Marriage and Personality: A Genetic Analysis

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There is substantial evidence that married people fare better than their unmarried peers on many life outcome variables. The authors asked whether self-selection might partially explain these benefits through genetic influences on personality contributing to propensity to marry. Using a population-based sample of 4,225 women and 2,869 men that included 2,527 complete twin pairs, the authors investigated the phenotypic associations between personality and propensity to marry, the heritability of propensity to marry, and the extent of genetic influence on the link between personality and propensity to marry. The results suggest that propensity to marry is heritable and that the phenotypic link between personality and propensity to marry is genetically influenced.

> Marriage is . . . the most natural state of man, and therefore the state in which you are most likely to find solid happiness. . . . it is the man and woman united that make the complete human being. Separate, she wants his force of body and strength of reason; he, her softness, sensibility, and acute discernment. Together, they are more likely to succeed in the world. A single man has not nearly the value he would have in the state of union. He is an incomplete animal; he resembles the odd half of a pair of scissors.
>
> —Benjamin Franklin, *Letter to a friend*

Though several notes in the above passage sound jarring to the modern ear, there is substantial current evidence that Franklin's observation was correct: Married people fare better than the unmarried on many life outcome variables (Waite & Gallagher, 2000). Positive outcomes associated with marriage include lower mortality (Hu & Goldman, 1990), greater self-rated physical health (Juster & Suzman, 1995)—itself a strong indicator of actual physical health (Murphy, Glaser, & Grundy, 1997), lower incidence of risky behavior (Bachman, Wadsworth, O'Malley, Johnson, & Schulenberg, 1997), greater well-being and mental health (Horwitz, White, & Howell-White, 1996), lower rates of antisocial behavior (Pickles & Rutter, 1991; Sampson & Laub, 1993), and greater financial success and stability (Gray, 1997). Men tend to experience these benefits to a greater extent than do women (Waite & Gallagher, 2000).

The mechanism through which the benefits of marriage are achieved is considered to be the system of mutual social and emotional support that marriage provides (House, Umberson, & Landis, 1988). This is thought to be coupled with reciprocal task specialization (DiLeonardo, 1987), secured by the permanence of the marriage contract (Waite & Gallagher, 2000). Most analysts have not credited self-selection with a significant role (Kobrin & Henderson, 1977). The fact that the marital relationship is highly individual and its quality may have varying effects from couple to couple has, however, been recognized, and is receiving increasing attention (Caughlin, Huston, & Houts, 2000).

Analogous cultural, sociological, and psychological factors have been used to explain the occurrence of divorce (Kitson, Barbi, & Roach, 1985), yet there is also evidence that the occurrence of divorce is genetically influenced (McGue & Lykken, 1992) and that the mechanism through which the genetic influence on divorce is expressed is the personality of each spouse (Jockin, McGue, & Lykken, 1996). It seems possible at least that attraction of a suitable partner, propensity to establish a relationship intended to be permanent, and maintenance of that relationship may have related etiologies and that these etiologies may have their roots in personality. We thus propose the possibility that there are common genetic influences on personality and propensity to marry. If so, these common genetic influences could help to explain some of the benefits associated with marriage.

Data supporting the interrelationship between personality differences and propensity to marry exist for antisocial behavior. Rutter and his colleagues (Pickles & Rutter, 1991; Rutter et al., 1997) followed a high-risk sample from inner London from childhood to early adulthood. Among those who showed antisocial behavior in childhood, those who lacked a supportive partner tended to continue with their antisocial behavior whereas those with marital support tended to desist. Laub, Nagin, and Sampson (1998) made similar observations and tested the causal explanation further by using yearly data to study within-individual changes over time. They found that both a cohesive marriage and job stability predicted desistance from antisocial behavior, in comparison both with those who did not marry and those whose marriages encountered difficulties. The hypothesis that a stable marriage was a directly causative agent was further supported by the observa-

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tions that none of the variables that predicted entry into crime predicted desistance and that the effects of stable marriage increased over time. This makes it sound like marriage caused desistance, but the picture was not quite that clear. Data presented by Quinton, Pickles, Maughan, and Rutter (1993) showed that the marriage that had the stabilizing effects itself could be predicted by indirect relationships with tendencies to exert planning, positive school experiences, lack of family discord, and relationships with nondeviant peers.

More general relationships between personality and propensity to marry have also been investigated, particularly with respect to marital stability and quality. One of the longest-running studies was conducted by Kelly and Conley (1987). They followed 300 couples from their engagements during the 1930s until 1980. On the basis of acquaintance ratings made in the 1930s, they concluded that marital satisfaction and stability were negatively related to neuroticism in either spouse and to impulse control in the husband. Larson and Holman (1994) summarized cross-sectional and longitudinal research on the premarital factors associated with positive marital outcomes. They identified individual traits and behaviors as some of the major factors contributing to later marital stability and quality. Studies such as these provide evidence that the possibility of a genetically mediated link between personality and propensity to marry is worth investigating.

That relationships exist between personality and propensity to marry has also been documented in another way. Using the same data as Kelly and Conley (1987), Caspi and Herbener (1992) investigated the extent to which spouses become more similar in personality over time. They found that couples maintained the same relative similarity across 20 years, and they argued that this stability appeared to be significantly influenced by environmental experiences the couples shared. Tambs and Moum (1992) reached a similar conclusion on the basis of a cross-sectional population sample of 23,000 couples residing in a Norwegian county. Considering all these studies, there is evidence that personality characteristics impact marital outcomes, that at least some of these characteristics predate the marriage, and that most personality characteristics in both spouses remain relatively stable throughout the marriage.

