

# WHERE GOD AND SCIENCE MEET

How Brain and Evolutionary Studies  
Alter Our Understanding of Religion

VOLUME 1

Evolution, Genes, and the Religious Brain

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GENETIC AND ENVIRONMENTAL  
INFLUENCES ON THE TRADITIONAL  
MORAL VALUES TRIAD—  
AUTHORITARIANISM, CONSERVATISM,  
AND RELIGIOUSNESS—AS ASSESSED  
BY QUANTITATIVE BEHAVIOR  
GENETIC METHODS

*Laura B. Koenig and Thomas J. Bouchard Jr.*

WHY STUDY GENETIC INFLUENCE ON SOCIAL  
ATTITUDES HIGHLY RELATED  
TO RELIGIOUSNESS?

The purpose of this chapter is to review data on the genetic and environmental influences on religiousness. The common perception is that religiousness and related variables are formed by socialization processes within the family and that genetic influences are largely irrelevant. Despite this perception, there are reasons why one should examine the possibility of genetic influence on religiousness. First, religiousness may be a biological adaptation, and it may be worthwhile to try to understand it from this perspective. Second, studies that control for or estimate genetic influence provide a clearer picture of the true environmental influences on the trait. Finally, unless religiousness is unlike most other psychological characteristics, it should be heritable. Each of these reasons is addressed in turn before we turn to the structure of social attitudes and the quantitative genetic findings related to religiousness.

**Is Religiousness a Biological Adaptation?**

Religiousness is a powerful driving force in all human societies—a human universal (Brown, 1991). Wilson (1978) has argued that “the predisposition to religious belief is the most complex and powerful force in the human mind and in all probability an ineradicable part of human nature” (p. 169). Indeed, despite the growth of scientific rationalism in the twentieth century, religion

continues to flourish. The huge body of writing on religious topics generated by literate societies and the commitment to religious beliefs by individuals of extremely high intellect testify loudly to the fact that religious belief systems can attain high levels of complexity and persuasiveness. Universality and complexity of a trait or characteristic strongly suggests that it is an evolutionary adaptation (Buss, Haselton, Shackelford, Bleske, & Wakefield, 1998; Williams, 1966). Yet it is also clear that religious fervor can lead to genetic extinction for particular individuals as witnessed by celibate religious orders over the centuries and suicide bombers in recent years.

These latter observations seemingly throw doubt on the idea that “religiousness” is an adaptation, but that is an incorrect interpretation for a number of reasons. First, behavioral expression by individuals at the extremes of a trait addresses the power of the trait to influence behavior, but behavior at the extremes may not reflect its most important function. This may be determined by the mean value. Indeed, one hypothesis generated by the adaptationist argument is that the trait is under some degree of balancing selection; that is, individuals at both extremes have a lower level of fitness. Second, the mechanism by which the trait influences fitness may be costly yet adaptive. Zahavi and Zahavi’s (1997) handicap principle (costly signaling theory [CST]) has been fruitfully applied to the role of religious ritual by Sosis (2004). We do not have space to explicate this theory here. Suffice it to say that a straightforward prediction of CST is that religious groups with the most stringent requirements for continuing membership generate the highest levels of commitment. This fact has been well known to the field of social psychology for many years, and the evidence overwhelmingly supports the hypothesis. Both military basic training and fraternity hazing draw on this principle for generating member commitment. Finally, it is probably a mistake to think that the adaptiveness of religious beliefs is mediated through a single process or mechanism. For example, religiousness could influence reproductive fitness by encouraging (a) families to have more children, (b) better health practices (avoidance of alcohol and drugs), or (c) greater paternal involvement in the care of children. Of course, a trait that evolved in the Pleistocene (the so-called environment of evolutionary adaptation [EEA]) may not express itself in the same way in modern environments. This fact makes testing the adaptiveness hypothesis difficult but not impossible. Nevertheless, if religiousness is/was an adaptation in the EEA, it follows that it must have a genetic basis. Demonstrating that it is a heritable trait, however, does not prove it is an adaptation.

## Understanding the Factors That Influence Religiousness

A second reason for carrying out behavior genetic studies of religiousness is in order to get a better understanding of the reasons why some parental

child-rearing practices and parents' characteristics correlate with offspring characteristics such as religiousness. It is widely believed that parenting is the major determinant of attitudes. Altemeyer (1988), quoting Mark Twain (1935), argued that we "get our opinions where we get our corn pone—at home" (p. 63). This "corn pone" theory is based, for example, on a correlation of 0.40 between parents and their adult offspring's right-wing authoritarianism (RWA) scores. This view of attitude and personality formation has come under considerable criticism in recent years (Harris, 1995, 1998, 2000; Rowe, 1994; Scarr, 1996, 1997). These critics have pointed out correctly that correlations between parenting/child-rearing behavior and offspring characteristics are ambiguous with regard to causation, as they may well reflect genetic factors. Indeed, the magnitude of "genetic influence" may be so great as to swamp the purported environmental influence. Developmental psychologists have come around to admitting the seriousness of this design "flaw," pointing out that they "often overstated conclusions from correlational findings; relied excessively on singular, deterministic views of parental influence; and failed to attend to the potentially confounding effects of heredity" (Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000, p. 218). The correlation between a measure of child rearing, no matter how it was obtained (observation at the time the behavior was emitted or retrospectively by either the parent or the child), and a measured characteristic of the child (phenotype) can be mediated in whole or in part by genetic factors. The relative influence of each is an empirical question that must be determined by an appropriate research design. We also note here that while the correlation may exist at one age, it may well disappear later. We illustrate this interesting possibility with age curves for conservatism and longitudinal research on authoritarianism and put the findings in a "life history/evolutionary" context. The error of interpreting correlations between parental behavior and offspring psychological traits continues to be repeated on a regular basis by correlational psychologists, although some investigators are now explicit about the possibility of a genetic confound (Koestner, Walker, & Fichman, 1999; Kraft & Zuckerman, 1999).

### **If Religiousness Is Just Another Trait, It Should Be Heritable**

Religiousness as trait falls into the domain of values/social attitudes. Until quite recently, the idea that social attitudes could be influenced by genetic factors was considered far-fetched. Psychologists (Adorno, Frenkel-Brunswick, Levinson, & Sanford, 1950; Altemeyer, 1981), sociologists (Freese, Li, & Wade, 2003), and even geneticists (Cavalli-Sforza & Feldman, 1981) simply assumed without much evidence that transmission of social attitudes was entirely cultural. Attitudes toward the possibility of genetic

influence on attitudes, however, have changed. Major textbooks on attitudes now acknowledge genetic influence (Eagly & Chaiken, 1993), as do experimental researchers in social psychology (Bourgeois, 2002; Crelia & Tesser, 1996; Tesser, 1993; Tesser, Whitaker, Martin, & Ward, 1998). This change reflects widespread recognition of what Turkheimer and Gottesman (1992; see also, Turkheimer, 2000) call the first law of behavior genetics, namely, that “all human behavioral traits are heritable.” Religiousness and related variables are no exception and should not be left out of the purview of behavior geneticists. As Lynch and Walsh (1998) have pointed out, “Almost every character in almost every species that has been studied intensively exhibits nonzero heritability” (p. 174). The use of the term “almost” is not accidental, as biology is the science of exceptions.

