

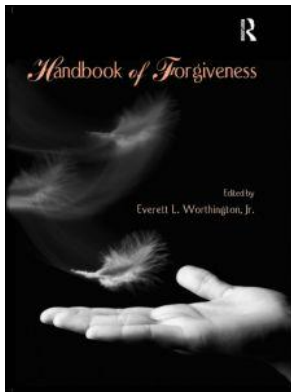
This article was downloaded by: 10.3.97.143

On: 01 Dec 2023

Access details: *subscription number*

Publisher: *Routledge*

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: 5 Howick Place, London SW1P 1WG, UK



Handbook of Forgiveness

Everett L. Worthington, Jr.

Genetic Influences on Forgiving

Publication details

<https://www.routledgehandbooks.com/doi/10.4324/9780203955673.ch15>

Ming T. Tsuang, Lindon Eaves, Tal Nir, Beth A. Jerskey, Michael J. Lyons

Published online on: 21 Jun 2005

How to cite :- Ming T. Tsuang, Lindon Eaves, Tal Nir, Beth A. Jerskey, Michael J. Lyons. 21 Jun 2005, *Genetic Influences on Forgiving from: Handbook of Forgiveness* Routledge

Accessed on: 01 Dec 2023

<https://www.routledgehandbooks.com/doi/10.4324/9780203955673.ch15>

PLEASE SCROLL DOWN FOR DOCUMENT

Full terms and conditions of use: <https://www.routledgehandbooks.com/legal-notices/terms>

This Document PDF may be used for research, teaching and private study purposes. Any substantial or systematic reproductions, re-distribution, re-selling, loan or sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The publisher shall not be liable for an loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.



Part Five

THE BODY AND FORGIVENESS



Chapter Fifteen

Genetic Influences on Forgiving

Ming T. Tsuang
Lindon Eaves
Tal Nir
Beth A. Jerskey
Michael J. Lyons

The significant genetic influences that have been demonstrated for a wide range of human behaviors provide a strong a priori basis for expecting that individual differences in forgiving, just as in many other behaviors, are influenced by genetic factors. Behavioral geneticists regularly investigate genetic factors that may make an individual more or less likely to carry out a behavior (e.g., to forgive). We are interested in identifying genetic factors that influence the probability that an individual will forgive.

Despite the vast literature attempting to resolve the contributions of genetic and environmental factors to individual differences in human behavior, the role of biological and social factors in making people more or less forgiving has hardly been explored empirically. Insofar as forgiveness is a temperamental trait, we might expect it to show similar genetic and nongenetic influences, as do other temperamental and personality traits that have been studied more extensively. However, insofar as the act of forgiving is contingent on exposure to hurt, we expect the role of social factors and perhaps the interaction of genetic and environmental influences to be substantially greater.

BEHAVIORAL GENETICS METHODOLOGY

Family studies are typically the first step in addressing the question of whether a given characteristic is influenced by genetic factors. If a characteristic is genetic, it should run in families. However, if a characteristic runs in families, there are two plausible explanations—sharing the same genes can produce similarities among individuals and sharing the same environment can produce similarities. Two approaches utilized to disentangle genetic from family environmental influences are adoption studies and twin studies. In adoption studies, one set of parents provides the individual with his

or her genes (the biological parents), and another set provides his or her family environment (the adoptive parents). By contrasting the degree to which the individual resembles the biological versus the adoptive parents, we can draw inferences about the relative influence of genes and the family environment. For a number of reasons (e.g., improved contraception, greater acceptance of single parenthood, confidentiality of birth-parent identity, and “open adoption,” in which birth parents select and interact with adoptive parents), adoption studies are difficult to conduct in contemporary America.

Twin studies offer another approach to disentangling genes from the environment as the source of family resemblance. Twins offer a naturally occurring experiment in which two individuals share the same environment from conception and either 100% (monozygotic twins; MZ) or 50% of their genes (dizygotic twins; DZ). Resemblance within twin pairs is typically quantified by calculating the correlation between twins within pairs separately for MZ and DZ pairs. To the extent that MZ resemblance exceeds DZ resemblance, genetic influences are implicated. To the extent that DZ resemblance exceeds 50% of the MZ resemblance, influences from the shared family environment are implicated. Biometrical modeling is used to quantify the relative contributions of genetic factors, the shared family environment, and the unique or nonshared environment.