The existence of genetic influence on personality is well established (Bouchard & Loehlin, 2001), and potential biological mechanisms and specific quantitative trait gene loci have been postulated as well. For example, a gene coding for the particular dopamine D4 receptor (DRD4) has been implicated in predicting novelty or sensation seeking (Cloninger, Adolfsson, & Svrakic, 1996). Though the finding has been replicated in many other studies, it has not been found consistently, a common problem in quantitative trait loci studies (McGue, 2002). The example, however, serves to articulate the means through which genes may influence personality. Genes code for the presence, levels, or reception of specific proteins, which in turn have specific effects on mood levels or pleasure and pain sensors and, over the long run, on personality traits. With respect to DRD4, the theory is that individuals with particular DRD4 alleles are dopamine deficient and seek novelty or sensation in order to increase dopamine release (Plomin & Caspi, 1999). Analogous mechanisms could be postulated regarding genetic influences on propensity to marry. The documentation of some phenotypic link between personality and marriage coupled with the substantial evidence for genetic influence on personality raises the additional possibility of a genetic link between personality and propensity to marry.

It is of course difficult to know what kinds of outcomes might be different for an individual who did marry if that individual had not married. To the extent, however, that the personality characteristics associated with propensity to marry are genetically mediated, we should expect that genetically identical individuals discordant for marital status should show minimal personality differences on these characteristics.

The purpose of this study was to investigate the etiology of the relationship between personality and propensity to marry. Specifically, the study addressed the following four questions:

1. Is there an association between personality and ever-married status?
2. In monozygotic (MZ) twin pairs discordant for marital status, do the personalities of the married differ from those of the unmarried?
3. Is propensity to marry heritable?
4. Is the link between personality and propensity to marry mediated in part by genetic mechanisms?

Method

Sample

The data used in these analyses were obtained from mailings to participants in the Minnesota Twin Registry. Participants in the registry were originally ascertained in the early 1980s using birth records provided by the Minnesota State Department of Health (Lykken, Bouchard, McGue, & Tellegen, 1990). About 80% of the intact twin pairs born in Minnesota between 1936 and 1955 were located, and about 80% of these agreed to participate. Zygosity was determined using a five-item questionnaire that has been shown to provide over 95% accuracy compared with zygosity determined from blood samples. Twins were assigned as Twin 1 and Twin 2 by order of birth. The base sample was the same as that used by Jockin et al. (1996) and McGue and Lykken (1992) to investigate genetic influences on divorce.

Marital history and personality data were available from 4,225 women and 2,869 men. We made use of these data to investigate the association between personality and marital status. We limited the genetic analyses to twin pairs in which both members provided data. Among women, there were 726 MZ pairs (mean age 39.3 years, $SD = 7.0$) and 616 same-sex dizygotic (DZ) pairs (mean age 40.4 years, $SD = 6.9$) who met these conditions. Among men, there were 413 MZ (mean age 39.7 years, $SD = 6.9$) and 292 same-sex DZ (mean age 39.9 years, $SD = 6.8$) pairs. There were also 470 opposite-sex DZ pairs (mean age 42.1 years, $SD = 5.3$), whose data were used only in the sex-limitation analyses described below. For the rest of the analyses, we used only MZ and same-sex DZ pairs. The 726 female MZ pairs included 621 concordant for being married, 33 concordant for being never-married, and 72 discordant for marital status. The 616 female DZ pairs included 508 concordant for being married, 10 concordant for being never-married, and 98 discordant for marital status. The 413 male MZ pairs included 331 concordant for being married, 26 concordant for being never-married, and 56 discordant for marital status (one of which had missing Multidimensional Personality Questionnaire [MPQ] data). The 292 male DZ pairs included 226 concordant for being married, 6 concordant for being never-married, and 60 discordant for marital status.

The mean age of about 40 years (at time of personality test administration; marital status was assessed slightly later—see below) and standard deviation of about 7 for all the zygosity groups suggest that the majority of the participants were through most of the "risk period" for initial marriage; according to U.S. Census data, the median age of marriage was about 26

for men and 24 for women in the late 1980s when this sample provided their data, and the proportion never married stabilized for both men and women around age 40 (Saluter, 1996). Over 90% of the women and about 87% of the men had married; this percentage is very comparable to national averages (Saluter, 1996). About 97% of respondents were Caucasian, reflecting the state's population for the birth years involved. Participants did not differ significantly by zygosity for marriage (for women, proportion married was .91 for MZs, .91 for DZs, $p = .99$; for men, proportion married was .87 for MZs, .88 for DZs, $p = .91$).