## RELIGIOUSNESS AND THE STRUCTURE OF SOCIAL ATTITUDES

There is no widely agreed-on structural model in the field of social attitudes comparable to the “big five” in personality (Bouchard & Loehlin, 2001) or the hierarchical (*g*) theory in mental abilities (Johnson & Bouchard, 2005). The major dimensions typically revealed in important studies, however, are religiousness, authoritarianism, and conservatism, and as Saucier (2000) has shown, they “form a strong mutually correlating cluster” (p. 375), or what might otherwise be called a syndrome. We call this syndrome the Traditional Moral Values Triad (TMVT). For example, intrinsic religiousness (discussed later in this chapter) correlates about 0.40 with RWA (Altemeyer, 1988, p. 218, table 7), and conservatism (Lorr’s Conservatism scale; Tarr & Lorr, 1991) correlates 0.57 with RWA. A reverse measure of authoritarianism is the Multidimensional Personality Questionnaire (MPQ) Traditionalism scale (Tellegen, 2000). It correlates about 0.76 with RWA (Altemeyer, 1996, p. 36) and 0.58 with conservatism as measured by the Wilson-Patterson Conservatism scale (Bouchard et al., 2003). It would be possible to conduct a behavior genetic study of genetic and environmental influence on the general factor, which accounts for the correlation between these variables, as well as on traits themselves with the general factor removed. To our knowledge, no one has carried out such a study. In any event, because of the high correlations between these related constructs, we report behavior genetics findings for all of them.

It is our view that scores on authoritarianism scales (RWA and traditionalism) reflect, to a considerable degree, a person’s concern with how families are organized (a sample RWA item reads as follows: Obedience and respect for authority are the most important virtues children should learn.). Scores on conservatism scales tend to contain items relevant to social policy and reflect concern with how societies are organized (sample items, responded to yes, ?,

or no: death penalty, abortion). Scores on religiousness scales tend to contain items about who controls the universe (sample item: My religion is important because it answers many questions about the meaning of life.). Items from each domain are interspersed throughout all three instruments. A research program that addressed this issue would be of considerable interest. In any event, the psychological focus of the TMVT appears to be the imposition of some sort of order/control/organization on the important entities in one's life. This is, of course, a hypothesis that remains to be tested. For a different point of view regarding the psychological meaning of these dimensions, see Eckhardt (1991), who also sees the "origin of these personalities in frustrating childhood disciplines (anxious, directive, hypocritical, inconsistent, and punitive)" (p. 118; see also Jost, Glaser, Kruglanski, & Sulloway, 2003).

### A NOTE ON RELIGIOUSNESS, SPIRITUALITY, MYSTICISM, AND EXISTENTIALISM

A related research program worth mentioning is the study of spirituality by MacDonald (2000), who, as a result of a comprehensive review of the literature (MacDonald, Friedman, & Kuentzel, 1999; MacDonald, Kuentzel, & Friedman, 1999) and a major scale development program, has demonstrated that there are five robust factors in this domain: cognitive orientation toward spirituality, experiential/phenomenological dimension (or the mysticism factor), paranormal beliefs, religiousness, and existential well-being. The correlations between his scales are shown in Table 3.1.

It is obvious that existential well-being is uncorrelated with any of the other factors. Cognitive orientation towards spirituality and religiousness form a higher-order factor, as do paranormal beliefs and experiential/phenomenological dimension. We note here that the best marker variable for religiousness and cognitive orientation toward spirituality is the Allport

**Table 3.1 Oblique Factor Intercorrelations for the MacDonald Expression of Spirituality Inventory ( $N = 938$ )**

Factor	1	2	3	4
Cognitive orientation toward spirituality				
Paranormal beliefs	0.13			
Experiential/phenomenological	0.39	0.28		
Existential well-being	0.08	-0.07	0.02	
Religiousness	0.63	-0.01	0.12	0.02

*Source:* MacDonald (2000, table 2).

and Ross (1967) Intrinsic Religiousness scale with loadings of 0.56 and 0.59. The best marker for experiential/phenomenological dimension is the Hood Mysticism scale (Hood, 1975; Hood et al., 2001). These two scales correlate near zero (Hood et al., 2001). MacDonald's work therefore suggests strongly that intrinsic religiousness is a reasonably good measure of the construct of religiousness, at least in Western populations, and the construct of mysticism is distinctly different. In our view, the Mysticism scale captures, to a large extent, what many people call spirituality/transcendence (MacDonald & Holland, 2002). The discriminant validity of the scales is demonstrated by the fact that the Intrinsic Religiousness scale correlates 0.37 with traditionalism and 0.02 with the MPQ Absorption scale (a measure of how easily one can be caught up in sensory experiences and relinquish a realistic frame of reference; Bouchard, McGue, Lykken, & Tellegen, 1999), whereas mysticism correlates 0.03 with traditionalism and 0.44 with absorption (unpublished data). Mysticism/spirituality does not appear to be a part of the TMVT, so is not discussed here, though we do regard it as an important concept.

## QUANTITATIVE BEHAVIOR GENETIC METHODS

Here we briefly introduce the reader to standard quantitative genetic methods (Falconer & Mackay, 1996; Plomin, DeFries, McClearn, & McGuffin, 2001; Posthuma et al., 2003) in order that the next section of this chapter will be readily interpretable. The variance (the extent to which people differ) in a quantitative phenotype ( $V_p$ ) is decomposed into three components: a genetic component ( $V_g$ ), a shared environmental component ( $V_c$ ), and a nonshared environmental component ( $V_e$ ). The typical form of the equation is:

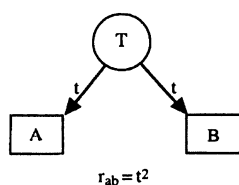
$$V_p = V_g + V_c + V_e \quad (1)$$

Figure 3.1 shows how various kinships are used to estimate the components. Figure 3.1a is the basic model that underlies all the others. It is the widely used (by psychologists) Hoyt Parallel Form Reliability (Hoyt, 1941; also called Alternate Form or Equivalent Form) discussed in most measurement textbooks. The circle is used to characterize a latent (underlying) construct, in this instance the "True scores," or  $T$ , of the individuals who has completed both forms of the test ( $A$  and  $B$ ). The test scores represented by  $A$  and  $B$  are measured phenotypes, and phenotypes are shown in boxes. The correlation ( $r_{ab}$ ) is estimated via analysis of variance. The correlation between two parallel tests is interpreted as a measure of the variance accounted for by the True scores. It is a direct measure of variance due to a latent trait. The important point to note here is that we do not square the correlation to get "variance accounted for by the true score." The correlation tells us that directly. Psychologists are accustomed to squaring correlations

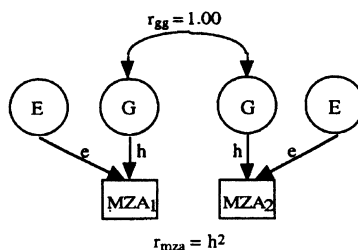
to obtain “variance accounted for,” but that procedure is not applicable when the influence of latent traits is being assessed, as in kinship models used to assess latent genetic and environmental influences. Figure 3.1a illustrates this interpretation in the form of a path model. The influence of  $T$  on test scores ( $A$  and  $B$ ) is shown by a directed arrow labeled  $t$ . By the rules of path analysis (Li, 1975), we multiply the value of all the paths connecting the phenotypes to determine the correlation. In this instance, it is simply  $t * t$ , or  $t^2$ .