ASSUMPTIONS ABOUT FORGIVENESS

Because we are unaware of any previous research on the relationship between genetics and forgiving, we start by describing our view and assumptions regarding the construct of forgiveness. First, although no consensual definition of forgiveness exists (Worthington, 1998), we agree with McCullough, Pargament, and Thoresen (2000) that all the existing definitions share core features—when people forgive, their responses toward people who have transgressed against them become more positive and less negative. In particular, Worthington and Wade’s definition (1999) of forgiveness as the emotional replacement of negative emotions of unforgiveness with positive emotions such as empathy, sympathy, compassion, or love informs our approach to studying forgiveness. After conducting a review of the available literature on the genetic influences on these putatively forgiveness-related emotions, we found that a genetic influence on empathy is the best established. Second, according to Worthington and Scherer (2004), unforgiveness is conceptualized as a stress reaction, and forgiveness is one way people reduce unforgiveness. Thus, forgiveness can be used as a coping strategy to reduce a stressful reaction to a transgression (Worthington & Scherer, 2004). Third, forgiveness may be related to the broader constructs of religion and spirituality (McCullough & Worthington, 1999 for a review). Fourth, forgiveness is related to personality traits such as neuroticism and agreeableness (Symington, Walker, & Gorsuch, 2002).

Described above are assumptions that inform our approach to forgiveness. Because there is little research specifically addressing genetic influences on forgiving, we will examine genetic influences on constructs that we assume are related to forgiving.

REVIEW OF THE THEORETICAL AND EMPIRICAL LITERATURE

Assumption One—Empathy

One current conceptualization of forgiveness is based on Batson's empathy-altruism hypothesis (Batson & Oleson, 1991) that empathy motivates individuals to help others, including strangers, by activating the human aptitude for altruism. Although the interpersonal context in which forgiveness occurs is often more complex than the context in which altruism occurs, McCullough, Worthington, and Rachal (1997) view empathy as vital to the notion of forgiveness as an altruistic behavior. They present evidence from two studies that forgiveness is a prosocial act largely mediated by empathy toward the transgressor. The first study found that the association between forgiveness and apology was mediated in part by increased empathy facilitated by the apology. The second study found that the usefulness of a psychosocial intervention for promoting forgiveness was partly mediated by the efficacy of the intervention in promoting empathy toward the offender. This link between empathy and forgiveness was also found by McCullough and colleagues (1998). According to the empathy-forgiveness link, empathy toward the transgressor seems to be a critical condition for the individual's capacity to forgive after experiencing a transgression. McCullough, Worthington, and Rachal (1997) considered various aspects of empathy and asserted that empathy is primarily an affective phenomenon but also considered perspective taking as an important element of empathy.

Influences on Empathy. Matthews and colleagues (Matthews, Batson, Horn, & Rosenman, 1981) investigated the heritability of empathy using adult men twin pairs. They found a correlation of .41 for MZ twins and .05 for DZ twins, yielding a heritability of 72%. Rushton, Fulker, Neale, Nias, and Eysenck (1986), using adult twin pairs, found evidence of substantial heritability of empathy. According to their results, 51% of the variance in empathy was due to genetic factors, 49% was due to the nonshared environment, and the shared environment had no detectable influence. Although both Matthews et al. (1981) and Rushton et al. (1986) reported high levels of heritability of empathy, both studies have been criticized for analytic approaches that may overestimate heritability (see Davis, Luce, & Kraus, 1994).

Zahn-Wexler, Robinson, and Emde (1992) studied the development of empathic concern in 14- and 20-month-old twin pairs. They found significant heritability at both 14 and 20 months, with MZ correlations of .29 and .30, respectively, and DZ correlations of .05 and .09. Heritability was of 23% at age 14 months and 28% at 20 months. Because behavior in young children may be different from that of older individuals, caution should be used when comparing aspects of empathy across developmental periods.

Davis et al. (1994) investigated the heritability of three facets of empathy: (a) empathic concern (feeling of sympathy, compassion, and concern for others), (b) personal distress (feelings of discomfort when confronting another's distress), and (c) perspective

taking (dispositional tendency to consider the psychological point of view of others). The first two are considered to be within the affective domain, whereas the last one is nonaffective and has not been previously researched. They used data from Loehlin and Nichols's (1976) study of twins. For empathic concern, they observed an MZ correlation of .22 and a DZ correlation of .08, producing a heritability estimate of 28%; for personal distress, the MZ twins correlated .22, and the DZ twins correlated .06, producing a heritability estimate of 32%. In contrast, the difference between MZ and DZ correlations for the perspective-taking aspect of empathy was not significant. These results suggest that dispositional affective empathy is substantially influenced by genetic factors.

Although there are only a few studies of the influence of genetic factors on empathy, all provide evidence for genetic influences. In general, previous research has not detected a significant shared environmental influence on trait empathy. This may be because it is nonshared aspects of the environment—whether within or outside the family—that have the greatest influence on empathy, or it may be due to the relatively lower power of the twin method for demonstrating shared environmental effects.

