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Overlapping genetic and environmental influences among men's alcohol consumption and problems, romantic quality and social support

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Abstract

Background—Alcohol consumption and problems are associated with interpersonal difficulties. We used a twin design to assess in men the degree to which genetic or environmental influences contributed to the covariance between alcohol consumption and problems, romantic quality and social support.

Method—The sample included adult male–male twin pairs (697 monozygotic and 487 dizygotic) for whom there were interview-based data on: alcohol consumption (average monthly alcohol consumption in the past year); alcohol problems (lifetime alcohol dependence symptoms); romantic conflict and warmth; friend problems and support; and relative problems and support.

Results—Key findings were that genetic and unique environmental factors contributed to the covariance between alcohol consumption and romantic conflict; genetic factors contributed to the covariance between alcohol problems and romantic conflict; and common and unique environmental factors contributed to the covariance between alcohol problems and friend problems.

Conclusions—Recognizing and addressing the overlapping genetic and environmental influences that alcohol consumption and problems share with romantic quality and other indicators of social support may have implications for substance use prevention and intervention efforts.

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Supplementary material

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Declaration of Interest

None.

Keywords

Alcohol; gene–environment correlation; marital quality; social support

Introduction

How often and how much someone drinks alcohol – as well as whether s/he develops alcohol problems – are related to the quality of his or her interpersonal relationships with romantic partners, friends and relatives (Fischer & Wiersma, 2012; Jarnecke & South, 2014). Important questions remain about the extent to which genetic or environmental influences contribute to the covariance among these variables. Discerning the nature of these associations may have important implications for substance use prevention and intervention efforts.

Alcohol consumption and problems are associated with the quality of interpersonal relationships (Peirce *et al.* 2000; Levitt & Cooper, 2010; Fischer & Wiersma, 2012). As reviewed in Fischer & Wiersma (2012), several studies find that higher levels of alcohol consumption and alcohol problems are associated with lower romantic quality and satisfaction (Renne, 1970; Kearns-Bodkin & Leonard, 2005; Whisman *et al.* 2006; Humbad *et al.* 2010; Cranford *et al.* 2011; Jarnecke & South, 2014). Although our focus here is on the within-person associations among these variables, we note that a separate ‘drinking partnerships’ literature shows that couples where both partners consume high levels of alcohol do not differ in terms of marital adjustment or intimacy from light social drinking couples (Roberts & Leonard, 1998). The literature on alcohol and social support from friends and relatives is much smaller, but there is some evidence that high levels of alcohol consumption and problems are associated with low levels of social support (Peirce *et al.* 1996; Hagihara *et al.* 2003), particularly during stressful periods (Steptoe *et al.* 1996). Recently, Jarnecke & South (2014) reported that higher perceived social support from friends/family members was associated with fewer alcohol problems ($r = -0.12$ and -0.09).

Twin studies report evidence for genetic influences on alcohol consumption and problems, romantic quality and social support. Additive genetic factors account for 31–51% of the variance in past-year alcohol consumption (Prescott *et al.* 1994; Hansell *et al.* 2008) and 43–53% of the variance in alcohol use disorders (AUDs) (Verhulst *et al.* 2014), with the balance primarily accounted for by unique environmental factors (i.e. events or experiences to which only one twin is exposed, such as different friends and spouses). Likewise, genetic factors accounted for 20 and 16% of the variance in self-reported romantic conflict and warmth in male–male twin pairs from the Virginia Adult Twin Study of Psychiatric and Substance Use Disorders (VATSPSUD) (Spotts *et al.* 2006), and 13–36% of the variance in the subscales of Spanier’s (1976) Dyadic Adjustment Scale in a sample of female–female twin pairs (Spotts *et al.* 2004). Perceived social support, indexed with separate measures of problems and support from friends and relatives, is modestly heritable, with additive genetic effects accounting for 19–42% of their variance (Kessler *et al.* 1992; Bergeman *et al.* 2001; Agrawal *et al.* 2002).

Characterizing the nature of the associations between alcohol use and interpersonal relationships is critical to understanding the shared etiology of these variables. Such knowledge will help us to understand whether the associations arise through correlated genetic or common environmental factors, or whether they are likely to be causally related (Marshall, 2003; Whisman *et al.* 2006). Understanding this etiology may guide future prevention or intervention methods. To this end, we examined whether overlapping genetic or environmental influences accounted for the covariance among men's alcohol consumption and problems, romantic quality and social support in a sample of adult male–male twin pairs.

Method

Participants

We used data collected from adult male–male twin pairs who participated in wave 2 of the population-based VATSPSUD (Kendler & Prescott, 2006). We focused on males because rates of alcohol consumption and problems are typically higher among males than females (Grant *et al.* 2004); accordingly, there is likely to be sufficient variation in alcohol consumption and problems for an examination of their associations with romantic quality and social support. Further, romantic quality was measured somewhat differently in the VATSPSUD female–female twin pair subsample, precluding an explicit test of sex differences. Our sample consisted of 2589 males: 1504 monozygotic (MZ) twins and 1085 dizygotic (DZ) twins from 697 and 487 complete pairs, respectively. Unpaired individuals (110MZ and 111 DZ) were included and their data contributed to the means and variances of the bivariate genetic models detailed below. Zygosity was previously determined through self-report measures, photographs and genotyping (Kendler & Prescott, 2006).