Figure 3.1 Path Diagrams

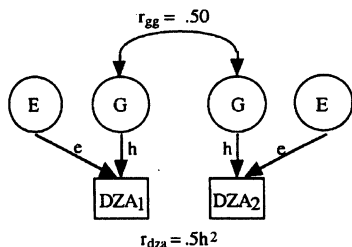
(a) Hoyt Parallel Form Reliability



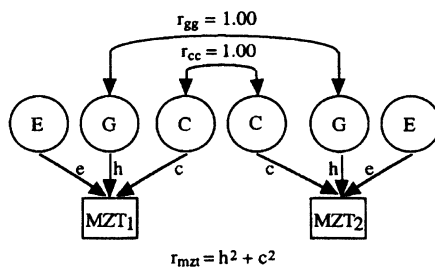
(b) Monozygotic Twins Reared Apart



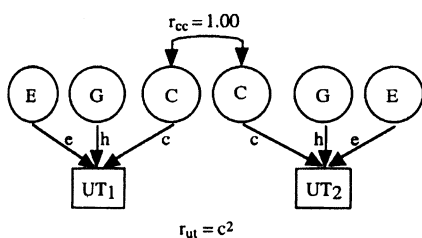
(c) Dizygotic Twins Reared Apart



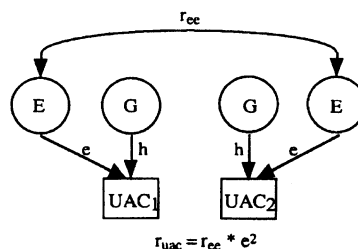
(d) Monozygotic Twins Reared Together



(e) Unrelated Individuals Reared Together



(f) Unrelated Individuals Reared in Correlated Environments



Notes: (a) reliability, (b) monozygotic twins reared apart, (c) dizygotic twins reared apart, (d) monozygotic twins reared together, (e) unrelated individuals reared together, and (f) unrelated individuals reared in correlated environments.



Figure 3.1b shows precisely the same model as it is used for monozygotic twins reared apart (MZA). Monozygotic twins have identical genotypes thus they can be considered “parallel forms.” Consequently,  $r_{gg} = 1.00$ . Assuming random placement (see the following discussion), the correlation between them can be due only to genetic factors, indexed as  $h$  on the paths joining the twins to the phenotype in the box. Because the twins are reared apart, they do not share environmental influences; thus, the latent trait  $E$  (for environment) is not connected by an arrow. The correlation between MZA twins thus estimates the variance due to the latent trait  $G$  (genetic influence), which is calculated as  $h * 1.00 * h$ , or  $h^2$ . We could have had only one  $G$  in a circle in this figure, but two  $G$ 's with a correlation of 1.00 represents the actual situation more clearly and facilitates the generalization to dizygotic twins. The symbol  $h^2$  represents heritability (where heritability is defined as the proportion of variance in a trait that can be explained by genetic variance). We do not square the value. Figure 3.1c represents the path diagram for dizygotic twins reared apart (DZA) and is identical to Figure 3.1b except for the fact that dizygotic twins share only half their genes in common by descent. Consequently, the  $G$ 's are correlated only 0.5 instead of 1.00, and the twin correlation estimates half the heritability. Figure 3.1d represents the correlations between monozygotic twins reared together (MZT). As in the reared apart case, the latent trait  $G$  is correlated 1.00, but in addition these twins are reared together and may share some environmental influences in common. This is represented by the correlation of 1.00 between the latent  $C$  factor ( $C$  for common environment, which is defined as environments that make individuals in the same family similar to one another, while the  $E$  represents environments that make individuals in the same family different from one another). This model represents the well-known view that MZT twins may be similar for two broad reasons: shared genes and shared (common) environment. Notice that the difference between the MZT and MZA correlation is the influence of  $C$ . Figure 3.1e illustrates the correlation between unrelated individuals reared together. Ideally, such individuals would be the same age, or “virtual twins” (Segal, 2000). The only reason for similarity, barring selective placement based on knowledge of their status on a trait (or that of one of their biological parents), is shared environmental influence. This correlation could be reduced by restriction of range in the trait-relevant environments in which they were placed (Stoolmiller, 1999). We specify “trait-relevant environments” because placement with regard to environments that do not influence the development of the trait are irrelevant, and demonstration of placement as a source of bias is unconvincing unless the variable on which placement has occurred is shown to be “causal.” Figure 3.1f shows a more general case of Figure 3.1e. UAC stands for unrelated individuals reared apart in correlated environments. It is obvious that if  $r_{ee} = 0.00$  (there was no correlation between their environment), we would be simply matching pairs of

people at random, and the expected correlation would be zero. The correlation thus depends on two factors: the degree of environmental influence on the trait ( $e$ ) and the degree of placement. What most people not trained in quantitative methods do not realize is how large these components have to be in order to generate very much of similarity. Bouchard, Lykken, McGue, Segal, and Tellegen (1990) present an example showing how much placement bias and degree of environmental influence is necessary to explain the similarity in IQ of MZAs.

Observed kinship correlations of the sort shown previously are fit to models using computer programs such as Mx (see also Loehlin, 2004; Neale, Boker, Xie, & Maes, 1999). These models can be quite elaborate and incorporate many special effects. For instance, many critics of twin research have argued that some monozygotic twins are monochorionic and others dichorionic (do or do not share the chorionic membrane) and that monochorionic twins therefore may be more similar because of this influence, which would inflate heritability estimates (Martin, Boomsma, & Machin, 1997). This effect has been built into the twin model with a data set that contained information on chorion type, and, at least for IQ, chorion type was shown to be inconsequential (Jacobs et al., 2001). As far as we are aware, almost any interesting hypothesis can be formulated in the elegant language of quantitative genetics, as it is simply a variant of the more fundamental analysis of variance.

We note here that the reason we speak of “causal influences” based on the analysis of kin correlations (actually most analyses are of covariances, but we will not pursue the distinction here) is because the twins are an experiment of nature and adoption is an experiment of society. In the case of adoption, since the participants are not necessarily randomly assigned to families (although this might well be approximated with regard to trait-relevant environmental factors because we have such limited knowledge of the causal factors), we should perhaps speak of a quasi-experimental design. Quasi-experimental designs are, of course, widely used in the social sciences (Campbell & Stanley, 1966).