Measures

The participants completed the MPQ (Tellegen, 1982) via mailings in the mid-1980s. The MPQ is a factor-analytically derived personality questionnaire that yields scores on 11 primary trait scales and three higher order factors. It was selected because of its desirable psychometric properties and relatively independent primary trait scales (Tellegen, 1982). The 11 primary trait scales are Well-Being (WB; high scorers are cheerful, active), Social Potency (SP; high scorers are decisive, persuasive), Achievement (AC; high scorers work hard, persist), Social Closeness (SC; high scorers are sociable, affectionate), Stress Reactivity (SR; high scorers are nervous, troubled by guilt), Alienation (AL; high scorers tend to feel mistreated), Aggression (AG; high scorers are vindictive, physically aggressive), Control (CN; high scorers are reflective, careful), Harm Avoidance (HA; high scorers do not enjoy adventure or danger), Traditionalism (TR; high scorers endorse high moral standards, religion), and Absorption (AB; high scorers are emotionally responsive to engaging sights and sounds). The three higher order factors are Positive Emotionality (with loadings from WB, SP, AC, and SC), Negative Emotionality (with loadings from SR, AL, and AG), and Constraint (with loadings from CN, HA, and TR). AB has small loadings on all three higher order factors. Thirty-day test–retest reliabilities for the scales range from .82 to .92; alpha consistency reliabilities range from .79 to .89. We regressed the effects of age from all MPQ scores separately for each sex prior to analysis (McGue & Bouchard, 1984).

The participants provided marital data in 1989, again by means of a mailed self-report questionnaire. We were not able to sequence the MPQ administration and marital history data exactly, because we did not obtain information on the dates of the life events reported in the marital history. Though not ideal, for our purposes the situation was better than it would have been had the order of data collection been reversed, because we conceptualized the personality variables as contributing to propensity to marry rather than vice versa. Participants were asked to indicate current marital status, with the choices "Married," "Divorced," "Widowed," and "Never Married." A note below the question read, "Note: For our records, 'married' includes common-law marriages, cohabitation, etc." Thus, our ever-married data probably included some individuals who were not legally married. The format of the marital status question has the advantage that gay couples in relationships they considered permanent likely felt comfortable answering that they were "married."

For our analyses, we decided to classify as ever-married all individuals who reported that they were married, divorced, or widowed. Only those who reported that they were never married were considered unmarried. In treating marital status in this way, we recognized that we were blurring the possible distinction between getting married and staying married, but we did this because we wished to investigate the personality characteristics associated with the willingness to engage in an intimate, cohabiting relationship intended to be permanent in the first place, come what may of that relationship later. We thus created a dichotomous ever–never-married variable for each participant.

Personality Analyses

To investigate our first question regarding the association between personality and propensity to marry, we carried out analysis of variance (ANOVA) comparisons of mean MPQ scale differences between the ever- and never-married groups, separately for women and men. We evaluated both the significance of the differences we observed and their effect sizes (i.e., the difference in the means in pooled standard deviation units). We did this both for the full sample reporting data and for the 127 pairs of MZ twins discordant for marital status in order to address our second question regarding the extent of differences in personality between the ever- and never-married members of MZ twin pairs discordant for marital status.

We also calculated biserial correlations between marital status and the continuous MPQ scale scores. Such correlations are based on the assumption that a latent, normally distributed liability rather than some dichotomous causative factor underlies the observed marital status distributions. Though marital status is a naturally occurring dichotomous variable, it is easy to conceive of it as reflecting legal, cultural, and practical constraints on an otherwise continuous propensity to associate intimately for purposes of procreation, child rearing, and mutual financial support.

There are several ways to approach the issue of assessing the genetic and environmental contributions to the association of personality with propensity to marry. We could have looked at each associated personality trait and its separate contribution to ever-married status, but such an analysis would not allow us to determine the aggregate strength of the association, and the effect of each personality trait was weak enough that only the overall effect was truly meaningful. Instead, we elected to treat ever-married status as an emergent variable that results from the presence of several, perhaps many, personality and other variables. There is no a priori reason to believe that causal variables should necessarily be correlated. In order to form a composite of the personality that predicted ever-married status, we therefore carried out logistic regressions to identify the MPQ traits that were associated with ever-married status in our sample (for a discussion of this method, see Cohen, Cohen, Teresi, Marchi, & Velez, 1990). We carried out this analysis separately for women and men and used the results to conduct our genetic analyses. Two points are noteworthy here. First, in measuring the extent of relationship between personality and propensity to marry, we assumed that the direction of causation is from personality to ever-married status. Because we did not have longitudinal data on personality and marriage, we could not test this assumption. Second, in the process of forming the composite personality variable, we did not achieve the disattenuation of measurement error associated with latent variable analysis. Consequently, our predictor variables were fallible.

Logistic regression is a method used to estimate the association between predictor variables and a categorical outcome variable. The regression coefficients are estimated using an iterative maximum-likelihood procedure, and the relationship between outcome and predictor variables is expressed as $1/[1 + \exp - (\text{sum of products of predictors and beta-weights})]$. Thus the quantity e^{β} is the logistic analog of the linear regression coefficient and represents the factor by which the odds of ever marrying change with an increase of one unit in a predictor, holding other predictors in the model constant. For this study, we derived models separately for women and men through a forward-inclusion stepwise procedure. We did this because preliminary investigations suggested that there were differences between women and men in the personality traits associated with propensity to marry and because the effects associated with each trait scale were relatively small, making an overall approach intractable. We set the inclusion criterion at $p = .15$ and removal criterion at $p = .20$. We chose these levels because more limited inclusion criteria such as $p = .05$ can potentially pass over variables that offer predictive information, and their associated coefficients have only small effects on the calculation of a composite. Stepwise regression procedures do not necessarily produce optimal subsets of variables. Rather, they provide a practical means to eliminate variables that add little predictive value. The main difficulty with using them is that the variables included and their regression coefficients may vary, depending on the specific stepwise technique, because of collinearity among the variables available for inclusion. This does not, however, present a problem when the variables are used to create

a composite as we did in this study. We confirmed this methodological point by correlating the personality composite with composites formed using different numbers of steps, backward elimination, and all available variables. For women, the correlations between the composite we used and these alternative composites were 1.00, 1.00, and .93. For men, the correlations were .85, .96, and .70, respectively. These data suggest that the stepwise procedure did not produce personality composites that merely reflected chance relationships within the data.

