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Can Personality Explain Genetic Influences on Life Events?

Kimberly J. Saudino
Pennsylvania State University

Nancy L. Pedersen and Paul Lichtenstein
Karolinska Institute

G. E. McClearn
Pennsylvania State University

Robert Plomin
Institute of Psychiatry

Previous research in the Swedish Adoption/Twin Study of Aging (SATSA) has found genetic influences on life events (R. Plomin, P. Lichtenstein, N. L. Pedersen, G. E. McClearn, & J. R. Nesselroade, 1990). The present study extends this finding by examining sex differences in genetic and environmental contributions to life events and by examining personality as a mediator of genetic influences on life events in SATSA. Analyses were based on 320 twin pairs, including identical and fraternal twins reared together and apart (mean age = 58.6 years). Controllable, desirable, and undesirable life events revealed significant genetic variance only for women. There was no significant genetic variance for either sex for uncontrollable events. Multivariate analyses of personality (as indexed by Neuroticism, Extraversion, and Openness to Experience) and life events suggest that all of the genetic variance on controllable, desirable, and undesirable life events for women is common to personality. Thus, in this sample of older adult women, genetic influences on life events appear to be entirely mediated by personality.

Perhaps one of the most intriguing findings to emerge from recent behavioral genetic research is that genetic factors contribute substantially to many measures of the environment (see Plomin, 1994, for a review). When treated as a phenotype in quantitative genetic analyses, environmental measures often show as much genetic variance as personality measures (Plomin & Bergeman, 1991). One widely used environmental measure that has consistently displayed genetic influence is life events (e.g., Kendler, Neale, Kessler, Heath, & Eaves, 1993; Moster, 1990, as cited in McGue, Bouchard, Lykken, & Finkel, 1991; Plomin, Lichtenstein, Pedersen, McClearn, & Nesselroade, 1990). Although these studies differ in design, sample characteristics, and measures of life events, the results are strikingly similar and suggest that to some extent, life events do not happen capriciously to the individual.

Life events appear to be heritable to the extent to which an individual has some influence on the events themselves. For example, genetic analyses of life events measures during the last half of the life span in the Swedish Adoption/Twin Study of Aging (SATSA) found significant genetic influence on *controllable* events, in which the individual can play an active role, but not for *uncontrollable* events, which are independent of the individual's actions (Plomin, Lichtenstein, et al., 1990). These findings were replicated in a study of reared-apart adult twins, which found controllable events to be substantially more heritable than uncontrollable events (McGue et al., 1991), and in a large epidemiological adult twin study of recent life events (Kendler et al., 1993), which found significant heritability for *personal* events, which were potentially dependent on the individual's behavior, but not for *network* events, which are described as "inherently uncontrollable" (p. 794).

The finding of genetic influence on measures of life events might at first appear paradoxical—events have no DNA; therefore, how can they be affected by genetic factors? The resolution of this apparent paradox is that the environment is not independent of the individual: Individuals play an active role in creating their own environments. That is, if measures of life events reflect genetically influenced characteristics of the individual, we can, by definition, expect to find genetic influence on such measures. The next step, then, is to identify those genetically influenced characteristics that are responsible for genetic variance on life events measures. One possible candidate is personality, in that genetically influenced personality traits might affect how people interact with their environments and, as a result, contribute to the events that they experience throughout the life course. (See Loehlin, 1992, for a review of the heritability of personality.)

Personality researchers have long been interested in the association between personality and the environment, as seen, for example, in research on person–situation interactions (e.g., Diener, Larsen, & Emmons, 1984; Emmons, Diener, & Larsen, 1985; Kenrick & Dantchik, 1983). Researchers examining the mechanisms through which individuals are exposed to certain situations have posited a model of *interactionism*. In this context, *interactionism* does not refer to Person × Situation interac-

Kimberly J. Saudino and G. E. McClearn, Center for Developmental and Health Genetics, Pennsylvania State University; Nancy L. Pedersen and Paul Lichtenstein, Institute for Environmental Medicine, Karolinska Institute, Stockholm, Sweden; Robert Plomin, Institute of Psychiatry, London, England.

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Correspondence concerning this article should be addressed to Kimberly J. Saudino, who is now at Department of Psychology, Boston University, 64 Cummington Street, Boston, Massachusetts 02215.

tions in a statistical sense; rather, it describes "a bidirectional causality between situations and persons" (Magnus, Diener, Fujita, & Pavot, 1993, p. 1046). Indeed, several studies have found that throughout everyday life, individuals tend to choose situations or activities that are reflective of their personality (e.g., Diener et al., 1984; Emmons et al., 1985; Snyder, 1981, 1983).

More specifically, personality has been shown to be related phenotypically to life events, suggesting that personality characteristics are correlated with life events. Most research examining the relation between personality and life events has focused on the major dimensions of Neuroticism and Extraversion. Neuroticism has been found to be significantly associated with negative life events and with the total number of life events reported (Fergusson & Horwood, 1987; Headey & Wearing, 1989; Horwood & Fergusson, 1986; Magnus et al., 1993; Poulton & Andrews, 1992). In contrast, Extraversion significantly predicts positive life events (Headey & Wearing, 1989; Magnus et al., 1993).