## INTERPRETING BEHAVIOR GENETIC DATA IN A LIFE HISTORY CONTEXT

It is important to remember that from an adaptationist point of view, a trait or character functions within the context of a life history. That means that its expression has maximum importance only during part of the life span. It is also the case that every adaptation is not necessarily expressed. For example, the thick skin called callus on the hands and feet is largely expressed when these parts of the body are exposed to wear and tear. They are considered an adaptation because there is an advantage to being born with thicker skin in areas of the body subject to constant wear and tear and to having phenotypic

plasticity. As Nesse (2005) has shown, many psychological defenses may never be elicited, but there is little doubt that they are there.

An objection to the idea that genetic factors may influence attitudes is that attitudes are malleable. Altemeyer (1988) provides a nice example. He has shown that student scores on his RWA scale decrease systematically over the course of a college career, the drop being greater among liberal arts students than nursing majors or administrative studies majors (Altemeyer, 1988, p. 93, fig. 3). This is a powerful and systematic environmental effect, although it is somewhat contaminated by self-selection and by systematic attrition—students with different levels of RWA go into different majors, and lower-ability students tend to drop out at a higher rate, as RWA is correlated with IQ. In any event, Altemeyer tested 90 college students as freshman and again 12 years later. The correlation between scores at the two time periods was 0.62, indicating both stability and change in ranking. The mean score in adulthood was 145.5 versus 152.5 as freshmen. The sample became “less authoritarian” but there was much less change than would have been predicted from the four-year student data reported here. What happened? A subgroup of more than half the follow-up sample had nearly the same scores as when they were freshman. Who were they? They were the participants who had become parents. This group ( $N = 41$ ) originally has a mean score of 152.1, and at the end of the 12-year period it was 151.1. Becoming a parent had entirely reversed the effects of a college education. The only systematic theory that we are aware of that would predict such an effect is evolutionary parental investment theory (Trivers, 1985, chap. 9). A look at the RWA items quickly explains the results. While a young college student might well answer positively to the item (number 7 on the 1982 RWA scale), “the sooner we get rid of the traditional family structure, where the father is the head of the family and the children are taught to obey authority automatically, the better. The old-fashioned way has a lot wrong with it” (Altemeyer, 1988, p. 97). It is unlikely the parent of a young child would do so. It would be desirable to see how much change occurs in a sample of non-college students over the same period and what influence having a child had on them. Note that the group that did not have children scored more nearly where they would have been expected to given the trajectory established in college. From the point of view of evolutionary theory, a couple with children is in “the average expected environment” (Hartman, 1958), as a family is a key part of the EEA. Couples without children do not pass on their genes or their environments to the next generation.

Altemeyer’s RWA scale is highly correlated with religiousness (authoritarians are more religious), so it is reasonable to believe that a similar effect would be found for religiousness were the appropriate study to be carried out. Most academics have friends who for years did not observe

any religious practices but who, on having children, resumed the practices of their upbringing or joined a new church. Although some longitudinal data have been collected in this area, these studies have measured church involvement/membership as opposed to a multidimensional measure of religiousness (O'Connor, Hoge, & Alexander, 2002; Sandomirsky & Wilson, 1990; Wilson & Sherkat, 1994). These studies have assessed individuals at a couple points in time starting in high school and ending with a measurement in the thirties and have found that getting married or having children increases the chance that an individual will belong to a church. Whether or not religiousness and not just church attendance/membership follows this same trajectory needs further investigation, and whether the same pattern of results seen with RWA in the Altemeyer studies where scores return to the precollege levels with parenthood is yet to be investigated.

These types of cultural and environmental influences on attitudes emphasize the need for the data on attitudes to be interpreted with a life history context, as scores may change with age and with certain life events. Studies that show environmental influences like those discussed previously provide fodder for individuals who think attitudes are completely socialized traits. In reality, however, the presence of cultural/environmental effects does not preclude any evidence for genetic effects. Data have shown that both are obviously at work, as we now turn to the evidence for the genetic influences on the TMVT.

## GENETIC INFLUENCE ON AUTHORITARIANISM

There are only four studies of genetic influence on authoritarianism that we are aware of. The first, by Scarr and Weinberg (1981), was an adoption study of adolescents and their parents that made use of the original F-Scale (F for "fascism"; Adorno et al., 1950; Christie, 1991). As Scarr and Weinberg put it, their study turned out to be "the empirical history of a control variable that failed" (p. 399). The F-scale was included in their adoption study of IQ as a contrast variable. Specifically, they expected much greater similarity between adoptive parents and their children on the F-scale (due to familial environmental influence—similar to  $c^2$  in Figure 3.1e but across generations rather than within generations) than on IQ, which they correctly hypothesized to be more influenced by genetic factors. What they found was that "differences in social-political attitudes, measured by the F-scale, appear to be genetically transmitted from parents to their children in the form of verbal ability and personality and to show no effect of direct learning" (p. 400). As their summary indicates, the findings have some interesting twists. First, the F-scale was highly correlated with IQ, a well-known fact that they had missed when choosing it as a control variable, and genetic transmission was largely through

this route. This finding was entirely consistent with the large literature in the heritability of IQ (Bouchard, 1998; Toga & Thompson, 2005). However, there was also evidence of a small amount of genetic transmission of authoritarianism from parent to child independent of IQ. Second, contrary to most theorizing up to that point, differences in F-scale scores (authoritarianism) among the adoptive children were unrelated to social class differences in the families. To be very specific, social class of rearing, long thought to be a causal factor, was not a cause of individual differences in authoritarianism. These results largely refute Eckhardt (1991) as cited earlier.

The second behavior genetic study of authoritarianism was conducted in our laboratory (McCourt, Bouchard, Lykken, Tellegen, & Keyes, 1999) using Altemeyer's (1981) RWA scale. The RWA scale had been included in the Minnesota Study of Twins Reared Apart (MISTRA; Bouchard et al., 1990) and also part of the Minnesota Twin Registry (MTR; Lykken, Bouchard, McGue, & Tellegen, 1990). Consequently, we had data from four groups: monozygotic twins reared apart (MZAs;  $N = 39$ ), monozygotic twins reared together (MZTs;  $N = 423$ ), dizygotic twins reared apart (DZAs;  $N = 38$ ), and dizygotic twins reared together (DZTs;  $N = 434$ ). All the participants in the studies were mature adults. The reared-apart sample was small, so the findings are determined mostly by the twins reared together. The basic findings from the study were as follows:

- a. Contrary to claims by Altemeyer that the RWA scales are free of correlation with IQ, we found a correlation of  $-0.37$ , a figure in much the same range as many of the studies of the correlation of IQ with the F-scale (Christie, 1991; Goldberg, Tucker, Altemeyer, Dawes, & Rothbarth, 1984; Stone, Lederer, & Christie, 1993).
- b. The MZA correlation, a direct estimate of heritability, was  $0.69$  (95% confidence interval [CI] =  $0.48$  to  $0.82$ ). Partialing out IQ reduced the correlation to  $0.59$  (95% CI =  $0.34$  to  $0.76$ ).
- c. The DZA correlation, an estimate of half the heritability under a simple additive model, was  $.00$  (95% CI =  $-0.31$  to  $0.33$ ) or  $-.09$  ( $-0.39$  to  $-0.23$ ) partialing out IQ. The large confidence intervals reflect the small twins-reared-apart sample sizes.
- d. The MZT correlation was  $0.63$  (95% CI =  $0.57$  to  $0.68$ ), and the DZT correlation was  $0.43$  (95% CI =  $0.34$  to  $0.49$ ). We did not have IQ data for the reared-together twin sample, so we could not partial out the influence of IQ. The larger MZT than DZT correlation suggests genetic influence.
- e. The RWA correlation for spouses (assortative mating) was  $0.62$  ( $N = 79$ ). Assortative mating for a heritable trait increases the trait variance and the correlation between relatives, and this effect can be estimated with the four-group design that was available to us. Assortative mating is highly

characteristic of attitude variables as opposed to personality variables, and our data were consistent with the findings reported by others. Nevertheless, it is important to recognize that the assortative mating coefficient is based on the current sample and not their parents. Obviously, the parental data, if they were available, would be the best for model fitting. In addition, one can ask, Do parents of children who are put up for adoption mate assortatively to the same degree as parents who raise their own children? McCourt et al. (1999) provide a more detailed discussion of this issue.