Genetic Analyses

Theory and assumptions. Our quantitative genetic model is based on the assumption that the observed phenotypic variance (Vp) is a linear additive function of additive genetic (Vg), dominant genetic (Vd), and shared (Vs) and nonshared (Vn) environmental variance, respectively. Shared environmental influences are experiential factors common to the members of a twin pair and operating to make them similar. They include experiences such as growing up in the same neighborhood and socioeconomic status. Nonshared environmental influences are those experiential factors unique to each member of a twin pair and operating to make them different. Such experiences may include injuries and illnesses, attending different schools, and participating in different leisure activities such as sports. The distinction between the two is subtle. For example, two children in the same family may experience the same event (e.g., parental divorce), but that event is only a shared environmental influence to the extent that it makes the children similar. We refer here to environmental influences on the members of a twin pair. Environmental influences tending to make spouses similar would not be part of the shared environmental influences discussed.

Symbolically, the genetic model can be summarized as

$$Vp = Vg + Vd + Vs + Vn.$$

Under this model, the nonshared environmental variance represents residual variance not explained by either of the other two sources. The nonshared environmental component also includes variance attributable to measurement error. Genetic variance can be additive in the sense that if multiple genes influence the trait, they do so independently of each other. It can also be nonadditive, reflecting dominance and other polygenic effects. We note that there is evidence for nonadditive effects on personality, but little evidence for shared environmental effects (Bouchard & Loehlin, 2001).

Under the assumption of additive genetic effects, the expected covariance (COV) between any two members of a twin pair, as a function of the variance components given above, can be specified as

$$COV(MZ) = Vg + Vd + Vs;$$

$$COV(DZ) = .5*Vg + .25*Vd + Vs.$$

Heritability estimates are based on several assumptions. The first is that twins (both MZ and DZ) are representative of the population as a whole for the trait in question. For personality traits, in particular as measured by the MPQ, this appears to be the case (Johnson, Krueger, Bouchard, & McGue, 2002). Second, we assume that MZ twins share trait-relevant environmental influences to the same degree as DZ twins. Numerous attempts have been made to uncover circumstances in which this assumption does not hold, with generally negative results (e.g., Borkenau, Riemann, Angleitner, & Spinath, 2002; Loehlin & Nichols, 1976). We also assume that there is no assortative mating (parents of the twins were not similar at the time they married) for the traits in question. The extent of assortative mating for personality traits is relatively small for the MPQ (the correlations range from 0 to .2; Lykken & Tellegen, 1993) and thus is unlikely to have a significant effect on estimates of genetic influence. Assortative mating for propensity to marry must, of course, be very high, but its existence leads to underestimation of genetic influences in the types of models used in this study. Finally, we assume that there are no genetic and environmental interactions or correlations. Again, though the concept of genetic and environmental interaction has great intuitive appeal, few replicable genotype–environment interactions and correlations have been found (Plomin, DeFries, & McClearn, 1988).

Genetic models. To investigate our third question regarding genetic influence on propensity to marry, we fit univariate structural equation models on the basis of the assumptions outlined above to the observed twin marital status data using Mx (Neale, 1997). Data for women and men were evaluated separately. In these models and in the bivariate models described below, additive genetic effects were denoted by *A*, shared environmental effects by *C*, dominance genetic effects by *D*, and nonshared environmental effects by *E*. Because these models are not identified when *A*, *C*, *D*, and *E* are estimated simultaneously, we considered several possible combinations of models, including models with additive genetic and shared and nonshared environmental parameters (*ACE* models) and models with additive and dominance genetic and nonshared environmental parameters (*ADE* models). We also considered models that constrained female and male heritabilities to be equal. To assess whether the genetic influence on propensity to marry in women and men seems to be caused by the same genes, we also fit a series of sex-limitation models involving various parameter constraints. These models estimate the correlation between the genetic effects on marriage in women and in men, commonly known as the *genetic correlation*. The square of the genetic correlation defines the proportion of the total heritability of marriage that is common to the two sexes.

We double entered the twin data for the univariate models in order to remove artifactual variance arising from the arbitrary order of twins within twin pairs, adjusting the degrees of freedom for the double-entered data. By doing this, because both the sample and the degrees of freedom are adjusted, the resulting likelihood statistic is distributed only approximately chi-square. Throughout, we also assessed model fit using the root-mean-square error of approximation (RMSEA) and Akaike information criterion (AIC). For RMSEA, values under .05 generally indicate good model fit; values of .05 to .08 indicate reasonable fit (Browne & Cudeck, 1992). For AIC, models with smaller positive or larger negative values are preferred (Akaike, 1983).