Assumption Two—Coping

Coping reflects thinking, feeling, or acting so as to preserve a satisfied psychological state when threatened (Snyder, 2001). Therefore, forgiveness as a means of coping can be thought of as a way to preserve a prosocial state between people in an interpersonal relationship. Although coping styles have often been studied with regard to their relationship to specific quality-of-life outcomes (i.e., coping after a diagnosis of a medical disorder), coping is also an important construct for geneticists interested in understanding more about individuals' "sensitivity to the environment" (Kendler & Eaves, 1986). Although forgiveness after being a victim of wrongdoing can generate various responses (e.g., emotional, motivational, cognitive, and/or behavioral; Snyder, 2001), many researchers interested in coping mechanisms divide strategies into two primary categories—those that are emotion-focused and those that are problem-focused. It has been postulated that forgiveness is principally an emotion-focused coping strategy, although it can be problem-focused as well (Worthington & Scherer, 2004).

Kendler and colleagues (Kendler, Kessler, Heath, Neale, & Eaves, 1991) were the first to investigate genetic and environmental influences on coping styles. Using the Ways of Coping checklist (Folkman & Lazarus, 1980), they conducted a factor analysis and found three factors—turning to others, problem solving, and denial. They categorized problem solving as a cognitive and problem-focused style, denial as emotion-focused, and turning to others as both problem-focused and emotion-focused. Their twin data indicated that familial resemblance for turning to others and problem solving was due solely to genetic factors (30% and 31%, respectively) but that shared environmental factors accounted for most of the familial influence on denial (19%). They concluded that genetic factors, presumably related to temperament, influence

the more problem-solving coping strategies of turning to others and problem solving. There was no strong evidence of familial environmental influences on the more problem-focused strategies, which is not consistent with a “social learning” model of learned behaviors from parents. In contrast, shared family environmental influences significantly influenced the more emotion-focused denial strategy.

Mellins, Gatz, and Baker (1996) investigated coping methods in children from a behavioral genetic standpoint. They found that genetic influences accounted for a substantial percentage of the reliable variance in problem-focused coping strategies, whereas the shared environment was a significant influence in emotion-focused alternatives. These are similar to Kendler et al. (1991): Problem-focused strategies are significantly influenced by genes, and emotion-focused strategies are influenced by the family environment. One caveat to this study was that the investigators measured the same construct using both open-ended and closed-ended instruments, but these measures yielded conflicting results, making clear-cut conclusions difficult to draw.

Using multivariate path analysis to test the hypothesis that different coping styles share some of the same genetic influences as well as having unique or unshared genetic influences, Busjahn and colleagues (Busjahn, Faulhaber, Freier, & Luft, 1999) used a coping questionnaire with 19 different types of reactions (e.g., “play down,” avoidance, self-medication/alcohol use). The majority of the response types (14 of 19) showed genetic influences without significant shared environmental effects, 2 of the 19 scales showed effects from the family environment without genetic effects (aggression and distraction from situation), and 3 of 19 scales showed a combination of genetic and shared environmental effects (situational control, avoidance, self-pity). Results from multivariate analyses demonstrated a complex genetic architecture with specific as well as shared genetic influences on coping behaviors.

Forgiveness has primarily been viewed as an emotion-focused coping strategy. Empirical evidence suggests that emotion-focused coping strategies may be primarily influenced by the shared family environment. More research is needed to determine what specific aspects of the family environment may mediate emotion-focused coping strategies specific to forgiveness.

Assumption Three—Spirituality and Religion

Religion Versus Spirituality. The relationship between religiosity and spirituality was examined by Wink and Dillon (2003), under the assumption that they are related but distinct constructs (Marty, 1993). They used different measurements for spirituality and religiosity and examined their interrelationship and relationship to psychosocial well-being. Religiosity was assessed using items regarding institutionalized beliefs and practice, and spirituality was assessed using items regarding daily personal (noninstitutionalized) beliefs and behaviors. Results indicated that religiosity is more related to communal behaviors, whereas spirituality is more concerned with one’s self (i.e., asserting, protecting, and expanding the self). Although there was some

overlap between religiosity and spirituality (both constructs correlated substantially with some communal characteristics), Wink and Dillon concluded that the two constructs are distinct. In contrast, Hill et al. (2000) reported that religion and spirituality represent related rather than independent constructs. According to Wuthnow (1998), associating religiosity and spirituality to institutional versus personal domains disregards the fact that all forms of spiritual expression unfold in a social context and that organized faith traditions are concerned with the ordering of personal affairs as well. In addition, empirical evidence indicates that most individuals experience spirituality within the context of an organized religion and do not decontextualize spirituality from religion (Marler & Hadaway, 2002; Zinnbauer et al., 1997).