We fit biometric models to our data using the program Mx (Neale et al., 1999) in order to estimate genetic additive effects, common environmental effects, nonadditive genetic (dominance) effects, and unshared environmental (plus error) effects. A purely environmental model failed badly and could easily be rejected. No model required nonadditive genetic effects. There were two equally parsimonious models. Ignoring assortative mating, a model with 50 percent additive genetic variance, 16 percent common environmental variance, and 34 percent unshared environmental variance, fit well. If assortative mating was included, we got an equally good fit with 64 percent additive genetic variance and 36 percent unshared environmental variance. The trade-off between common environment and additive genetic variance due to assortative mating is well known, and the choice between models given the available data set is arbitrary. We note here that for conservatism, which as we pointed out previously is highly correlated with RWA, one very large study as reported later was able to distinguish between common environment and assortative mating and found considerable variance due to assortative mating and very little variance due to shared environment. Consequently, we would argue that the McCourt study suggests a heritability of around 0.55 to 0.60 with very little shared environmental variance.

An additional feature of the study, because of its inclusion of adoptees, was the ability to examine environmental correlates of RWA. We included the Family Environment Scale (FES; Moos & Moos, 1994) to index the family-rearing environment experienced by the participants in our study. If any of these measures were truly causal and free of genetic influence, we would expect correlations between the FES scales and RWA in both the adoptees and the nonadoptees. If the influences were mediated genetically, then we would expect correlations only in the sample of nonadoptees. As Table 3.2 indicates, we found significant correlations only for the nonadoptees, and the strongest correlation was for moral religious orientation (0.35). The Organization and Control scales yielded correlations of 0.28 and 0.26, respectively. The simplest explanation of these findings is that family environmental influences of the sort measured by the FES do not "cause" variation in RWA. It must,

**Table 3.2 Correlations between RWA Scores and Retrospective Rearing Environment Scores Derived from the Family Environment Scales**

Measure of Rearing Environment	Nonadopter ( <i>N</i> = 104)	Adoptees ( <i>N</i> = 139)
Cohesion	0.12	0.04
Expressiveness	-0.02	-0.02
Conflict	-0.13	-0.03
Independence	0.04	0.05
Achievement orientation	0.22*	0.07
Intellectual cultural orientation	-0.12	-0.08
Active recreational orientation	0.05	-0.08
Moral religious emphasis	0.35**	0.1
Organization	0.28**	0.08
Control	0.26**	0.13

*Note:* Spouses are the major portion of the sample of nonadoptees.

\**p* < 0.05.

\*\**p* < 0.01.

however, be kept in mind that our FES data were gathered retrospectively and that longitudinal data from adoptive and biological families would be far superior. One possible inference from this evidence would be that the same genetic influence is “causing” families to exert a moral religious orientation as well as organization and control. This inference, however, runs up against the fact that these scales do not appear to be heritable. Table 3.3 shows the estimated heritabilities of the FES scales from three studies: the Western Ontario Twin Study (Vernon, Jang, Harris, & McCarthy, 1997), which used ordinary adult twins who were reared together; our study of twins reared apart (MISTRA; Hur & Bouchard, 1995); and a recent twin study of contemporaneous perceptions of one’s rearing environment using 17-year-old twins (Herndon, McGue, Krueger, & Iacono, 2005). The results of the different kinds of studies are roughly in agreement, especially with regard to the inference that the measure of moral religious orientation has a near zero heritability.

As was pointed out earlier, the MPQ Traditionalism scale correlates 0.76 with RWA. Since the four-year test–retest reliability of RWA is 0.75, the Traditionalism scale, while not an alternate form, is a reasonable proxy for RWA. Consequently, we consider the study reported next a third study of authoritarianism.

Finkel and McGue (1997) addressed the question of the heritability of traditionalism using a 12-group design (twins reared together, parents, siblings,

**Table 3.3 Correlations between RWA Scores and Family Environment Scales for Non-Adoptees ( $N = 104$ ) and Adoptees ( $N = 139$ ) and Heritabilities for the FES from the Western Ontario Twins Study (WOTS), the Minnesota Study of Twins Reared Apart (MISTRA), and the Minnesota Twin Family Study (MTFS)**

FES Measure	Correlations from MISTRA		Heritabilities		
	Nonadoptees	Adoptees	WOTS	MISTRA	MTFS
Cohesion	0.12	0.04	<b>0.58</b>	<b>0.35</b>	0.25
Expressiveness	-0.00	-0.02	<b>0.39</b>	0.10	0.44
Conflict	-0.13	-0.03	<b>0.30</b>	<b>0.27</b>	0.20
Independence	0.04	0.05	0.00	<b>0.36</b>	0.22
Achievement orientation	0.22*	0.07	<b>0.50</b>	0.00	0.27
Intellectual cultural	-0.12	-0.08	0.00	0.09	0.36
Active recreational orientation	0.05	-0.08	<b>0.53</b>	<b>0.14</b>	0.37
Moral religious orientation	0.35**	0.10	0.00	<b>0.15</b>	0.01
Organization	0.28**	0.08	0.00	0.00	0.00
Control	0.26**	0.13	0.00	0.00	<b>0.46</b>

*Note:* Heritabilities in bold are statistically significant.

\* $p < 0.05$ .

\*\* $p < 0.01$ .

offspring, spouses of various genders; total  $N = 4,300$  pairs). Note that this sample did not include MZA and DZA twins. The heritability of traditionalism was 0.52 for men and 0.55 for women (not a significant difference) and was all simple additive genetic variance. This design had considerable power to detect shared environmental influence, yet there was no statistically significant evidence for such a source of influence. Unfortunately, these investigators did not attempt to fit a model with assortative mating. Personality traits, on average, show modest assortative mating at best. If we exclude traditionalism, the mean spousal correlation for the remaining 10 MPQ scales is 0.08 ( $N = 1,185$ ; Lykken & Tellegen, 1993), but the assortative mating coefficient for traditionalism is 0.48. In any event, the heritability estimate of 0.52 to 0.55 from the Finkel and McGue study is nicely replicated by an MZA correlation of 0.54, as reported in Bouchard et al. (2004), which directly estimates the broad heritability ( $N = 74$ , with no sex difference). The DZA correlation is 0.32 ( $N = 54$ ), roughly half the MZA correlation as expected if differences in the trait are largely under additive genetic influence. Again,



confidence intervals around these estimates were large because of the small sample sizes.