To investigate our fourth question regarding genetic influences on the link between personality and propensity to marry, we fit bivariate structural equation models separately for women and men, using Mx. The models yielded estimates of genetic and environmental contributions to variance in and covariance between the personality composite and propensity to marry. The path coefficients in these models were standardized partial regression estimates, with the genetic and environmental path estimates to the personality composite the same as in the univariate case. The effects of the genetic and environmental influences on propensity to marry, however, were decomposed into those specific to marriage and those in common with the personality composite. We evaluated this decomposition by estimating the bivariate heritability, or the total genetic contribution to the covariance between the personality composite and marriage. Figure 1 presents a general diagram of the models we applied. The paths ($g_1 r_g g_2$) indicated in the figure, when combined with information about the extent of genetic influences on each phenotype, indicate the proportion of bivariate genetic influences on the phenotypic covariance. That is, the bivariate genetic influence is $(g_1 r_g g_2)/r_p$, where r_p is the phenotypic correlation.

Because the marital status variable was dichotomous and thus not normally distributed, we used an asymptotically weighted least squares function, which does not require normally distributed data, in fitting our bivariate models. We used PRELIS 2 (part of LISREL 8.5; Jöreskog & Sörbom, 2001) to compute the required 4×4 correlation matrices and their associated asymptotic covariance matrices for input to Mx.

One possible objection to the analysis of twin correlation data for marital status is that closer twin relationships might make marriage slightly less likely, thus leading to greater concordance for marital status between MZ

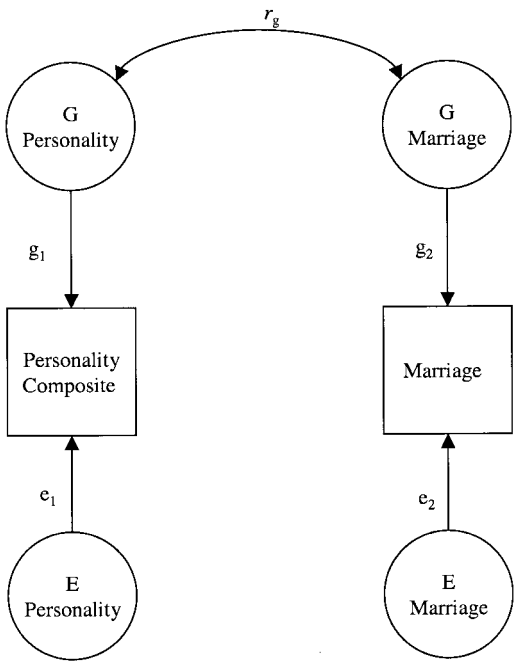

Figure 1. Bivariate Cholesky model of common influences on personality and marriage. r_g = genetic correlation; G = latent construct of genetic influence, both additive and dominant, and g = the associated path coefficient; E = nonshared environmental influence, and e = the associated path coefficient.

than DZ twins. This environmental factor would be confounded with genetic influences on propensity to marry. To address this, we noted that a portion of our sample completed an 11-item questionnaire evaluating the closeness of their twin relationship. Using only the MZ pairs who completed this questionnaire to control the extent of genetic relationship, we stratified the scores separately for women and men into the bottom 5%, the next 20%, the next 25%, the next 25%, the next 20%, and the top 5% of the distribution of closeness scores and reviewed the proportion ever-married in each category, using the chi-square test to assess the significance of differences in the proportion ever-married. In addition, we conducted logistic regression analyses, using the closeness variable to predict ever-married status. We carried out this analysis for both MZ and DZ twins.

Results

Personality Analyses

Table 1 displays the MPQ age-corrected means for ever- and never-married women and men, the significance of ANOVA comparisons of those means, and the effect sizes of the mean differences. Many of the mean differences were significant, with effect sizes warranting attention. These included higher SC, lower AL, and higher HA and TR for ever-married women; and higher WB, SP, AC, and SC, lower AL, higher AG and TR, and lower AB for ever-married men. In conducting these analyses, we did nothing directly to adjust for the dependency within twin pairs. This has little effect on parameter estimates but makes our tests for differences slightly more sensitive (McGue, Wette, & Rao, 1984). In reviewing Table 1, however, note that there were really no scales with differences of borderline significance: Either the differences were significant by most any standard or they were not. The biserial correlations between the age-corrected personality scale scores and marriage produced very similar results. Both methods of measurement suggested better life adjustment among the ever-married than among the never-married.

Table 1 also shows the MPQ age-corrected means for the ever- and never-married members of MZ twin pairs discordant for marital status. None of the mean differences was significant. Most of the effect sizes were smaller than those for the full sample, and some differed in sign. The discordant MZ sample was much smaller than the full sample, so we expected its results to be more variable. We thought it most noteworthy that the largest effects in the full sample were all trivial in the discordant MZ sample, suggesting that the MZ twins who differed in marital status did not differ on these personality traits.

The MPQ personality traits contributing significantly to propensity to marry in the logistic regressions are shown in Table 2. The significant traits differed somewhat for women and men. For women, the significant predictors were greater SC and SR, lower AL, and greater HA and TR. For men, the significant predictors were greater WB, SP, and AC, lower AL, greater AG and TR, and lower AB. All of the effects were rather modest, with odds ratios around 1.3. Nevertheless, the biserial correlation between the personality composite and marital status was highly significant for both women and men. Note that AL and TR were predictive for both sexes, but the other traits differed. The correlation between the two composites in women and men together was .33.

The sex difference in the MPQ traits associated with marital status was robust; logistic regression of the MPQ traits associated with marriage in women on the men's data showed extremely poor fit and insignificant regression coefficients. This was also true of logistic regression of the MPQ traits associated with marriage in men on the women's data. In addition, logistic regression on the women's and men's data together produced the same significant predictors, along with sex, and the interactions between sex and SP, AC, SR, AG, and AB. In addition, CN was a significant predictor in the combined regression.