Average age at assessment was 36.28 years ($s.d. = 9.13$, range = 20–58). Participants had on average 13.56 years ($s.d. = 2.67$) of education. In terms of relationship status, 62% of the participants were married, 8% were living with a partner in a marriage-like relationship, 10% were separated/divorced/widowed, and 20% were never married and not living with a partner. Average marriage length was 12.07 years ($s.d. = 9.11$; range 0–39). Participants who were living with a partner in a marriage-like relationship had lived with their partner for 3.20 years ($s.d. = 3.66$; range 0–25) on average. Only participants who were married or in a marriage-like cohabiting relationship for at least 6 months were asked questions about their romantic quality.

Measures of past-year alcohol consumption and lifetime alcohol problems

A measure of average monthly alcohol consumption in the past year was calculated by multiplying participants' reports of drinking frequency (number of days out of 30 that they had an alcoholic drink in the typical month in the past year) by drinking quantity (number of drinks they usually had on drinking days in the past year). The alcohol problems measure was assessed during a structured clinical interview using symptom counts based on the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) (APA, 1994) to index lifetime alcohol dependence (possible range 0–7). Data for time-delimited (i.e. past-year) alcohol dependence symptoms were not available in this sample.

Measures of romantic conflict and warmth

Eligible participants (married or in marriage-like cohabiting relationships for at least 6 months in the year prior to survey) responded to a series of eight items adapted from the National Comorbidity Survey (Zlotnick *et al.* 2000) regarding the degree to which their relationship was characterized by conflict (e.g. degree to which the partner makes too many demands, degree to which the partner is critical, degree to which there is relationship tension, and frequency of conflict) and warmth (e.g. feelings of being loved and cared for by the partner, how much the partner is willing to listen, how dependable the partner is, and how much the participant can open up to the partner about important things). Conflict frequency was measured on a six-point Likert scale ranging from 1 (daily) to 6 (never). All other romantic conflict and warmth items used a five-point Likert scale ranging from 1 (a great deal) to 5 (not at all). Previous factor analytic work in this sample confirmed that these items load onto separate conflict and warmth scales (Spotts *et al.* 2006). For the present analyses, we extracted scores from principal component analyses of the respective conflict and warmth items, and reverse coded them so that higher values indicated greater conflict and warmth.

Measures of friend and relative problems and support

Five items adapted from the Social Interaction Scale developed by the Institute for Social Research (Schuster *et al.* 1990) were used. This measure included three items about frequency of problems (make too many demands, criticize, and create tensions or arguments) and two about frequency of providing support (make you feel cared for and express interest in how you are doing), using four-point Likert scales anchored 1 (often) to 4 (never). Participants responded to each of these five items for friends and relatives separately. A prior factor analysis of these items identified four separate scales: friend problems, friend support, relative problems, and relative support (Agrawal *et al.* 2002). Four separate sum scores of the respective friend and relative problems and support items were subsequently calculated. These scales were reverse coded so that higher values indicated greater problems and support.

Analytic plan

We examined whether twins from complete pairs differed from incomplete pairs with respect to the focal variables using *t* tests. We then ran preliminary descriptive analyses, applied transformations for variables with skew greater than |1|, and examined their zero-order correlations. Twin-pair correlations were calculated for the alcohol, romantic quality and social support variables to examine their sources of individual differences.

Bivariate twin modeling

We used bivariate genetic models in OpenMx version 1.31 (Boker *et al.* 2011) to estimate whether alcohol consumption and problems had overlapping genetic, common environmental and unique environmental influences with romantic quality and social support. Bivariate twin models permit the partitioning of the overlapping and unique latent genetic and environmental influences for two variables via comparison of the phenotypic covariation of MZ and DZ twin pairs. Additive genetic (A), common environmental (C) and

unique environmental (E) influences can be estimated owing to the fact that both types of twins are exposed to the same rearing environment, but that MZ twins share all of their genetic variation, while DZ twins share half of their genetic variation, on average. When some or all data for the relevant variables in a model were available for both members of the twin pair, these pairs contributed the decomposition of the variance into genetic and environmental factors. Data from single twins contributed to estimates of means, variances and phenotypic covariances between variables. Missingness was handled by analysing all possible data using maximum likelihood estimation.