The fourth behavior genetic study of authoritarianism, an adoption study, is superficially discordant with the previous three. It consists of adoption data reported briefly (three short paragraphs) by Altemeyer (1996). Altemeyer reports almost all his findings in books (Altemeyer, 1981, 1988, 1996) as opposed to refereed scientific publications, and as a consequence of this practice, many details are lost. In this case, the specific age of the parents and the offspring are not reported. The data are summarized in Table 3.4.

The biological parent  $\times$  offspring data are a little higher than one would expect from a moderately heritable trait. If only genes were at work, we would simply double the correlation to estimate the heritability. In any event, the adoptive correlations are higher than the biological, thus clearly refuting a genetic interpretation of the data. Recall that the adoptive correlations estimate environmental influence. As Altemeyer (1996) puts it, "These numbers do *not* support the notion of fascism genes and instead direct our attention to environmental influences" (p. 75). As stated, this conclusion is out of line with the other results just discussed. A possible explanation for this is given next.

## GENETIC INFLUENCE ON CONSERVATISM

Directly related to Altemeyer's (1996) adoption study demonstrating environmental influence is a twin study that also demonstrates environmental influence. In this instance, the outcome is shown on a highly related trait—conservatism. Figure 3.2 shows cross-sectional twin data from the Virginia Twin Registry taken from Eaves et al. (1997).

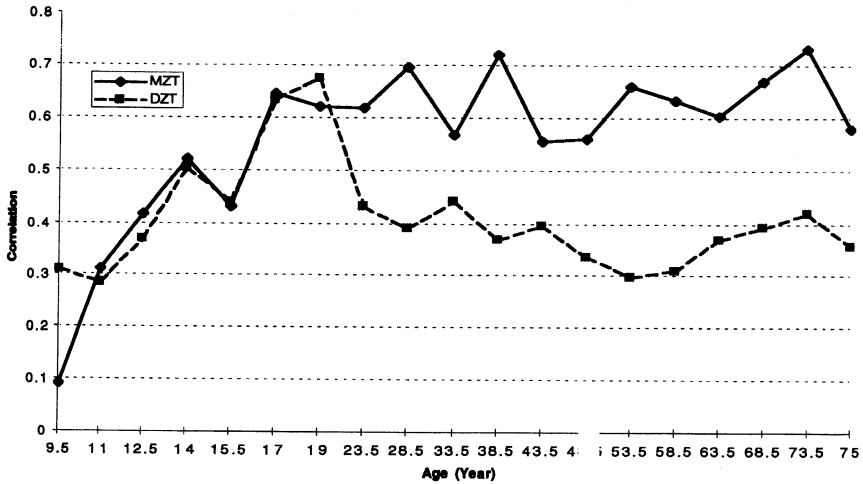
The figure illustrates two important points. First, age is important. Using the differences between the monozygotic and dizygotic correlations as a rough approximation of one-half the heritability (see Figure 3.1), it is clear that there is no genetic influence on the trait prior to age 20. After that, there

**Table 3.4 Correlations between RWA Scores of Parents and Offspring in Biological and Adopted Families and 95 Percent Confidence Intervals for Adoptive Families**

Kinship	Correlation	Sample Size
Biological parents $\times$ offspring	0.27 to 0.51 Mean = .40	2,097
Adoptive mother $\times$ child	0.61 (0.35 to 0.78)	35
Adoptive father $\times$ child	0.5 (0.22 to 0.75)	40

*Note:* Altemeyer reports that daughters tend to resemble their parents more than the sons but does not report any data (Altemeyer, 1998, p. 64). He also does not report the age of the parents or children but implies the children are about age 16 (p. 65).

**Figure 3.2 Monozygotic Twin (MZT) and Dizygotic Twin (DZT) Correlations for Conservatism at Different Ages, as Reported in Eaves et al. (1997)**



is considerable genetic influence. These findings are entirely consistent with those of Altemeyer's (1996) adoption study. Altemeyer's conclusion, however, is incorrectly stated, as it does not take age into account. A more reasonable conclusion based on both studies is that twin and adoption studies are consistent and suggest that environmental factors clearly account for much of the variance in conservatism and authoritarianism prior to age 20; after age 20 genetic factors become highly influential. We refrain from a stronger statement because of the Scarr and Weinberg (1981) findings with an adolescent sample that there was genetic influence on the F-scale mediated by IQ and a small amount of genetic influence mediated by personality. In our opinion, the items in all the instruments used to measure authoritarianism and conservatism lack appropriate salience for younger individuals, and there is reason to question the meaningfulness of the measures generated by such samples. Whether a valid Authoritarianism scale could be constructed for young people is an open question. The second important point made by Figure 3.2 is the large variability in heritability estimates one would obtain had the adult estimates been based on only one sample drawn at one age. The average sample size at each age grouping is 180 monozygotic and 100 dizygotic twin pairs, and most are over 100. Consequently, these data nicely demonstrate that only very large twin studies will generate highly reliable heritability estimates.

The most definitive behavior genetic study of conservatism is the study of the Virginia 30,000 (Eaves et al., 1999). This study used 80 distinct kinships and was able to estimate many genetic and environmental influences not estimable using twins alone. The results of this study are presented in

Table 3.5. This study suggests a somewhat high heritability for females (0.645) and about what might be expected on the basis of other studies for males (0.447). It also reveals considerable genetic variance due to assortative mating. Most other effects are modest in size. Note that the Twin and Sibling effects under the heading "Environmental" are shared environmental effects and are essentially zero for males and quite modest for females (0.052 and 0.042). Another presentation of the data of conservatism from the Virginia 30,000 that draws out the implications for political scientists can be found in Alford, Funk, and Hibbing (2005). These authors have also formulated an interesting evolutionary approach to political science (Alford & Hibbing, 2004).