The Heritability of Marriage

Table 3 shows the twin marital status correlations and their 95% confidence intervals (CIs) as well as the heritability estimates resulting from the models fit with heritabilities constrained equal for women and men. The twin marital status correlations suggest highly significant genetic influence on marriage in both women and men. Because the MZ correlations were more than twice the DZ correlations, nonadditive genetic effects were likely, and there was no evidence for shared environmental influence. The structural equation models' fit to the data suggested the same conclusion as the correlations: The model including shared environmental variance (*ACE* model) fit poorly (AIC = 4.76, RMSEA = .02), although it still provided a heritability estimate of .68 for marriage (95% CI = .58–.74). The model including nonadditive genetic variance (*ADE* model) fit well and significantly better than the *ACE* model (AIC = −6.60, RMSEA = .00). It provided a total heritability ($A + D$) estimate of .70 (95% CI = .63–.76).

We evaluated the relationship between the genetic influences on marital status in women and the genetic influences on marital status in men by fitting a sex-limitation model to estimate their correlation. The best-fitting model allowed both additive genetic

Table 1
Personality Scale Means, Effect Size Estimates, and Analysis of Variance Results Relating Marital Status to Multidimensional Personality Questionnaire (MPQ) Scale Scores

	Women				Men			
	M				*M*			
Trait scale	Ever-married	Never-married	*p*	Effect size	Ever-married	Never-married	*p*	Effect size
				Full sample[a]				
Well-Being	.01	−.11	.02	.12	.04	−.29	< .001	.33
Social Potency	−.02	.11	.01	−.13	.04	−.30	< .001	.34
Achievement	.00	.07	.18	−.07	.05	−.25	< .001	.30
Social Closeness	.03	−.23	< .001	.26	.04	−.20	< .001	.24
Stress Reactivity	.01	−.04	.33	.05	−.01	.14	.01	−.15
Alienation	−.01	.18	< .001	−.19	−.03	.19	< .001	−.22
Aggression	−.01	.10	.04	−.11	.02	−.15	.003	.17
Control	.00	−.02	.66	.02	−.01	.02	.62	−.03
Harm Avoidance	.03	−.30	< .001	.33	.00	−.08	.15	.08
Traditionalism	.02	−.27	< .001	.29	.03	−.22	< .001	.25
Absorption	−.01	.12	.01	−.13	−.01	.15	.003	−.16
				Discordant MZ pairs[b]				
Well-Being	−.04	.06	.42	−.10	−.06	−.13	.64	.07
Social Potency	−.09	.07	.17	−.16	−.32	−.38	.59	.06
Achievement	.08	.17	.45	−.09	−.08	−.21	.43	.13
Social Closeness	−.21	−.24	.81	.03	−.06	−.21	.32	.15
Stress Reactivity	−.04	−.15	.37	.11	.04	−.07	.49	.10
Alienation	−.08	−.10	.92	.02	−.22	−.10	.25	−.14
Aggression	−.04	−.16	.31	.13	−.02	−.20	.17	.17
Control	.02	.09	.60	−.07	.28	.27	.94	.01
Harm Avoidance	−.09	−.21	.39	.11	.06	−.08	.30	.12
Traditionalism	−.20	−.30	.41	.09	−.12	−.20	.55	.08
Absorption	.06	.00	.63	.06	−.16	.05	.22	−.19

Note. MPQ scale scores were age corrected within sex. They are thus standardized residuals, with $M = 0$ and $SD = 1.00$. Discordant MZ pairs are twin pairs, one of whom has married, the other not. There were 72 discordant MZ female pairs and 55 discordant MZ male pairs. Effect size is (mean score ever-married − mean score never-married)/total standard deviation. MZ = monozygotic.
[a] Women: $n = 4{,}225$; men: $n = 2{,}869$. [b] Women: $n = 144$ individuals; men, $n = 110$ individuals.

and dominance influences and had the genetic correlation fixed at 0 and estimated total heritabilities of propensity to marry of .72 for women and .66 for men. It seems likely that most of the genetic influences on marital status in women and men, mediated by personality, are different, corresponding to the sex differences in MPQ trait scales associated with propensity to marry in the logistic regressions presented above and the relatively low correlation between them (.33) in women and men combined. Sex-limitation models eliminating genetic dominance or allowing shared environmental influences all fit significantly worse than the models presented. Sex-limitation models estimating the genetic correlation freely showed wide variation in the genetic correlation along with wide CIs.

Genetic Influences on the Link Between Personality and Marriage

Table 4 displays the cross-twin and within-individual correlations between personality and ever-married status. The correlations were both significant and suggested substantial genetic influence on the association. Because the cross-twin correlations suggested the possibility of dominant genetic effects, the model we applied allowed for both additive and dominant genetic effects (*A* and *D*), though we have summed them for purposes of presentation. When we applied the model diagrammed in Figure 1 to the data for women, both the common genetic and environmental pathways were significant. The estimated heritability for the personality composite was .52 (95% CI = .50–.54). This personality composite score does not measure a fundamental personality dimension; it is merely the linear combination of the MPQ primary scale scores that best predicted marriage in our sample. Still, its heritability seems to be quite typical of those reported in other studies of personality (Bouchard & Loehlin, 2001). The estimated heritability of marital status was .72 (95% CI = .61–.83), very similar to the total estimated heritability from the univariate model. The bivariate heritability was estimated at .83, suggesting that genetic factors predominate in the covariance between personality and propensity to marry, though that covariance itself is rather low (biserial correlations were .24 for women and .28 for men). The model fit well: $\chi^2(7, N = 1{,}342) = .56$, $p = .99$ (RMSEA = .00, AIC = −13.44).