In an attempt to increase the predictability of life events from personality, Headey and Wearing (1989) included a measure of Openness to Experience, a third major dimension of personality (Costa & McCrae, 1985). Openness to Experience was significantly associated with both positive and negative life events, prompting the authors to conclude the following:

> If we know four things about a person—his or her age and three personality traits (Neuroticism, Extraversion, Openness to Experience)—we can predict to a modest degree the kinds of events that will subsequently happen to him or her. (p. 735)

The relation between personality and life events is sufficiently robust that some researchers have suggested that personality may, to some extent, be the cause of life events (Magnus et al., 1993; Poulton & Andrews, 1992). Thus, it is plausible that personality might mediate genetic variance on life events measures. The purpose of the present study is to explore the extent to which personality can explain genetic influence on life events in the SATSA sample. Because Kendler et al. (1993) found evidence of differential heritabilities across gender for some measures of life events, we first examine gender differences in genetic and environmental variance components for the previously reported SATSA measures of controllable, uncontrollable, desirable, and undesirable life events (Plomin, Lichtenstein, et al., 1990). Multivariate genetic analyses are then used to explore the extent to which genetic variance for Neuroticism, Extraversion, and Openness to Experience can explain genetic variance on life events in our adult sample. Although we had no specific hypotheses about gender, on the basis of previous research, we predicted that neither men nor women would show genetic influence for uncontrollable life events. Moreover, given the phenotypic relation between personality and life events and that Neuroticism, Extraversion, and Openness to Experience are among the most heritable personality dimensions in SATSA (Bergeman et al., 1993; Pedersen, Plomin, McClearn, & Friberg, 1988), we expected to find that these personality traits would account for a portion of genetic influence on life events measures.

Method

Sample

The SATSA sample of twins reared apart and twins reared together is a subset of twins from the population-based Swedish Twin Registry, which includes nearly 25,000 pairs of same-sex twins born in Sweden between 1886 and 1958 (Cederlöf & Lorich, 1978). The identification of twins separated early in life and matched twins reared together has been described elsewhere (Pedersen, Friberg, Floderus-Myrhed, McClearn, & Plomin, 1984). For the twins reared apart, approximately half (48%) the twins were separated by their 1st birthday, 82% were separated by age 5, and all were separated by age 11. Although the reasons for separation varied, the majority of twins were separated as a consequence of the death of one or both parents or economic hardship. A sample of twins reared together was matched to reared-apart twins for gender and date and county of birth. The average age of the twins was 58.6 years (SD = 13.6 years), and consistent with gender expectations for the latter half of the life span, 60% of the sample was female.

Life events and personality data from both members of a twin pair were complete for 39 pairs of identical twins reared apart (MZA), 80 pairs of identical twins reared together (MZT), 96 pairs of fraternal twins reared apart (DZA), and 105 pairs of fraternal twins reared together (DZT). Fraternal twins consisted of same-sex twin pairs. Zygosity was diagnosed by means of physical similarity criteria and confirmed using serological analyses (see Pedersen et al., 1991, for details).

Measures

Life events. The SATSA measure of life events was based on the Social Readjustment Rating Scale (Holmes & Rahe, 1967), which has been modified for use with older individuals (Persson, 1980). Participants were presented with a list of 25 life events and were asked to indicate whether the event occurred and the importance of the event. Four subscales were constructed by summing each reported event within a scale weighted by the average importance assigned to the event. These scales were controllable events (e.g., getting married or divorced); uncontrollable events (e.g., serious illness in child or death of spouse); desirable events (e.g., major improvement in financial status or making a new acquaintance); and undesirable events (e.g., major deterioration in financial status or death of a child). There was some overlap in items across scales, so that items could be in scales in the *controllable–uncontrollable* dimension, as well as in the *desirable–undesirable* dimension. This measure was described elsewhere in detail (Plomin, Lichtenstein, et al., 1990).

Personality. Neuroticism and extraversion were assessed by means of a short form of the Eysenck Personality Inventory (Floderus, 1974). Each scale consists of nine items, scored as either yes (1) or no (0; see Pedersen et al., 1988, for more details). Internal consistency, as measured by Cronbach's alpha, was .75 for Neuroticism and .66 for Extraversion (Floderus-Myrhed, Pedersen, & Rasmuson, 1980). Note that although they are reasonable, these reliabilities are somewhat lower than those reported for the full scales in the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1975). Openness to Experience was assessed by means of a shortened version of the Openness scale of the NEO Personality Inventory (NEO-PI; Costa & McCrae, 1985; see Bergeman et al., 1993, for more details). Six Openness items were scored on a 5-point scale, according to the traditional scoring of the NEO-PI, that is, ranging from *strongly agree* (1) to *strongly disagree* (5). Internal consistency for this scale was .92.

Raw scores for the personality and life events measures were standardized by means of a regression technique, to adjust for possible main effects of age and gender and the Age × Gender interaction, which could inflate twin correlations (McGue & Bouchard, 1984).

Multivariate Model-Fitting Analyses

Multivariate model-fitting analyses of the SATSA data were used to explore the extent to which common genetic and environmental factors affect measures of Neuroticism, Extraversion, Openness to Experience, and life events during the latter half of the life span. Model-fitting procedures provide an elegant analysis of covariation among measures, because they analyze all of the data simultaneously and take into account the heritabilities of each measure and the phenotypic covariance among measures (see Neale & Cardon, 1992, for a description of multivariate analyses). Quadrivariate Cholesky models were fitted to observed covariance matrices by means of LISREL VIII (Jöreskog & Sörbom, 1993) maximum-likelihood estimation procedures to assess personality as a mediator of genetic influences on each measure of life events.

The model is illustrated as a path diagram in Figure 1. The rectangles represent the phenotypic variances of Neuroticism, Extraversion, Openness to Experience, and life events, respectively. The circles represent latent genetic and environmental factors. The *Ga* factors refer to *additive genetic influences:* the sum of the average effect of all genes that influence a trait. Identical (MZ) twins are genetically identical, having 100% of their genes in common, whereas fraternal (DZ) twins share on average 50% of their segregating genes. *Nonadditive genetic variance* (*Gd*) refers to effects of genes that are not linear and additive. For example, if there is dominance among alleles (alternate forms of a gene) or if a trait is influenced by epistasis (interaction of alleles across loci), the phenotypic expression of the trait does not represent the sum of the average effects of alleles. MZ twins share all nonadditive genetic effects, whereas DZ twins share only a quarter of genetic variance due to dominance and even less variance due to epistasis (Plomin, DeFries, & McClearn, 1990). *Shared environment* (*Es*) refers to the influence of shared rearing environments on twin resemblance. Twins reared together share rearing environments; however, in the absence of selective placement, the influence of shared rearing environments on twins reared apart is zero. Finally, the *En* factors reflect *nonshared environmental variance* and measurement error. Nonshared environmental influences are those environmental factors that are unique to each member of a twin pair and that make twins different from each other.

