frequently, and Truett et al. (1994) found greater heritability in females as compared to males for adult church attendance. In addition, this sample consists of adult Minnesotans. The distribution of religiousness as a trait in the midwestern United States may differ from religiousness elsewhere in the United States or in other countries. Kirk et al. (1999) reported more shared environmental effects, as well as less maternal and more paternal environmental effects, on Australian church attendance compared to U.S. attendance. The data was

best fit when the model did not constrain the estimates for the two countries to be equal.

The concept of religiousness as defined in this study also deserves comment, as religiousness can be defined in many ways. While our measure formed one coherent scale, we lack the means to make the distinction between the different types of religiousness seen in the literature (e.g. intrinsic, extrinsic, quest), except for the rational parsing of items into internal and external aspects of religiousness. Religiousness is also only one facet of the broader concept of spirituality. Saucier (2000), in a lexical analysis of attitudes using "isms," found that while religious terms loaded onto one factor (including religionism, theism, and evangelicism), words expressing other spiritual terms loaded onto a different factor (including transcendentalism, existentialism, and spiritualism). MacDonald's (2000) factor analysis of several spirituality scales revealed seven factors, one of which he labeled religiousness. The other factors dealt with other aspects of spirituality, including existential, paranormal, and experiential dimensions. The present study is informative about religiousness and is not meant to represent the entire concept of spirituality.

Although the retrospective ratings provided data that are not available in many other studies, the use of these ratings is a further limitation of the study, as retrospective ratings are not nearly as informative as longitudinal data. Nonetheless, the twins could reliably rate their childhood religiousness. Members of a twin pair agreed fairly highly on their retrospective ratings, whether rating themselves or their parents. Since members of a pair agreed for retrospective ratings almost as much as for current ratings, the retrospective ratings appeared to be reliable measure of religiousness. Agreement on another's religiousness, while not perfect, is higher than level of interrater agreement for variables found in other studies. Parent, teacher, and child ratings of psychopathology, for example, often correlate only modestly with one another, even when rating current behavior. In their meta-analysis of different informant ratings, Achenbach, McConaughy, and Howell (1987) found that raters with a similar relationship (e.g., two parents or two teachers) to the subject agreed significantly, but not completely (with a correlation around .60), on behavioral, emotional, or temperamental problems. Raters with different relationships to the subject agreed at an even lower level. The agreement found in this study was as high, or

higher, than Achenbach et al. found. Bouchard et al. (1999) also provide support for the validity of retrospective religious ratings. Adult adoptees provided ratings of their childhood religious environment (parental religiousness as assessed by the Moral Religious Scale of the Family Environment Scale). These ratings correlated only slightly (.10) with current intrinsic religiousness. For adults reared by their biological parents, however, the correlation between childhood religious environment and current religiousness was much higher (.53). These correlations reflect modest environmental transmission in the adoptee sample and both environmental and genetic transmission in the nonadoptee sample. These results were consistent with the genetic findings based on twins reared apart reported in the same paper. Had the retrospective reports on the childhood religious environment been largely unreliable or lacked veridicality, the correlations would have been low in both the adoptee and nonadoptee samples. While a more direct empirical check on the reliability of retrospective religiousness ratings would be desirable, the high level of agreement between raters in the current study, and the indirect evidence cited above, strongly supports their use.

While overall agreement of religiousness ratings was high, an interesting finding was that the twins agreed somewhat less about their mother's religiousness than their father's, both retrospectively and currently, though confidence intervals for these parental estimates were large. This finding seems counterintuitive since the twins most likely spent more time with their mother than their father and probably have had more communication with her both while growing up and as adults. Hood, Spilka, Hunsberger, and Gorsuch (1996) state that women tend to be more religious than men, that mothers assume the majority of the rearing responsibilities for their children, and that mothers seem to be more influential (as compared to fathers) in affecting their children's religiousness. Based on this information, one might expect that the twins would agree more on their mother's religiousness. All the twins in the current study were male, however, so it is possible that they were more inaccurate in reporting religiousness for a female because religiousness is expressed differently between genders. A study of female and opposite-sex twins could help resolve this issue.

The presence of a high correlation between parents for religiousness was consistent with the presence of high assortative mating for the trait. The assumption underlying twin models is that MZ twins

share 100% of their genes while DZ twins share only 50%. When assortative mating is present, the genetic similarity of the parents increases the genetic similarity of the DZ twins. This causes a higher than expected DZ correlation, as compared to the MZ correlation, which the model incorrectly attributes to shared environmental influences. The presence of assortative mating for religiousness in this sample may have resulted in an overestimate of shared environmental influence in religiousness. If assortative mating were driving the shared environmental effect in this data, however, then genetic and environmental estimates would be expected to be similar over time. Nonetheless, the estimates of A, C, and E did differ from adolescence to adulthood. The effects of assortative mating could be modeled using a twin-family approach, but this would require that the variance decomposition was the same for the parents as it was for the twins. This assumption might be met for the twins' current—but clearly not for their retrospective—ratings of religiousness. For this reason, twin-family models were not fit.

This study's finding that the heritability of religiousness increases across retrospective and current ratings adds further to the literature indicating that genetic factors increase in importance while shared environmental factors decrease in importance during the transition from adolescence to adulthood. For example, Eaves et al. (1997) used cross-sectional twin data to show that the heritability of conservatism also increased with age. These findings are consistent with the hypothesis that developmental change occurs around the time an adolescent leaves the family home. When this happens, parents begin to lose influence over their child since they cannot monitor his or her behavior to the same degree as they previously had. While growing up, a child is likely to be given little choice over attending church, celebrating religious holidays, or discussing religious teachings; but when he or she leaves the home, these activities are more difficult, if not impossible, for the parents to influence directly. Thus, the adolescent begins to decide for him- or herself whether religion will continue to be an important aspect of his/her life. The results of the two religiousness subscales support this explanation since the external items, which, by conceptual definition, are aspects of religiousness that can be more easily influenced by parents or other individuals, seem to be more environmentally, and less genetically, mediated for the retrospective, childhood ratings. With current ratings, however, external religiousness becomes more heritable. The

internal items are more equally heritable across the two time points. Other studies have found, though not unequivocally, that religiousness changes during college years when the child leaves the home (Hood et al., 1996). This change coincides with the change in heritability in religiousness (and conservatism), and is a possible explanation for the effect.

The finding that adult religiousness is more genetically influenced than retrospectively recalled childhood religiousness is interesting, but replication, with longitudinal data, is highly desirable. The reasons behind this change should be investigated as well. While age could be considered a moderator of the heritability of religiousness, other possible moderators should also be examined. These results also provide further evidence that religiousness should be added to the standard list of personality variables. Like other personality traits, adult religiousness is heritable, and though changes in religiousness occur during development, it is fairly stable. Research by psychologists on religiousness should continue so that the sources of individual differences in religiousness can be further understood.

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