The relationship between forgiveness and religion was explored by McCullough and Worthington (1999) within the three major monotheistic traditions in the West (Christianity, Islam, and Judaism). They also examined the extent to which forgiveness and religion are connected in human functioning by reviewing the existing body of research on these two constructs. Based on their review, they concluded that forgiveness is a concept that generally has deep religious roots in Western culture.

Kendler and colleagues (2003), using adult twins, conducted a factor analysis to assess religiosity, spirituality and related attitudes. They found seven dimensions of religiosity. One was named *forgiveness* and included items reflecting caring, loving, and a forgiving approach to the world. Another dimension, named *unvengefulness*, was partly extracted from the same measure as the items of forgiveness but reflected an attitude that emphasized avoiding retaliation rather than promoting forgiveness. Other dimensions were general religiosity, social religiosity, involved God, God as judge, and thankfulness. These results indicate the complexity and multidimensionality of the construct of religiosity. Moreover, although some have argued that religiosity and spirituality are different dimensions (i.e., religiousness represents an institutional, formal, inhibiting expression; spirituality represents a personal, subjective, freeing expression; Koenig, McCullough, & Larson, 2001), Kendler et al. (2003) observed no major distinction between the two constructs.

Genetics and Spirituality/Religion. Using adolescent twins, Loehlin and Nichols (1976) reported that the frequency of religious activities was substantially correlated in twin pairs and that there were only moderately higher correlations for MZ than for DZ pairs. Similarly, Rose (1988), using the MMPI, found that twin resemblance for religious orthodoxy was mainly influenced by shared environmental factors. Rose (1988) found that 10% of the variance in religious orthodoxy was due to genetic influence, 61% was due to the shared environment, and 29% was due to the nonshared environment.

Using adult twins reared together and reared apart, Waller and colleagues (Waller, Kojetin, Bouchard, Lykken, & Tellegen, 1990) examined five measures of religiosity and reported substantial heritability for all scales, including an MMPI-based measure of religious fundamentalism. They found that for fundamentalism, 46% of the variance was contributed by genetic factors, and the remaining variance was contributed

by the nonshared environment. Truett et al. (1994) used a large twin-family study (29,698 subjects, of which 5,670 were twin pairs) that included data on frequency of church attendance. Applying a gender-dependent model, they found that in males, genes and the family environment each contributed about one quarter of the variance in frequency of church attendance, whereas the nonshared environment accounted for about half. In females, genetic factors, the family environment, and the nonshared environment contributed roughly equally to the variance. Some variance was attributable to the covariance of genes and environment. Kendler, Gardner, and Prescott (1997) studied resemblance for religiosity (i.e., personal devotion, personal conservatism, institutional conservatism) in female twin pairs. They found that personal conservatism could be explained mainly on the basis of twins' nonshared environment (55%), but shared environment contributed to the variance as well (45%). No evidence was found for the influence of any genetic factors on personal conservatism. For institutional conservatism, genetic factors had a minor role (12%); the nonshared environment explained 37% of the variance, but most of the variance could be explained by the shared environment (51%). Interestingly, for personal devotion, family environment and genetic factors made similar contributions to twin resemblance (24% and 29%, respectively), and the balance was due to the nonshared environment (47%).

D'Onofrio and colleagues (1999), using twin pairs and their family members, found that additive genetic effects explained 18% of the variance for females and 19% for males for church attendance. The contribution of nonadditive genetic influences accounted for approximately 30% in females and 23% in males. Using adult male twin pairs from the Vietnam Era Twin Registry, Tsuang, Williams, Simpson, and Lyons (2002) reported that shared environmental factors accounted for 45% of the variance in spiritual involvement, nonshared environmental factors accounted for 32%, and genetic factors accounted for 23%. These results are suggestive only due to the relatively small sample size (100 pairs). It appears as though both shared environmental and genetic factors influence dimensions of religiosity. (For further information on twin correlations and parameter estimates of other religious constructs, see D'Onofrio, Eaves, Murrelle, Maes, & Spilka, 1999.)

Assumption Four—Personality

It has been suggested that a variety of factors influence forgiving a transgression and that at times, individual differences such as personality are significant contributors to forgiveness, whereas at other times, social and relational factors are more important (for a review, see chapter 11 by Mullet, Neto, & Rivi re; Snyder, 2001). Symington and colleagues (2002) found that neuroticism and agreeableness were personality traits that played a significant role in a variety of forgiveness dimensions; researchers have also found these traits to have an opposite effect on forgiveness. Agreeableness is positively correlated with forgiveness, and neuroticism is negatively correlated (Brose, Rye, Lutz, & Ross, 2002). McCullough and colleagues (McCullough, Bellah, Kilpatrick,

& Johnson, 2001) found vengefulness to play a major role in forgiveness (i.e., vengeful people are less forgiving). They also found that vengefulness was positively correlated to neuroticism and negatively correlated to agreeableness.