The quadrivariate model decomposes the phenotypic variances and covariances of Neuroticism, Extraversion, Openness to Experience, and the life events measure into genetic and environmental variance that is common to all four measures (Ga_4, Gd_4, Es_4, and En_4); variance common to Extraversion, Openness to Experience, and the life events measure (Ga_3, Gd_3, Es_3, and En_3); variance common to Openness to Experience and the life events measure (Ga_2, Gd_2, Es_2, and En_2); and variance unique to the life events measure (Ga_1, Gd_1, Es_1, and En_1). Each subsequent factor reflects variances that are independent of prior factors. The unique factors assess whether there are any unique genetic or environmental influences on the life events measure that is independent of personality, whereas the paths leading from the other factors to the life events measure represent genetic and environmental covariance between personality and life events.

Path coefficients are partial regressions that indicate the relative influence of the latent variables on the phenotype. When path coefficients have been standardized, the percentage of variance explained by a path is the square of its path coefficient. Heritability (h^2), the proportion of variance of a variable that is due to genetic influences, is the sum of all squared standardized *G* path coefficients leading to the phenotype. The

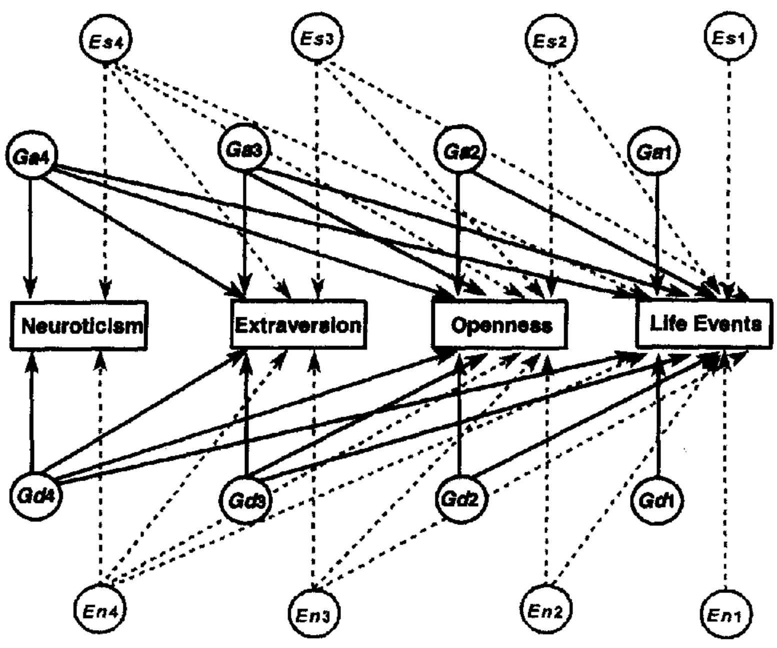

Figure 1. Quadrivariate path model depicting common and unique factors for genetic and environmental sources of variance and covariance for Neuroticism, Extraversion, Openness to Experience, and Life Events. The latent variables Ga_4, Gd_4, Es_4, and En_4 represent the additive and nonadditive genetic, shared environmental, and nonshared environmental variance, respectively, that is common to all four measures; Ga_3, Gd_3, Es_3, and En_3 represent genetic and environmental variances that are common to Extraversion, Openness to Experience, and the life events measure; Ga_2, Gd_2, Es_2, and En_2 represent variance common to Openness to Experience and the life events measure; and Ga_1, Gd_1, Es_1, and En_1 represent genetic and environmental influences that are unique to the life events measure.

proportions of variance due to shared and nonshared environmental variance for each measure are derived in a similar manner. Path coefficients can also be used to estimate the extent to which the same genetic and environmental influences contribute to the covariance between measures. For example, the genetic contribution to a phenotypic correlation between two measures can be estimated by multiplying the path coefficients for both phenotypes within each common *G* factor and summing across the common *G* factors that are shared across phenotypes. In Figure 1, the genetic mediation of the phenotypic correlation between Neuroticism and the life events measure is estimated by multiplying the coefficients from the Ga_4 path leading to neuroticism and the Ga_4 path leading to the life events measure and summing it with the product of the Gd_4 path leading to neuroticism with the Gd_4 path leading to the life events measure. Similarly, the phenotypic correlation between Openness to Experience and the life events measure can be genetically mediated via the Ga_4, Gd_4, Ga_3, Gd_3, Ga_2, and Gd_2 factors. Thus, the genetic mediation between Openness to Experience and the life events measure can be estimated by summing the multiples of common paths for these six contributions. Estimates of shared and nonshared environmental contributions to the phenotypic correlation between measures can be obtained by applying the same principles.

Results

Gender Differences in Genetic Influences on Life Events

Before conducting multivariate analyses examining the role of personality as a mediator of genetic influences on life events, univariate model-fitting analyses were used to evaluate gender differences in genetic and environmental variance components (i.e., *Ga, Gd, Es,* and *En*) for each life events scale (see Plomin, Lichtenstein, et al., 1990, for a description of the basic univariate model). To test for gender differences, the fit of a model that allowed the variance components to vary across gender (Model 1) was compared to the fit of a model equating variance components across men and women (Model 2). Note that Model 1 is equivalent to fitting two separate univariate models, one for men and one for women. The chi-square for Model 1 is equal to the sum of the chi-squares from the separate male and female univariate models. Significant gender differences are indicated by the difference in chi-squares between Models 1 and 2, with degrees of freedom equal to the difference in degrees of freedom between the two models.