Table 2
Logistic Regression Models of Multidimensional Personality Questionnaire (MPQ) Scales as Significant Predictors of Ever-Married Status

	Women[a]			Men[b]		
Trait scale	β	e^{β}	p	β	e^{β}	p
Well-Being				.19	1.20	.03
Social Potency				.29	1.33	.00
Achievement				.24	1.28	.01
Social Closeness	.19	1.21	.01			
Stress Reactivity	.15	1.16	.09			
Alienation	−.24	0.79	.00	−.26	0.77	.00
Aggression				.31	1.36	.00
Control						
Harm Avoidance	.23	1.26	.00			
Traditionalism	.23	1.26	.00	.27	1.31	.00
Absorption				−.28	0.76	.00

Note. These logistic equations were derived on the full sample who both completed the MPQ and provided marital history data (4,225 women and 2,869 men). The quantity e^{β} is the logistic analog of the linear regression coefficient and here represents the factor by which the odds of ever marrying change with an increase of 1 standard deviation in a predictor, holding other predictors in the model constant. The biserial correlations between the personality composites and the dichotomous marriage variable estimate the strength of the overall relationship between personality and marriage. Only predictors that were significant at $p < .15$ were included. Empty cells indicate nonsignificant predictors.
[a] $r_b = .24$, $p < .01$. [b] $r_b = .28$, $p < .01$.

The model for men was similar; both the genetic and nonshared environmental pathways were significant throughout. The estimated heritability for the personality composite was .38 (95% CI = .33–.42), somewhat less than for women but within the range typically observed for personality (Bouchard & Loehlin, 2001). The estimated heritability of marital status was .68 (95% CI = .55–.82), very similar to the total estimated heritability from the univariate model. The bivariate heritability was estimated at .61, suggesting that genetic factors are very important in the covariance between personality and propensity to marry. This model fit only slightly less well in the male than in the female sample: $\chi^2(7, N = 705) = 10.24$, $p = .18$ (RMSEA = .00, AIC = –3.76).

Analysis of the closeness questionnaire completed by a portion of our MZ sample showed no effects of closeness of twin relationship on propensity to marry. The chi-square test showed no statistically significant differences in proportion ever-married. Visual inspection of the proportions ever-married in each category revealed no trends that reached statistical significance. In addition to this analysis, we used the Social Closeness scale to predict ever-married status in logistic regression analyses on both MZ and DZ twins. The closeness variable was not significant in either of those regressions. The lack of association between closeness of twin relationship and marital status in either MZ or DZ twin pairs also helps to address the possibility that the much greater MZ than DZ twin correlations resulted from greater contact between MZs than DZs during adulthood. In addition, there was no difference in overall rates of marriage between MZs and DZs: $\chi^2(1, N = 1,343) = .34$, $p = .56$.

Discussion

To the best of our knowledge, this study is one of the largest investigations of the relationship between personality and ever-married status undertaken to date and the only one to investigate genetic influences. In our sample, we found that people who have married do differ slightly from the never-married on several personality dimensions. The relationships that we observed are generally in agreement with previous research regarding personality traits associated with marriage (Kelly & Conley, 1987; Larson & Holman, 1994), and they make conceptual sense in relation to the benefits that prior research has associated with marriage (Waite & Gallagher, 2000). For example, both ever-married women and ever-married men showed lower AL than the never-married, a personality attribute whose association with better health, both mental and physical, seems highly plausible. Ever-married men scored higher on SP and AC, attributes that bear an obvious relationship to likely career, and thus financial, success. There were, however, personality traits associated with propensity to marry that do not, at least intuitively, relate to the benefits associated with marriage that have been observed. For example, ever-married men scored higher on AG and lower on AB, and ever-married women scored higher on SR. SR was a borderline predictor, only included in the personality composite as a result of the high significance value we allowed for inclusion ($p = .15$), as discussed above. However, this was not the case for AG.

The observed overall biserial correlations between the personality composite and propensity to marry of .24 in women and .28 in men were rather modest. They should be evaluated, however, in

Table 3
Twin Ever-Married Status Concordance Statistics, Tetrachoric Correlations, and Heritability Estimates

	Women		Men	
Measure	r	95% CI	r	95% CI
Tetrachoric correlations				
Marriage				
Monozygotic	.72	.63, .79	.67	.57, .76
Dizygotic	.21	.06, .36	.12	−.08, .32
Opposite sex	.14	−.10, .37	.14	−.10, .37
Parameters[a]				
ACE Model[b]				
Heritability	.68	.58, .74		
Shared environment	.00	.00, .07		
Nonshared environment	.32	.26, .39		
ADE Model[c]				
Additive heritability	.02	.00, .49		
Dominance heritability	.68	.19, .76		
Total heritability	.70	.63, .76		
Nonshared environment	.30	.24, .37		

Note. CI = confidence interval; A = additive genetic effects; C = shared environmental effects; D = dominance genetic effects; E = nonshared environmental effects; AIC = Akaike information criterion; RMSEA = root-mean-square error of approximation.
[a] Data for men were constrained equal to women. [b] $\chi^2(2, N = 2,048) = 8.76$; AIC = 4.76; RMSEA = .02. [c] $\chi^2(2, N = 2,048) = 1.40$; AIC = −2.60; RMSEA = .00.