The MISTRA study incorporated the Conservatism scale used in the Virginia 30,000 study in 1986 as a result of an important paper in the *Proceedings of the National Academy of Sciences* (Martin et al., 1986). This paper reported a heritability of 0.62 for conservatism based on a large twin study. The authors, acknowledging numerous criticisms of the twin method, also challenged their critics to what we call a "strong inference" test of their ideas. Specifically, Martin et al. asserted:

The problem with many "social" explanations of our data is that they do not lead to predictions about other kinds of relationship unless social interaction is based ultimately on genetic differences. . . . Our model can be used

**Table 3.5 Estimates of Sources of Variance (%) for Males and Females to Conservatism Scores Based on Data from the Virginia 30,000**

Sources of Variance	Males	Females
Genetic		
Additive	35.5	19.8
Assortative mating	22.2	12.4
Nonadditive	6.7	12.5
Total genetic	64.5	44.7
Environmental		
Maternal	1.5	0.1
Paternal	0	0
Sibling	0	5.2
Twin	0.1	4.2
Residual	40.1	36.6
Total environmental	41.7	47.2
G by E covariance	-6.2	8.1

to predict the results of other studies. For example, we predict a zero correlation between foster parent and adult foster child for all our attitude scales. Our model . . . predicts a parent-offspring correlation of .52 for conservatism. We predict a correlation of . . . 31 for the offspring of monozygotic twins and an  $h^2 = .62$  for separated monozygotic twins. (p. 4368)

MISTRA took up that challenge (Bouchard et al., 2004). The results strongly confirmed the prediction and are consistent with the Virginia 30,000 findings as well. Specifically, MISTRA found a heritability of .56 (95% confidence interval 0.38 to 0.70) based on a sample of 54 MZA twins and 46 DZA twins (Bouchard et al., 2003), quite close to the prediction, especially for social science research. The MISTRA study also reported a considerable amount of information regarding the validity of the Conservatism scale, including evidence that it is highly correlated with the RWA scale (0.72) but much less influenced by IQ than the RWA scale (a correlation of  $-0.23$  with IQ). These findings suggest that conservatism as measured with this version of the Wilson-Paterson scale is a valid psychological construct and that most of the genetic variance in conservatism is not mediated by IQ.

## GENETIC INFLUENCE ON MEASURES OF RELIGIOUSNESS

Behavior genetic findings on measures of religious affiliation, attitudes, and behavior have been reviewed in some detail by D'Onofrio, Eaves, Murrelle, Maes, and Spilka (1999). They demonstrate that religious affiliation, the religion that one practices, is cultural and little influenced by genetic factors. Genetic influence is more specific to religious behaviors and traits. Our focus will be on "trait" measures of religiousness rather than on single-item reports of behavior (i.e., frequency of attendance at religious ceremonies or church attendance). Attendance at religious ceremonies indexes numerous psychological factors, such as conformity to contemporary norms, sociality, interest in rituals, and so on. For example, frequency of attendance at religious ceremonies is almost always included as an item within a measure of religiousness because when used as an item on a scale with other items (items that correlate with each other and in part also reflect religiousness), the factor common to all the items can be more reliably assessed. Consequently, frequency of church attendance as a single item is a much less reliable estimator of religiousness than a composite of related items, and a heritability estimate based on the item alone reflects factors other than religiousness. In Table 3.6 we have reproduced those findings from the D'Onofrio et al. (1999) review that deal with trait measures, and we have added recent studies. We then comment on the studies in order to put them into context.

**Table 3.6 Adult Twin Estimates of Genetic and Environmental Influence on Trait Measures of Religiousness**

Scale	Sample	Heritability (genetic influence)	Shared Environmental Influence	Source
Religious fundamentalism (MMPI)	MZA, DZA, MZT, and DZT	0.54	0.00	Bouchard et al. (2004)
Religious occupa- tional interests	MZA, DZA, MZT, and DZT	0.44	0.00	Bouchard et al. (2004)
Religious leisure- time interests	MZA, DZA, MZT, and DZT	0.57	0.00	Bouchard et al. (2004)
Religious activities (SCII)	MZA, and DZA	0.43	ne	Bouchard et al. (2004)
Religious values	MZA, and DZA	0.46	ne	Bouchard et al. (2004)
Intrinsic religiousness	MZA, and DZA	0.43	ne	Bouchard et al. (1999)
Extrinsic religiousness	MZA, and DZA	0.39	ne	Bouchard et al. (1999)
Religious fundamentalism (MMPI)	Adoption data	0.28	0.26	Beer et al. (1998)
Religious funda- mentalism (MMPI)	Adoption, MZT, and DZT	0.41	0.50	Beer et al. (1998)
Personal devotion	Female MZT, and DZT	0.29	0.24	Kendler et al. (1997)
Personal conservatism	Female MZT, and DZT	0.00	0.45	Kendler et al. (1997)
Religiousness	Male MZT, and DZT	0.44	0.18	Koenig et al. (2005)

*Note:* MZA = morozygotic twins reared apart; DZA = dizygotic twins reared apart; MZT = monozygotic twins reared together; DZT = dizygotic twins reared together; ne = cannot be estimated with this design.

The findings for the first three scales (Religious Fundamentalism, Religious Occupational Interests, and Religious Leisure Time Interests) come from a joint analysis of data from MISTRA and MTR. The Religious Fundamentalism scale (10 items in this study) was derived by Wiggins (1996), and other scales constructed from Minnesota Multiphasic Personality Inventory (MMPI) items are almost identical to the Wiggins scale. The Religious Occupational Interest (four items) and Religious Leisure Times Interest (six items) scales were derived from the Minnesota Interest Inventory (Lykken, Bouchard, McGue, & Tellegen, 1993). These

findings are dominated by the twin-reared-together data, as the sample sizes for these kinships are much larger than those for twins reared apart. These findings for these samples suggest that a variety of approaches to the measurement of religious attitudes and interests lead to a heritability of around 0.50.

The next four scales were studied with the MISTRA twins-reared-apart samples. The Religious Activities scale is from the Strong Campbell Interest Inventory (Hansen & Campbell, 1985), a widely used instrument in counseling psychology. The Religious Values scale was from the Allport-Vernon-Lindzey measure called the Study of Values (Allport, Vernon, & Lindzey, 1960). The Intrinsic and Extrinsic Religiousness scales come from a revision of older scales with the same name by Gorsuch and Venable (1983). These data, also based on a variety of measures but only twins reared apart, suggest a heritability of around 0.40 to 0.45.

The next study by Beer, Arnold, and Loehlin (1998) carried out two different analyses. The first analysis was limited to adoption data from the Texas Adoption Project, while the second combined twins-reared-together data from a college sample with the adoption data. The first analysis suggested a heritability of 0.28 and shared environmental influence of 0.26. The more comprehensive analysis with multiple kinships suggested higher values for both sources of influence: a heritability of 0.41 and shared environmental influence of 0.50. These authors acknowledge that their findings are a bit difficult to reconcile with the Waller, Kojetin, Bouchard, Lykken, and Tellegen (1990) findings, which were updated by Bouchard et al. (2004) and are reported in Table 3.6. We suggest that age is mostly likely the source of much of the shared environmental influence and somewhat lowered genetic influence. The adoptees and biological offspring used in the Texas Adoption Study were aged 17.7 and 20.2, respectively. The twins were a little older but were all still in college. Studies of young twins have regularly shown that religiousness is at best modestly heritable. For example, Winter, Kaprio, Viken, Karvonen, and Rose (1999), in a study of 16-year-old twin pairs, using the MMPI Religious Fundamentalism scale, found a heritability of 0.11 for girls and 0.22 for boys (see also Abrahamson, Baker, & Caspi, 2002; Boomsma, de Geus, van Baal, & Koopmans, 1999; Loehlin & Nichols, 1976). These findings are consistent with the age data on conservatism presented earlier and a study from our laboratory (Koenig, McGue, Krueger, & Bouchard, 2005) to be discussed shortly.