Table 1 presents standardized parameter estimates and variance components for men and women for each of the four life events scales. Controllable, uncontrollable, and desirable events displayed significant gender differences. For these three scales, a model that allowed separate parameter estimates for men and women fit significantly better than one that equated parameters across gender: controllable $\chi^2_{\text{Difference}}(4, N = 297) = 11.39$, $p < .05$; uncontrollable $\chi^2_{\text{Difference}}(4, N = 320) = 10.93$, $p < .05$; desirable $\chi^2_{\text{Difference}}(2, N = 315) = 8.54$, $p < .05$. The overall pattern of results, however, differed across measures. For controllable and desirable life events, only women displayed significant genetic influences. Broad heritability estimates for the controllable life events scale were .53 ($h^2 = .37 + .16$) and .14

Table 1
Parameter Estimates, Percentage of Variance, and Goodness-of-Fit Statistics, When Variance Components Are Allowed to Differ Across Gender

Life events scale	*Ga*	*Gd*	*Es*	*En*	χ^2	*df*	*p*
Controllable							
Men	.00	.38	.00	.93*	11.62	8	.169
% Variance	0	14	0	86			
Women	.61†	.40†	.36	.59*	11.78	8	.161
% Variance	37	16	13	35			
Uncontrollable							
Men	.00	.00	.48*	.88*	22.54	8	.004
% Variance	0	0	23	77			
Women	.20	.42	.00	.89*	12.86	8	.117
% Variance	4	18	0	79			
Desirable							
Men	.29	—	—	.96*	7.20	10	.706
% Variance	8	0	0	92			
Women	.71*	—	—	.71*	4.56	10	.919
% Variance	50	0	0	50			
Undesirable							
Men	—	.30	.45*	.84*	13.39	9	.146
% Variance	0	9	20	71			
Women	—	.64*	.00	.77*	17.94	9	.036
% Variance	0	41	0	59			

Note. *Ga* = additive genetic parameter; *Gd* = nonadditive genetic parameter; *Es* = shared environmental parameter; *En* = nonshared environmental parameter. Dashes indicate parameters that were consistently estimated as zero in all models, and therefore, reduced models omitting these parameters were used to test the significance of gender differences. The significance of parameters was based on the change in chi-square that resulted when the parameter was set to zero. Summing the chi-squares for men and women gives the overall chi-square for the model (i.e., Model 1).
* $p < .05$. † Broad heritability significant at $p < .05$ (i.e., can drop either *Ga* or *Gd* but not both genetic parameters).

(h^2 = .00 + .14) for women and men, respectively. Similarly, for desirable life events, the estimate of heritability was .50 for women and .08 for men. The univariate results for uncontrollable events are consistent with previous SATSA findings, in that neither women nor men displayed significant genetic variance for this measure (h^2 = .22 women; h^2 = .00 men). In contrast, there was no significant gender difference in variance components for the undesirable life events measure, $\chi^2_{\text{Difference}}(3, N = 296) = 5.56, p > .05$. However, when variance components were estimated separately by gender, significant genetic variance on the undesirable life events measure was indicated only for women (h^2 = .41 women; h^2 = .09 men).

Because significant genetic variance for measures of life events was found only for women, the remaining analyses exploring personality as a mediator of genetic influence on life events were conducted on a subsample of 17 MZA, 40 MZT, 64 DZA, and 52 DZT female twin pairs.

Phenotypic Associations Between Personality and Life Events

A first step in identifying genetically influenced characteristics that mediate genetic influences on measures of life experiences is to explore the phenotypic associations between those life events measures displaying a genetic influence and genetically influenced characteristics of individuals. Phenotypic correlations between the personality measures and controllable, desirable, and undesirable life events are presented in Table 2.

The correlations in Table 2 were generally consistent with previous research. Extraversion and Openness to Experience were significantly related to all three life events scales. In contrast, Neuroticism was significantly correlated with only undesirable life events. However, in multiple regression analyses, Neuroticism, Extraversion, and Openness to Experience were each found to make significant independent contributions to the prediction of all three life events measures; hence, all three personality dimensions were included in the multivariate model-fitting analyses.

Multivariate Model-Fitting Analyses

Quadrivariate models were fit to the data for female twins, to determine the degree to which genetic variance is shared between personality and life events. The parameter estimates from the maximum-likelihood model-fitting analyses are presented in Figures 2, 3, and 4 for controllable, desirable, and undesirable life events measures, respectively. For clarity of presentation, the *Ga* and *Gd* parameters are presented separately from the *Es* and *En* factors.

Controllable life events. The quadrivariate model for controllable life events (Figure 2) fit the data well, $\chi^2(104, N = 162) = 92.83, p = .78$. The zero path coefficients for the Ga_1 and Gd_1 factors indicate that there are no genetic effects unique to the measure of controllable life events. That is, once the genetic variance common to personality is removed, there is no remaining genetic influence on controllable life events. The fact that the univariate model indicated significant genetic variance on controllable life events but the multivariate model showed no unique genetic variance on controllable life events, once personality was included in the model, suggests that there must be significant genetic covariance between personality and controllable life events. Indeed, when the covariance paths from each *Ga* and *Gd* factor leading to controllable life events were dropped from the model, there was a significant decrement in fit, $\chi^2_{\text{Change}}(5, N = 162) = 19.49, p < .05$. In contrast, there was no significant environmental covariance between personality and controllable life events. All *Es* and *En* covariance paths to the controllable events measure could be dropped from the model without a significant change in fit, $\chi^2_{\text{Change}}(5, N = 162) = 4.82, p > .05$. Thus, the phenotypic relation between personality and life events appears to be due to genetic factors.