Loehlin (1992) summarized five large twin studies that investigated neuroticism and found that model-fitting analyses across twin and adoption designs produced heritability estimates of 41%. With regard to environmental effects, no more than 10% of the variance in neuroticism was accounted for by shared environment, and the greatest variance was attributed to nonshared environmental influences (and error).

Bergeman and colleagues (1993) published a genetic analysis of twins reared together and apart on other dimensions of personality, including the other primary personality trait related to forgiveness—agreeableness. Using model-fitting techniques, they found that the total genetic influences were approximately 12%, shared environmental effects were 21%, and nonshared environmental effects accounted for 67% of the variance. Jang and colleagues (Jang, Livesley, & Vernon, 1996) reported that 41% of the variance for both neuroticism and agreeableness was genetically determined. The evidence supporting a significant genetic influence on agreeableness is not as well established as that for the genetic influence on neuroticism.

RELEVANCE FOR CLINICAL AND APPLIED INTERVENTIONS

It seems highly unlikely that any knowledge we may gain about the influence of genetic factors on forgiveness, either at the quantitative or molecular level, will have any applied implications in the foreseeable future. The relationship of genes and the proteins for which they code to the behavior of forgiving will undoubtedly prove to be complex, and manipulation of the relevant genes would be morally and ethically problematic, even if it were scientifically possible. If all we are interested in is the technical application of scientific understanding of genetic influences on forgiveness, we will inevitably be disappointed.

However, genetic research into behavior has the potential to address questions about human nature that may be more meaningful: Why are we humans the way we are? Suggesting that a trait or behavior is influenced by genetic factors has various implications. Genetic explanations are antithetical to some ideologies because they are assumed to imply deterministic mechanisms that preclude any possibility of changing or influencing the characteristic. For some people, concluding that a trait or behavior is influenced by genetic factors may lead to therapeutic nihilism; that is, they may conclude that if a factor is genetically influenced, it is immutable or unchangeable. Fortunately, this view is misguided.

The disorder phenylketonuria (PKU) is a convenient example of the shortcomings of this view. If an infant has two defective copies of the gene that codes for the enzyme that metabolizes phenylalanine, the result is a buildup of phenylpyruvic acid, which damages that developing nervous system, leading to mental retardation. However, for individuals who have the genotype for PKU, an environmental manipulation

(i.e., excluding phenylalanine from the diet) can prevent the clinical syndrome. This demonstrates that “genetically determined” outcomes are not necessarily inevitable. Evidence that may demonstrate significant genetic influences on an individual’s probability of forgiving would not be incompatible with efforts to improve understanding of forgiveness and environmental interventions to promote forgiveness.

Although for some people the belief in genetic influences might lead to pessimism about the efficacy of interventions, genetic explanations can also be used to promote a nonjudgmental stance (and perhaps forgiveness itself). Tolerance toward traits such as obesity or homosexuality that have often been stigmatized in our culture may be promoted by evidence supporting the influence of genetic factors. If obesity to a great extent reflects genetic predispositions, it is more difficult to sustain a view of the obese individual as having a character flaw; if sexual orientation is a reflection of genetic influences, it is more difficult to characterize an orientation as “sinful.” An appreciation of genetic influences on human behavior may help reduce blame and promote tolerance. Although understanding genetic influences on forgiveness will not translate into a clinical intervention, it can inform how we think about people in a way that will lead to attitudes that are both more realistic and more humane.

NEW RESEARCH DIRECTIONS NEEDED IN THE AREA

To date there has been little work on the genetic and environmental influences on forgiving, so additional exploration in the field could prove to be valuable. Twin studies might be the best starting point for research on genetic influences on forgiving. Twin studies could inform our understanding of genetic influences on the construct of forgiveness but might also provide information about the nature of the relationships of other relevant constructs to forgiveness. Such research could, for example, explicate that nature of the relationship between forgiveness and personality traits such as neuroticism.

Another factor to keep in mind in trying to understand genetic influences on forgiving is the complexity introduced by the potential for environmental factors to influence gene expression. At any given time or context, many genes remain unexpressed. Developmental and environmental factors can alter the expression of genes. It may be that certain developmental or environmental factors affect the expression of genes that influence the probability of forgiving. There may be an interaction between genes and the environment in which certain genetic influences are manifested only under certain environmental conditions.