The next study by Kendler, Gardner, and Prescott (1997) is based on a very large sample of female twins who were part of a study of substance use and abuse. Their two scales were derived from a factor analysis of 10 items. The first factor, Personal Devotion, appears to us to be the better measure of religiousness, and the results are not entirely out of line with others, with a heritability of 0.29 and shared environmental influences of 0.24. The Personal Conservatism factor yields a zero heritability and a large shared

environmental component and is out of line with other studies. We are not sure what to make of these findings. We do, however, find the results of the factor analysis a bit odd and the items atypical. It would be desirable to see these scales validated.

The last study shown in Table 3.6, from our lab (Koenig et al., 2005), used a sample of adult male twins from the MTR. These twins were assessed on a nine-item measure of religiousness when they were approximately 33 years old. The scores for the nine items were summed to create a total Religiousness score. The heritability of this scale was 0.44, with a small shared environmental effect. These results are very similar to the estimates given by the other studies in the table. The more interesting analysis in the Koenig et al. study, however, made use of retrospective ratings of religiousness provided by the twins. Along with the current, adulthood ratings, these twins were also asked to respond to the same items with respect to when they were growing up. The retrospective, childhood ratings were less heritable (0.12). There was also a stronger shared environmental influence for these ratings (0.56). These results support the conclusion stated previously that age moderates the heritability of religiousness, as it does in the Eaves et al. (1997) study of conservatism.

Koenig et al. (2005) also examined the heritability of what they called internal and external Religiousness subscales. The nine items of the full scale were divided into items that were more external in nature (e.g., frequency of church attendance and membership in youth/study groups) and those that were more internal in nature (e.g., seeking help through prayer and deciding moral actions for religious reasons). As hypothesized, the external scale had very little genetic influence (8%) and a strong shared environmental influence (53%) in childhood. This was not surprising, as these external items were likely to be influenced by parents or other adults when children were young. However, the relative strength of these effects were switched for the current ratings (39% genetic and 18% shared environment). For the internal scale, shared environmental effects were strong in childhood (44%) but not estimated to be as large as they were for the external ratings. The shared environmental effect for the internal items was only 24 percent for adulthood ratings. Genetic effects were moderate at both time points (20% and 34% for retrospective and current internal Religiousness ratings, respectively). The authors found that the difference in heritability and shared environmental estimates were not significantly different for the internal ratings (i.e., the internal ratings did not become more heritable and less environmental with age), though the current and retrospective genetic and environmental influences were different for the external items of religiousness. As we stated in the paper, these findings suggest that the increase in heritability seen with age may be due to the increase in importance of personal factors and a decrease in importance of other external

factors. The differences in heritability and shared environmental influence for different aspects types of religiousness deserve further study.

## CONCLUSION

The evidence presented in this review certainly and strongly suggests that the components of the TMVT are partly heritable: differences in observed variance on these traits can be partly explained by genotypic variance. Heritability estimates tend to run in the range of 0.40 to 0.50, with some exceptions. How big are these genetic effects? They are large in comparison to typical findings in the social sciences. Richard, Bond, and Stokes-Zoota (2003), on the basis of a meta-analysis summarizing 100 years of social psychology, recently reported an effect size (Pearson correlation) for “social psychological effects” of 0.21 (standard deviation = 0.15). The smallest effect sizes came from “Social Influence” studies (0.13), and the largest came from “Group Process” studies (0.32). Hemphill (2003) reported on two large meta-analyses of the psychological literature (psychological assessment and treatment). Similar effects were found for assessment and treatment, so they were combined. The lower third of the distribution of correlations ranged from -0.08 to 0.17. The middle third of the distribution ranged from 0.18 to 0.29, and the upper third of the distribution ranged from 0.29 to 0.78. These three ranges might well be called small ( $<0.20$ ), medium (0.20 to 0.30), and large effects ( $>0.30$ ). All these correlations should be squared in order for them to reflect “variance accounted for,” while heritability estimates already index “variance accounted for” without the need for squaring the value. Another basis of comparison would be the magnitude of genetic effects in other psychological domains. Various reviews (Bouchard, 2004; Bouchard & Loehlin, 2001; Devlin, Daniels, & Roeder, 1997; Waldman & Rhee, 2006) suggest that most reliably measured psychological traits yield heritabilities in the range 0.40 to 0.60 and thus are quite comparable to those reported here. For example, the heritability of intelligence ( $g$ ) is around 0.50 to 0.70, and the heritabilities of the liability to schizophrenia and attention deficit/hyperactivity disorder are around 0.70 to 0.80. Personality variables and occupational interests have heritabilities in the 0.35 to 0.50 range, much like the TMVT. Estimates of 0.40 to 0.50 for the heritabilities for the TMVT traits are moderate and significant—certainly larger than common effect sizes seen in social psychology.

More important than the actual heritability estimate, however, is the fact that there *is* significant heritability. Different studies provide different estimates of genetic influence, depending on the specific sample and the type of kinships represented in the sample, but the majority of studies provide evidence that these TMVT traits are under genetic influence. Socialization researchers must take account of the fact that any



correlation seen between a parent and child for religiousness, conservatism, or authoritarianism cannot be automatically explained by a shared family environment.

An important moderator of the heritability of the TMVT is age. Younger samples or retrospective ratings almost invariably produce smaller heritability estimates and larger effects of the shared environment. One interpretation of this finding is that the TMVT can be influenced by parents while the child is still at home, but once the child leaves the home, parental influence wanes. Genetic differences then become more important in determining differences in the TMVT. A good example of this would be frequency of church attendance, which, as previously stated, is in almost all multiple-item indexes of religiousness. It is easy to see how the frequency of church attendance would be the same for all members of a family when the members live in the same household. Children would have no choice as to whether they attend religious services. Once a child leaves the home, however, he or she is free to choose whether to attend religious services, and parental influence wanes. How this example translates to the items used on Conservatism or Authoritarianism scales is less clear.

A further question that arises with behavior genetic studies is how the results from quantitative genetic analyses compare to those from molecular genetics. For example, Hamer (2004) has written a book with the title *The God Gene*. Hamer, however, is a careful investigator and in the text makes it clear that individual genes will account for only a tiny fraction of the variation in a trait. The gene he discusses (VMAT2, also called SLC18A2) may be important in influencing the kinds of traits we are discussing, as their products modulate mechanisms through which psychoactive drugs work on the central nervous system. It is likely that continuous psychological traits of the sort discussed in this chapter will be influenced by many genes of small additive effect acting in a manner similar to those found for quantitative characters in other biological organisms, such as oil and protein in corn (Hill, 2005).

In conclusion, religiousness and the rest of the TMVT are moderately heritable, especially in adulthood. Certainly, family influences are important in childhood, and further research should be carried out to determine the specific factors at work. More research also needs to be done to explicate the genetic influences seen on these traits. A moderate heritability for a trait does not mean that there is one gene for that trait. The influence is quantitative; that is, there are many genes, acting within the context of the environments, that support the development of these traits. These genetic effects may be shared with other attitudes or personality traits, and, as mentioned earlier, there may be genetic and environmental influences that are common to the TMVT as well as genetic or environmental influences that are unique to each measure. These types of questions call for more

research on the TMVT and the genetic and environmental influences on differences in these traits.

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