Desirable life events. The effects of nonadditive genetic variance (*Gd*) and shared environment (*En*) were estimated as zero in the univariate analyses of desirable life events (see Table 1). Therefore, only *Ga* and/or *En* can mediate the relation between personality and life events, and consequently, the *Gd* and *Es* covariance paths to desirable life events were omitted from the quadrivariate model. The multivariate model-fitting results for desirable life events are presented in Figure 3. The model fit the data well, $\chi^2(112, N = 174) = 75.42, p = 1.0$. As was the case for controllable life events, the zero path estimate for the Ga_1 factor suggested that once the genetic variance common to personality was removed, there was no remaining genetic influence on the measure of desirable life events. Dropping the covariance paths from each *Ga* factor leading to desirable life events resulted in a significantly worse fit of the model, $\chi^2_{\text{Change}}(3, N = 174) = 33.59, p < .05$; whereas the fit of the model was not significantly worsened when the *En* covariance paths were dropped, $\chi^2_{\text{Change}}(3, N = 174) = 0.55, p > .05$. Thus, only genetic factors appear to be significantly contributing to the covariation between personality and desirable life events.

Undesirable life events. Multivariate model-fitting results for undesirable life events are presented in Figure 4. Because additive genetic and shared environmental influences on undesirable life events were estimated as zero in the univariate model (Table 1), the *Ga* and *Es* covariance paths to the undesirable life events measure were omitted from the quadrivariate model. The model fit the data well, $\chi^2(112, N = 160) = 106.94, p = .62$. In keeping with the multivariate genetic analyses of controllable and desirable life events, once the genetic variance common to personality was removed, there was no remaining genetic influence on the measure of undesirable life events. That is, the zero path estimate for the Gd_1 suggests that there is no significant

Table 2
Phenotypic Correlations Between Personality and Life Events Measures for Women

Life events scale	Neuroticism	Extraversion	Openness
Controllable	.08	.20*	.26*
Desirable	.02	.22*	.21*
Undesirable	.14*	.10*	.12*

Note. The main effects of age, gender, and the Age × Gender interaction have been removed from the correlations. Openness = Openness to Experience.
* $p < .05$.

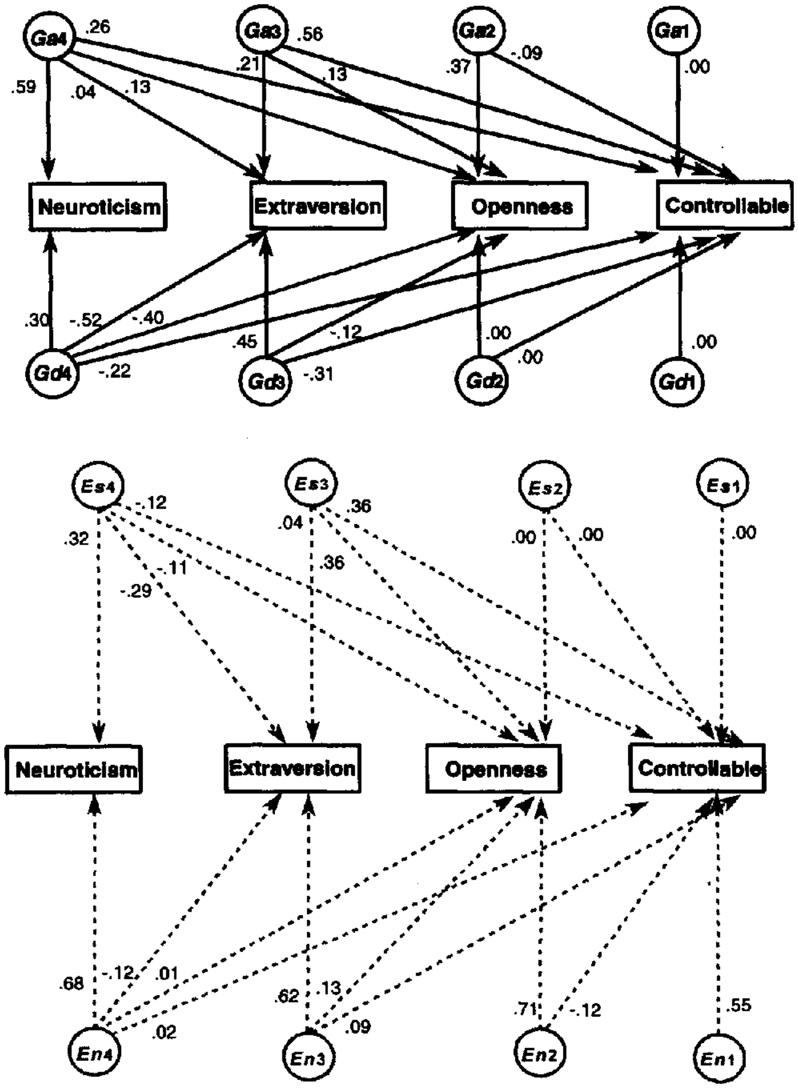

Figure 2. Quadrivariate model-fitting results for the association between Neuroticism, Extraversion, Openness to Experience, and controllable life events. The latent variables Ga_4, Gd_4, Es_4, and En_4 represent the additive and nonadditive genetic, shared environmental, and nonshared environmental variance, respectively, that is common to all four measures; Ga_3, Gd_3, Es_3, and En_3 represent genetic and environmental variances that are common to Extraversion, Openness to Experience, and the controllable life events measure; Ga_2, Gd_2, Es_2, and En_2 represent variance common to Openness to Experience, and the controllable life events measure; and Ga_1, Gd_1, Es_1, and En_1 represent genetic and environmental influences that are unique to the controllable life events measure.

genetic influence unique to undesirable life events. Given this, and the univariate results showing significant nonadditive genetic influences on undesirable life events, it was not surprising to find significant genetic covariance between personality and undesirable life events. Dropping the covariance paths from each *Gd* factor leading to undesirable life events resulted in a significantly poorer fit of the model, $\chi^2_{\text{Change}}(3, N = 160) = 8.87$, $p < .05$. Once again, the *En* covariance paths to the life events measure could be dropped without significantly altering the fit of the model, $\chi^2_{\text{Change}}(3, N = 160) = 2.13$, $p > .05$.