Table 4
Cross-Twin and Within-Individual Correlations Between Personality and Ever-Married Status

Measure	Women			Men		
	N (pairs)	*r*	*SE*	*N* (pairs)	*r*	*SE*
Twin correlations for MPQ composite						
Monozygotic	726	.52	.02	413	.35	.03
Dizygotic	616	.18	.03	292	.24	.04
Correlation between marriage and MPQ composite						
Within individual (genetic analysis sample)		.24	.02		.27	.03
Monozygotic (cross-twin)	726	.21	.04	413	.18	.05
Dizygotic (cross-twin)	616	.08	.04	292	.01	.06

Note. The cross-twin correlations were derived from the genetic analysis sample. Twin correlations are intraclass. The correlations of marriage with composite personality are biserial. MPQ = Multidimensional Personality Questionnaire.

light of three factors. First, marriage is a positively valued normative behavior in our culture. Social pressures encourage it in all individuals regardless of their personalities. Until relatively recently, and for at least the older members of the Minnesota birth cohort from which our sample was taken, marriage was also really the only socially sanctioned means through which individuals could establish sexual relationships and reproduce. Coercion to the biosocial mean (Cattell, 1979) would seem likely to operate to produce the large majority of people who marry at some point during their lives. From this perspective, it seems somewhat surprising to find any significant relationship between personality and marriage.

Second, marriage is not an individual attribute but rather the product of a transaction between two people. Though there may be many conceivable marriage partners for any given individual, circumstances generally limit the possibilities in a practical manner (Lykken & Tellegen, 1993). This places some upper limit (well short of 100%) on the proportion of total variance in marriage that could be explained by personality, though what that upper limit might be is not clear. Third, the estimated association between personality and propensity to marry is attenuated by the unreliability of the measures. The 30-day retest reliability of the higher order MPQ scales, likely a good approximation of the 30-day retest reliability of our composite personality score, is .89 (Tellegen, 1982).

We also observed that genetic factors appear to exert considerable influence on propensity to marry in both men and women, with dominance effects likely, and that genetic factors explain a portion of the covariance between personality and propensity to marry. From an evolutionary perspective, it makes sense that personality traits that lead to marriage, which may in turn increase the chances of offspring survival, would be subject to selection. Obviously, these same genetic influences on personality may also lead to specific kinds of behavior within the marriage that have positive consequences for the individual, but we did not address this question. Still, our findings provide evidence in support of common genetic influences on personality and propensity to marry. This evidence was bolstered by the observation that genetically identical individuals discordant for marital status did not differ significantly in personality. It is of course possible that the never-married members of the pairs we classified as discordant have since married, but this would not really provide evidence contradicting the possibility that the personality characteristics involved in propensity to marry contribute to the motivation and ability to establish and maintain a long-term intimate relationship. The personality effects involved could actually be rather small, given that marriage is a cultural norm (Glenn, 1996). Good luck (Lykken & Tellegen, 1993) in establishing such a long-term intimate relationship and its importance to each of its participants could then lead directly, through the paths of mutual emotional support and reciprocal task specialization already identified, to the benefits that have been observed.

Though both the speculated process through which the benefits associated with marriage are realized and the model we applied suggest that personality influences propensity to marry, our data do not allow us to distinguish the direction of causation. Marital status was assessed after participants completed the MPQ, for some as many as 5 years later, but participants obviously could have been married for some time before they completed the MPQ. The Minnesota Twin Family Study (Iacono, Carlson, Taylor, Elkins, & McGue, 1999), a longitudinal epidemiological study of environmental factors and life outcomes following participants from ages 11 and 17 into adulthood, should allow assessment of the direction of causation more clearly in the future.

There was no evidence in our data for shared environmental correlations between personality and marriage. Of course, the effects of measurement error are included in the estimated environmental effects, and these effects would not be expected to correlate across measures, thus reducing any potential environmental correlation somewhat. The evidence still suggests, however, that the environmental influences on marriage are largely independent of those on personality. Two major variables that are not reflected in our analysis are the personalities of the spouses and the quality of the marital relationships. The quality of the marital relationships probably reflects an interaction of the personalities of the spouses, with its own set of genetic influences, but the spouse's personality is an environmental effect from the perspective of our participants. These would both appear to be likely influences on the benefits to individuals associated with marriage.

The particular traits associated with marriage in women and men suggest an evolutionary explanation (Buss, 1987): Women marry as an expression of affiliation and desire for protection, men as an expression of dominance. Ever-married women showed higher SC, SR, and HA, whereas ever-married men showed higher

WB, SP, AC, and AG. The effects were, however, very modest; people obviously marry for other reasons as well. Our data may also be relevant only to the culture of the people involved in this study. Nevertheless, the evolutionary psychological explanation of human mate preferences is consistent with our findings.

As with all psychological studies, the results we have described may not generalize beyond the sample from which they were obtained. In particular, the results from this study could be unique to the culture and the time period in which the participants in our study grew up. Investigations of samples from other cultures and time periods could help to elucidate the processes at work when individuals form pair-bonded sexual relationships. These results do, however, make clear that studies examining the mechanisms through which individuals benefit from marriage and the behaviors associated with marriage need to take into consideration the possibility that people who marry may differ somewhat from those who do not before they ever meet their prospective spouses.

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