We are aware of only two ongoing studies of genetic influences on forgiveness—each study is being conducted by an author of this chapter. Tsuang and colleagues (Tsuang, 2005) recently completed data collection on a project entitled, “Is There a Role for Forgiveness and Spirituality in Coping with Combat Trauma?” In this study, we conducted an empirical investigation of the role of forgiveness in coping with trauma associated with military service in Vietnam. The overall objective is to explicate the

actual and potential roles of forgiveness for coping with combat and other traumatic life-threatening experiences. This study utilized 170 pairs of identical twins from the Vietnam Era Twin Registry in which one twin served in Vietnam and experienced high levels of combat exposure and the co-twin served in the military but did not serve in Vietnam.

The second study, “The Causes and Effects of Forgiveness: A Twin Family Study” by Eaves (2005), investigates whether religion and forgiveness protect against drug use. The study is investigating whether genetic and psychological factors play a part in using drugs as well as factors that may influence forgiveness. Questionnaires on religiosity, adolescent behavioral outcomes, and social risk and protective factors were mailed to adolescent twins and their parents. Data are also being collected on adult twins, along with their spouses and children, examining similar constructs. Preliminary analyses indicate that the correlation for MZ twins is greater than that for DZ twins and lead to the inference that there is a small genetic influence on forgiveness, such as is found with a number of other temperamental traits.

PERSONAL THEORETICAL PERSPECTIVES ON THE FIELD

The approach we have taken in our twin study of forgiveness in Vietnam veterans provides an example of how we believe that genetic factors can be incorporated into a study examining forgiveness. We are investigating the influence that forgiveness may have on the individual’s ability to cope with combat stress. The outcomes we are examining include variables such as physical health, psychiatric disorders (e.g., post-traumatic stress disorder, depression, substance abuse), demoralization (nonspecific distress), and “life success” as indicated by occupational functioning, family functioning, and life satisfaction. In our model, the question of the moderating effect of forgiveness on combat exposure is addressed by determining whether forgiveness influences the relationship between combat and social/psychological outcomes later in life. This question may seem straightforward, but answering the question unambiguously may actually be fairly complicated. One way to think of this design is that each pair of twins represents two copies of a single set of genes and family environmental influences. Conceptually speaking, one copy of the genes and family environment is sent to Vietnam and exposed to combat trauma; the other set is not exposed. The outcome of the unexposed individual is the best predictor of the status of the combat-exposed twin if he had not been exposed to combat. In this way, we are not judging the influence of forgiveness on the psychological and social outcomes per se. Rather, we are judging the influence of forgiveness based on the deviation of the combat-exposed twin’s outcomes from the outcomes of his unexposed co-twin. This will allow us to determine whether forgiveness can ameliorate some of the adverse consequences of combat trauma.

Although it is still the “early days” in the behavior-genetic study of forgiveness, the above theoretical perspective has its precedent in other areas of psychiatric genetics. A recent study by Eaves, Silberg, and Erkanli (2003) focused on the relationship between prepubertal anxiety, adverse life events, and later depression in a sample of adolescent female twins. Briefly, they showed how early genetic differences on anxiety (the analogy of a forgiving temperament in our model) created differences in later depression through three distinct pathways. The first pathway is due to the fact that the same genes that affect early anxiety also influence later depression. Such a process is known to geneticists as *pleiotropy* and to developmental psychopathologists as *heterotypic continuity*. The second pathway arises because early genetic effects on anxiety increase exposure to life events that in turn increase risk to depression (“genotype-environment correlation;” rG-E). Finally, the genes that create differences in early anxiety also make young women more sensitive to the depressogenic effects of environmental adversity (“genotype \times environment interaction,” G \times E). This basic threefold mechanism, *mutatis mutandis*, is exactly that envisioned on our model for the relationship between a forgiving temperament, exposure to wrong, and subsequent successful social adaptation.

CONCLUSIONS

Studying genetic (and environmental) influences on forgiving will be difficult because forgiving occurs in the context of an event that provides the opportunity to forgive or not to forgive. That is, if the individual has not been wronged, there is not an opportunity to determine whether he or she would forgive the wrong. Because traditional approaches to studying genetic influences depend on assessing similarity among relatives, this creates a situation in which relatives could be dissimilar in their forgiving for reasons having to do with forgiveness per se, or they could be dissimilar because they did not both experience a transgression or experienced different transgressions. To have a clear-cut assessment of the degree of similarity among relatives for their forgiving behavior, it would be very helpful if both relatives had experienced a similar transgression from which to judge their forgiving. Perhaps on a lifetime basis, it would be possible to identify comparable instances of being wronged for each individual, then to assess how forgiving he or she was in that situation.