Genetic and environmental mediation of the phenotypic correlations between personality and life events. Table 3 presents estimates of the genetic and environmental contributions to the phenotypic correlations between each personality and life events measure. As indicated earlier, the genetic contribution to a phenotypic correlation between two measures can be estimated by multiplying the path coefficients for both phenotypes within each common *G* factor and summing across the common *G* factors that are shared across phenotypes. For example, from Figure 2, the genetic contribution to the phenotypic correlation between Extraversion and controllable life events is the sum of the Ga_1 (.04 × .26), Gd_1 (−.52 × −.22), Ga_2 (.21 × .56),

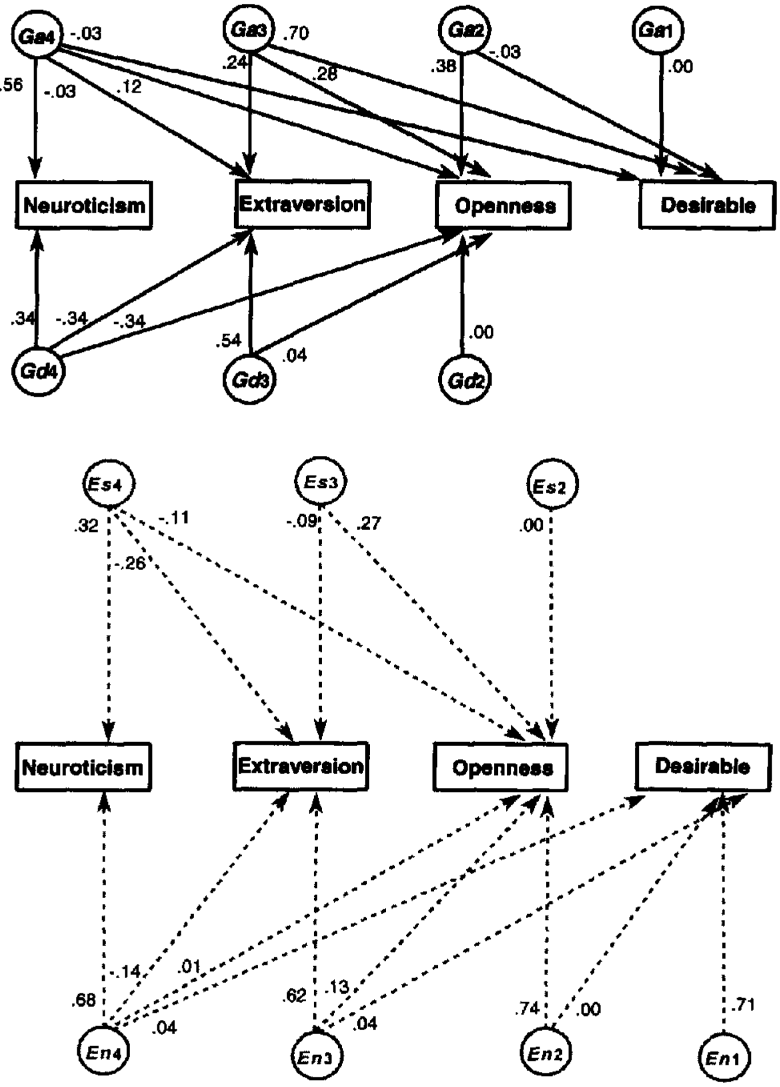

Figure 3. Quadrivariate model-fitting results for the association between Neuroticism, Extraversion, Openness to Experience, and desirable life events. The latent variables Ga_4, Gd_4, Es_4, and En_4 represent the additive and nonadditive genetic, shared environmental, and nonshared environmental variance, respectively, that is common to all four measures; Ga_3, Gd_3, Es_3, and En_3 represent genetic and environmental variances that are common to Extraversion, Openness to Experience, and the desirable life events measure; Ga_2, Gd_2, Es_2, and En_2 represent variance common to Openness to Experience and the desirable life events measure; and Ga_1, Gd_1, Es_1, and En_1 represent genetic and environmental influences that are unique to the desirable life events measure.

and Gd_2 ($.45 \times -.31$) components. Environmental contributions to the correlation are estimated in a similar fashion. A model-fitting estimate of the phenotypic correlation can then be derived by summing over the genetic and environmental contributions. As can be seen in Table 3, the phenotypic correlations between personality and life events are primarily mediated by genetic factors. This is not surprising given that there was no significant environmental covariance between personality and life events measures. Moreover, the model-fitting estimates of the phenotypic correlations between personality and life events are comparable to the observed phenotypic correlations presented in Table 2, providing support for the adequacy of our multivariate models.

Discussion

Can personality explain genetic influences on life events measures? For our sample of older adult female Swedish twins, the answer to this question is yes. Multivariate model-fitting analyses revealed that genetic variance for the major personality dimensions of Neuroticism, Extraversion, and Openness to Experience explained all of the genetic variance on controllable, desir-

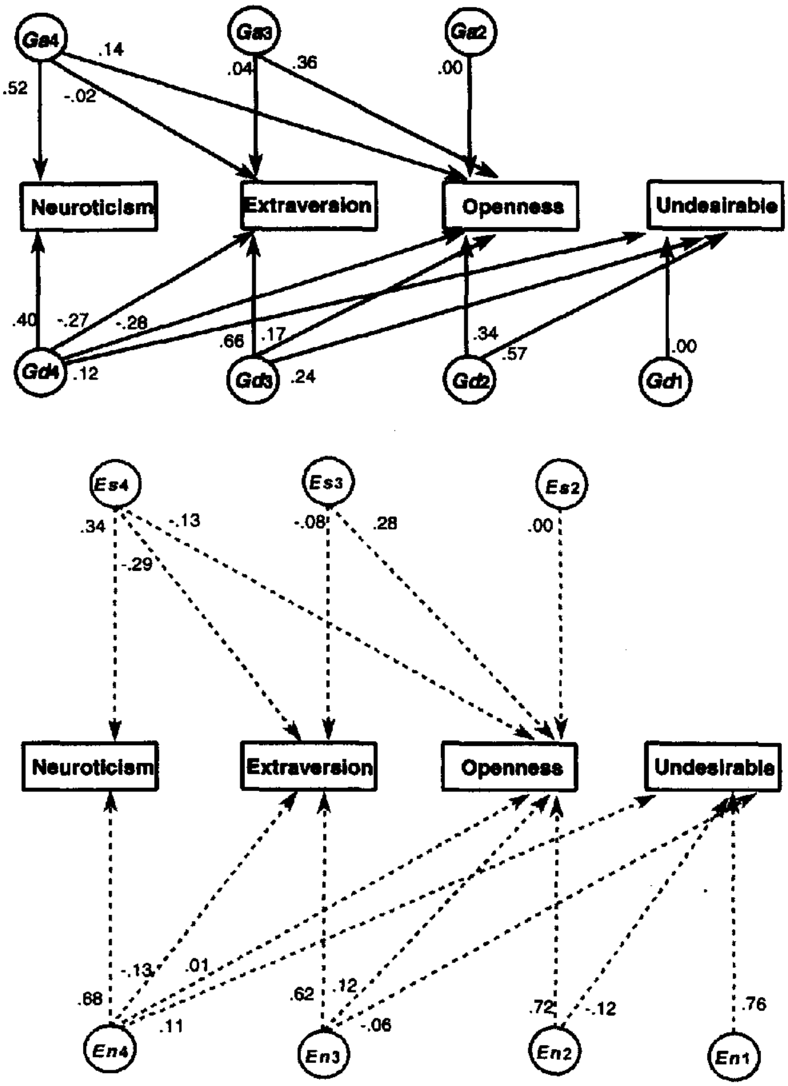

Figure 4. Quadrivariate model-fitting results for the association between Neuroticism, Extraversion, Openness to Experience, and undesirable life events. The latent variables Ga_4, Gd_4, Es_4, and En_4 represent the additive and nonadditive genetic, shared environmental, and nonshared environmental variance, respectively, that is common to all four measures; Ga_3, Gd_3, Es_3, and En_3 represent genetic and environmental variances that are common to Extraversion, Openness to Experience, and the undesirable life events measure; Ga_2, Gd_2, Es_2, and En_2 represent variance common to Openness to Experience and the undesirable life events measure; and Ga_1, Gd_1, Es_1, and En_1 represent genetic and environmental influences that are unique to the undesirable life events measure.

able, and undesirable life events measures. There was no unique genetic variance on life events above and beyond genetic variance shared with the three personality dimensions studied.

It is interesting that most of the genetic variance on all three life events scales was independent of genetic variance common to Neuroticism, the personality dimension that is studied most frequently in conjunction with life events (e.g., Fergusson & Horwood, 1987; Headey & Wearing, 1989; Horwood & Fergusson, 1986; Magnus et al., 1993; Poulton & Andrews, 1992). However, in retrospect, this is not surprising given the low phenotypic correlations between Neuroticism and life events in our sample. The genetic influence on controllable and desirable life events was predominantly mediated by genetic variance that was common to both Extraversion and Openness to Experience, whereas a major portion (82%) of genetic variance on undesirable life events could be accounted for independently by Openness to Experience. Few studies have considered Openness to Experience as a personality dimension potentially related to life events; however, Headey and Wearing (1989) did find this major personality dimension to be related to both positive and negative events, which correspond roughly to our desirable and undesirable life events measures. Moreover, the SATSA controllable

Table 3
Genetic and Environmental Contributions to the Phenotypic Correlations Between Personality and Life Events Measures

Life events scale	Genetic	Shared environment	Nonshared environment	Estimated r
Controllable				
Neuroticism	.09	−.04	.01	.06
Extraversion	.10	.03	.05	.18
Openness	.20	.14	−.09	.25
Desirable				
Neuroticism	−.02	—	.03	.01
Extraversion	.17	—	.02	.19
Openness	.19	—	.00	.19
Undesirable				
Neuroticism	.05	—	.07	.12
Extraversion	.13	—	−.05	.08
Openness	.20	—	−.09	.11

Note. Dashes indicate that the variable was not included in the model. Openness = Openness to Experience.

life events measure includes both positive and negative events. Thus, our finding of an association between Openness to Experience and controllable, desirable, and undesirable life events is consistent with Headey and Wearing's findings. We would add, however, that these associations and the associations between life events and Neuroticism and Extraversion are mediated genetically.

The finding that genetic variance for personality mediates genetic influence on measures of life events raises the question as to how the genetic effects arise. The answer to this question depends on the extent to which the measure of life events is veridical (Plomin, 1986). In the present study, life events were measured through self-report. Therefore, it is possible that responses to the questionnaire might reflect the individual's perceptions of events rather than their actual occurrence. These perceptions will be filtered through the individual's genetically influenced personality. Moreover, because each of the personality traits, Extraversion and Openness to Experience especially, contribute independent genetic variance to life events, explanations of mechanisms should consider processes separately for each dimension. For example, when reporting on life events, extraverts might give more salience to events that have greater social repercussions, or neurotics might exaggerate the extent of negative life events. Thus, personality might bias an individual's perceptions, and consequently, the genetic covariation between personality and life events might arise due to the effects of personality on the person's perceptions, not the life events per se.