Because most human behavior is influenced by genetic factors, it seems very likely that forgiving will be found to be as well. Although there has been dramatic progress in biological and statistical aspects of genetic research, the rate-limiting step in explicating the genetic influences on forgiving is likely to be the complex and multifaceted nature of the construct and the difficulty of measuring and quantifying the phenomenon.

ACKNOWLEDGMENTS

The authors wish to thank the Atlantic Philanthropic Services, *A Campaign for Forgiveness Research*, and the John Templeton Foundation for separate contributions that helped fund the work described in this chapter.

REFERENCES

- Batson, C. D., & Oleson, K. C. (1991). Current status of the empathy-altruism hypothesis. In M. S. Clark (Ed.), *Prosocial behavior* (pp. 62–85). Newbury Park, CA: Sage Publications.
- Bergeman, C. S., Chipuer, H., Plomin, R., Pedersen, N., McClearn, G. E., Nesselroade, J. R., et al. (1993). Genetic and environmental effects on openness to experience, agreeableness, and conscientiousness: An adoption twin study. *Journal of Personality*, *61*, 159–179.
- Brose, L. A., Rye, M. S., Lutz, C. J., & Ross, S. R. (2002 August). *Forgiveness and the five-factor model of personality*. Poster presented at the 110th annual convention of the American Psychological Association, Chicago.
- Busjahn, A., Faulhaber, H.-D., Freier, K., & Luft, F. C. (1999). Genetic and environmental influences on coping styles: A twin study. *Psychosomatic Medicine*, *61*, 469–475.
- Davis, M. H., Luce, C., & Kraus, S. J. (1994). The heritability of characteristics associated with dispositional empathy. *Journal of Personality*, *62*, 369–391.
- D'Onofrio, B. D., Eaves, L. J., Murrelle, L., Maes, H. M., & Spilka, B. (1999). Understanding biological and social influences on Religious affiliation, attitudes, and behaviors: A behavior genetic perspective. *Journal of Personality*, *67*, 953–984.
- Eaves, L. J. (2005). [The causes and effects of forgiveness: A twin family study]. Unpublished raw data, Virginia Commonwealth University, Richmond.
- Eaves, L. J., Silberg, J. L., & Erkanli, A. (2003). Resolving multiple epigenetic pathways to adolescent depression. *Journal of Child Psychology and Psychiatry*, *44*, 1006–1014.
- Folkman, S., & Lazarus, R. S. (1980). An analysis of coping in a middle-aged community sample. *Journal of Health and Social Behavior*, *21*, 219–239.
- Hill, P. C., Pargament, K. I., Hood, R. W., Jr., McCullough, M. E., Swyers, J. P., Larson, D. B., et al. (2000). Conceptualizing religion and spirituality: Points of commonality, points of departure. *Journal for the Theory of Social Behaviour*, *30*, 51–77.
- Jang, K. L., Livesley, W. J., & Vernon, P. A. (1996). Heritability of the Big Five personality dimensions and their facets: A twin study. *Journal of Personality*, *64*, 577–591.
- Kendler, K. S., & Eaves, L. J. (1986). Models for the joint effect of genotype and environment on liability on psychiatric illness. *American Journal of Psychiatry*, *143*, 279–289.
- Kendler, K. S., Gardner, C. O., & Prescott, C. A. (1997). Religion, psychopathology, and substance use and abuse: A multimeasure, genetic-epidemiologic study. *American Journal of Psychiatry*, *154*, 322–329.
- Kendler, K., Kessler, R. C., Heath, A. C., Neale, M. C., & Eaves, L. J. (1991). Coping: A genetic epidemiological investigation. *Psychological Medicine*, *21*, 337–346.
- Kendler, K. S., Liou, X. Q., Gardner, C. O., McCullough, M. E., Larson, D., & Prescott, C. A. (2003). Dimensions of religiosity and their relationship to lifetime psychiatric and substance use disorders. *American Journal of Psychiatry*, *160*, 496–503.

- Koenig, H. G., McCullough, M. E., & Larson, D. B. (2001). *Handbook of religion and health*. New York: Oxford University Press.
- Loehlin, J. C. (1992). *Genes and environment in personality development*. Newbury Park, CA: Sage.
- Loehlin, J. C., & Nichols, R. C. (1976). *Heredity, environment, and personality*. Austin, TX: University of Texas Press.
- Marler, P. L., & Hadaway, C. K. (2002). "Being religious" or "being spiritual" in America: A zero-sum proposition? *Journal for the Scientific Study of Religion*, *41*, 289–300.
- Marty, M. (1993). Where the energies go. *Annals of the American Academy of Political and Social Sciences*, *553*, 11–26.
- Matthews, K. A., Batson, C. D., Horn, J., & Rosenman, R. H. (1981). "Principles in his nature which interest him in the fortune of others...": The heritability of empathic concern for others. *Journal of Personality*, *49*, 237–247.
- McCullough, M. E., Bellah, C. G., Kilpatrick, S. D., & Johnson, J. L. (2001). Vengefulness: Relationships with forgiveness, rumination, well-being, and the Big Five. *Personality and Social Psychology Bulletin*, *27*, 601–610.
- McCullough, M. E., Pargament, K. I., & Thoresen, C. E. (2000). The psychology of forgiveness: History, conceptual issues, and overview. In M. E. McCullough, K. I. Pargament, & C. E. Thoresen (Eds.), *Forgiveness: Theory, research, and practice* (pp. 1–14). New York: Guilford Press.
- McCullough, M. E., Rachal, K. C., Sandage, S. J., Worthington, E. L., Jr., Brown, S. W., & Hight, T. L. (1998). Interpersonal forgiving in close relationships II: Theoretical elaboration and measurement. *Journal of Personality and Social Psychology*, *75*, 1586–1603.
- McCullough, M. E., & Worthington, E. L., Jr. (1999). Religion and the forgiving personality. *Journal of Personality*, *67*, 1141–1164.
- McCullough, M. E., Worthington, E. L., Jr., & Rachal, K. C. (1997). Interpersonal forgiving in close relationships. *Journal of Personality and Social Psychology*, *73*, 321–336.
- Mellins, C. A., Gatz, M., & Baker, L. (1996). Children's methods of coping with stress: A twin study of genetic and environmental influences. *Journal of Child Psychology and Psychiatry*, *37*, 721–730.
- Rose, R. J. (1988). Genetic and environmental variance in content dimensions of the MMPI. *Journal of Personality and Social Psychology*, *55*, 302–311.
- Rushton, J. P., Fulker, D. W., Neale, M. C., Nias, D. K. B., & Eysenck, H. J. (1986). Altruism and aggression: The heritability of individual differences. *Journal of Personality and Social Psychology*, *50*, 1192–1198.
- Snyder, C. R. (Ed.). (2001). *Coping with stress: Effective people and processes*. Oxford: Oxford University Press.
- Symington, S. H., Walker, D. F., & Gorsuch, R. L. (2002). The relationship between forgiveness and reconciliation to five and sixteen factors of personality. *Journal of Psychology and Christianity*, *21*, 141–150.
- Truett, K. R., Eaves, L. J., Walters, E. E., Heath, A. C., Hewitt, J. K., Meyer, J. M., et al. (1994). A model system for analysis of family resemblance in extended kinships of twins. *Behavior Genetics*, *24*, 35–49.
- Tsuang, M. T. (2005). [Is there a role for forgiveness and spirituality in coping with combat trauma?] Unpublished raw data, Harvard Institute for Psychiatric Epidemiology and Genetics, Cambridge, MA.

- Tsuang, M. T., Williams, W. M., Simpson, J. C., & Lyons, M. J. (2002). Pilot study of spirituality and mental health in twins. *American Journal of Psychiatry*, *159*, 486–488.
- Waller, N. G., Kojetin, B. A., Bouchard, T. J., Jr., Lykken, D. T., & Tellegen A. (1990). Genetic and environmental influences on religious interests, attitudes, and values: A study of twins reared apart and together. *Psychological Science*, *1*, 138–142.
- Wink, P., & Dillon, M. (2003). Religiousness, spirituality, and psychosocial functioning in late adulthood: Finding from a longitudinal study. *Psychology and Aging*, *18*, 916–924.
- Worthington, E. L., Jr. (Ed). (1998). *Dimensions of forgiveness: Psychological research and theological perspectives*. Philadelphia: Templeton Foundation Press.
- Worthington, E. L., Jr., & Scherer, M. (2004). Forgiveness is an emotion-focused coping strategy that can reduce health risks and promote health resilience: Theory, review, and hypotheses. *Psychology and Health*, *19*, 385–405.
- Worthington, E. L., Jr., & Wade, N. G. (1999). The social psychology of unforgiveness and forgiveness and implication for clinical practice. *Journal of Social and Clinical Psychology*, *18*, 385–418.
- Wuthnow, R. (1998). *After Heaven: Spirituality in America since the 1950s*. Berkeley: University of California Press.
- Zahn-Wexler, C., Robinson, J., & Emde, R. N. (1992). The development of empathy in twins. *Development Psychology*, *28*, 1038–1047.
- Zinnbauer, B. J., Pargament, K. I., Cole, B. C., Rye, M. S., Butter, E. M., Belvich, T. G., et al. (1997). Religion and spirituality: Unfuzzifying the fuzzy. *Journal for the Scientific Study of Religion*, *36*, 549–564.