However, such perceptual processes may not tell the whole story. It is also possible that genetic factors are responsible for real differences in the occurrence of life events. In support of this hypothesis is research showing that measures of personality correlate with life events even when life events are assessed using objective, externally verifiable events (Headey & Wearing, 1989; Magnus et al., 1993). In other words, personality appears to be related to events that actually occur to individuals, not simply to their perceptions of these events. If personality is related to actual life events and not just perceptions of events, the finding of significant genetic covariation between personality and life events suggests that the genetic influence on life events arises as a result of genotype–environment correlation. That is, individuals are differentially exposed to life events as a function of their genetically influenced personality. In our adult sample, genotype–environment correlations may be reactive or active in nature (Plomin, DeFries, & Loehlin, 1977). *Reactive* genotype–environment correlations refer to experiences that occur as a consequence of other people's reactions to genetically influenced characteristics of the individual. For example, a person who is very receptive to new experiences might be sought out when exciting activities are in the offing. *Active* genotype–environment correlations occur when individuals actively select or create environments correlated with their genetically influenced characteristics. In other words, people seek out environments or experiences that are compatible with their personalities. This active role of individuals in determining their experiences has been called "niche picking" and "niche building" (Scarr & McCartney, 1983). For example, openness to experience might lead people to seek out new experiences, thus leading to a positive correlation between openness and controllable life events.

The finding of gender differences in genetic and environmental variance on measures of life events was an unexpected outcome in this study. We can only speculate as to why life events for women show a genetic influence, whereas the same measures for men do not. It is possible that the association between personality and life events might differ across gender. That is, personality factors may not influence life events as strongly for men as they do for women. This possibility has generally been unexplored in the life events literature. Most of the studies reporting significant relations between personality traits and life events are based on samples that have a preponderance of women (e.g., Fergusson & Horwood, 1987; Horwood & Fergusson, 1986; Magnus et al., 1993; Poulton & Andrews, 1992), so women may be driving the observed associations.

To explore this possibility, we examined the phenotypic correlations between controllable, desirable, and undesirable life events and Neuroticism, Extraversion, and Openness to Experience for men in the SATSA sample. As was the case for women (see Table 2), Openness to Experience was significantly correlated to all three life events scales (controllable $r = .24$, desirable $r = .26$, undesirable $r = .18$), and Neuroticism was correlated only with undesirable life events ($r = .23$). However, Extraversion, which was significantly related to all three life events scales for women, was significantly related to only desirable life events for men ($r = .12$). Note that although there is some difference in the overall pattern of correlations between personality and life events for men and women, there were few significant differences in the correlations for men versus women. For both men and women in SATSA, personality is to some extent associated with life events. However, the mechanisms that mediate this phenotypic relation differ across gender: Although genetic factors mediate the correlation between personality and life events for women, life events for men show no genetic influence, and thus, the association between personality and life events can be due only to environmental factors.

Why does personality contribute genetic variance to individual differences on life events for women and not men? Two possibilities come to mind. First, it is possible that personality is less heritable for men than women and thus contributes little genetic influence to individual differences in life events. There is some evidence suggestive of differential heritability of personality across gender (Eaves, Eysenck, & Martin, 1989; Loehlin, 1992); however, behavioral genetic analyses using same- and opposite-sex twin pairs are required to future explore gender differences in genetic and environmental contributions to personality. At this point, however, we are doubtful regarding possible differential heritability of personality for men and women. If the heritability of personality is similar for men and women, this suggests that the gender difference lies in the genetic links between personality and perceptions of life events. For some reason, perceptions of life events may be imbued with genetically influenced aspects of personality for women but not for men. Although this largely restates the finding that genetic factors appear to mediate the correlation between personality and life events for women and not men, it suggests that mechanisms for this interesting gender difference might be sought in attributional processes involved in perceiving and interpreting life events.

The finding that genetic variance for personality mediates genetic influences on life events was not unexpected, given the well-documented relations between personality and life events. It was surprising, nonetheless, to find that in our sample of older adult women, the personality dimensions of Neuroticism, Extraversion, and Openness to Experience could account for all of the genetic variance on controllable, desirable, and undesirable life events. Previous multivariate genetic studies exploring sources of genetic influence on measures of the environment in adolescence and adulthood have found that traditional trait measures such as personality, psychopathology, and perceived self-competence can account only for a small portion of the genetic influence on other measures of the environment (e.g., Chipuer, Plomin, Pedersen, McClearn, & Nesselroade, 1993; McGuire, Reiss, Hetherington, & Plomin, 1992). Taken together, these findings suggest that personality may be differentially important across measures of the environment.

The results of the present study have practical implications for the study of life events and, possibly, other psychosocial factors. Although this research cannot specifically address the issue of why genetic influences on life events occur only for women, our results highlight the need for consideration of gender differences in future research on life events and suggest that it may be necessary to use different measures for men and women when examining self-reported life events. More generally, the present findings remind us that environmental measures are not necessarily simple measures of the environment. Researchers need to consider that self-report measures of life events may be tapping genetically influenced personality as well (i.e., life events as filtered through the individual's personality). It may not be possible, however, to construct a measure of life events that is truly independent of personality. That is, if the genetic influence on life events arises as a result of genotype–environment correlations, then actual life events, themselves, would reflect the personality characteristics of individuals. Future behavioral genetic research using objective measures of life events is needed to address the issue of genetic mediation through perceptions versus genotype–environment correlation.

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