An illustrative bivariate model examining alcohol consumption and romantic conflict is shown in Fig. 1. Two sources of genetic variation contribute to alcohol consumption: that which overlaps with conflict (a_{21}) and that which is specific to alcohol consumption after accounting for conflict (a_{22}). Likewise, there are two sources of common and unique environmental influence (c_{21} and c_{22} ; e_{21} and e_{22}) that contribute to alcohol consumption. In addition, there are distinct additive genetic, common environmental and unique environmental influences on romantic conflict (a_{11} , c_{11} and e_{11}). The diagonal elements of either an A, C or E matrix produce the variances due to that specific effect for each of the individual measures, while the off-diagonal elements produce the covariances due to either of the effects. Thus, the Cholesky factorization model allows us to partition A, C and E influences that are specific to alcohol consumption, as well as the A, C and E influences that overlap (i.e. covary) with romantic conflict. For descriptive purposes, we report the overlapping and specific variance components for the 'full' bivariate models, which include all possible A, C and E influences prior to fitting the reduced models.

We were primarily interested in assessing the overlapping latent genetic and environmental influences for alcohol consumption and problems; romantic quality; and social support. The statistical significance of the genetic and environmental covariances was assessed by comparing twice the log-likelihood of the full Cholesky model with that of submodels in which the genetic or environmental covariation between the alcohol variable and the romantic quality or social support variable was set to zero (degrees of freedom = 1). Under certain regularity conditions, such differences are asymptotically distributed as χ^2 with one degree of freedom. Accordingly, submodels where a_{21} , c_{21} and e_{21} parameters were removed were compared with the full bivariate model. In addition to testing for the significance of the genetic, common environmental and unique environmental covariance, tests of model parsimony were also assessed using the Akaike information criterion (AIC; Akaike, 1974). Lower AIC values denote more parsimonious models.

Results from the Cholesky model can be used to decompose the covariance between two variables into A, C and E components by dividing the genetic, common environmental and unique environmental covariances (i.e. $a_{21} \cdot a_{11}$, $c_{21} \cdot c_{11}$, $e_{21} \cdot e_{11}$) by the overall covariance. The Cholesky results can also be algebraically transformed into latent genetic and environmental correlations by dividing the genetic/environmental covariance by the square root of the product of the genetic/ environmental variances of the two variables. These decomposed sources of covariance and latent genetic and environmental correlations provide an intuitive way to conceptualize the source and magnitude of covariance between two variables, and are also reported.

Ethical statement

All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Results

Twins from incomplete and complete pairs did not significantly differ in alcohol consumption, romantic conflict, romantic warmth, friend problems, friend support or relative problems. Twins from complete pairs did, however, have fewer alcohol problems ($t_{2575} = 2.39, p = 0.02$, Cohen's $d = 0.16$) and lower relative support ($t_{2564} = 2.10, p = 0.04$, Cohen's $d = 0.16$) compared with twins from incomplete pairs. The effect sizes for these differences were small. All variables were examined and, if needed, corrected for skewness prior to analysis (for complete representativeness results and a description of the transformation procedures, see online Supplementary material). Descriptive statistics and zero-order correlations are shown in Table 1. Higher alcohol consumption was associated with higher alcohol problems, higher romantic conflict, higher friend problems, higher relative support and lower romantic warmth. Higher alcohol problems were related to higher romantic conflict, higher friend problems, higher relative problems and lower romantic warmth. Alcohol consumption and problems were not significantly associated with friend support, and alcohol problems were not significantly associated with relative support.

Twin pair correlations

Under additive genetic effects, MZ twins share 100% of their genetic variation and the MZ genetic correlation is expected to be 1.0, while DZ twins on average share 50% of their genetic variation and the DZ genetic correlation is expected to be 0.5. The observed MZ twin phenotypic correlations are generally smaller than 1, reflecting the contribution of unique environmental influences. The pattern of DZ and MZ twin correlations shown in Table 2 suggests that additive genetic and unique environmental influences play a significant role in alcohol consumption, romantic conflict, romantic warmth and friend support. There was evidence for both additive genetic and common environmental influences on alcohol problems and relative problems. There were common environmental influences (and no additive genetic influences) on friend problems and relative support.

Bivariate twin models

The majority of variance in alcohol consumption was accounted for by additive genetic and unique environmental influences that were specific to alcohol consumption (Table 3, top panel). There was also evidence that alcohol consumption had small overlapping genetic influences with romantic conflict [genetic covariance (cov_A) = 0.06], romantic warmth ($cov_A = 0.02$) and relative problems ($cov_A = 0.01$). Alcohol consumption also had overlapping common environmental influences with romantic warmth [common environmental covariance (cov_C) = 0.01], relative problems ($cov_C = 0.01$) and relative support ($cov_C = 0.02$); and overlapping unique environmental influences with romantic conflict [unique environmental covariance (cov_E) = 0.01]. Friend problems were a

noticeable exception; overlapping genetic influences for alcohol consumption and friend problems accounted for 38% of the variance in alcohol consumption.

The majority of variance in alcohol problems was accounted for by genetic and unique environmental influences that were specific to alcohol problems (Table 3, bottom panel). There was also evidence that alcohol problems had overlapping genetic influences with romantic conflict ($\text{cov}_A = 0.14$), romantic warmth ($\text{cov}_A = 0.01$), friend problems ($\text{cov}_A = 0.24$), relative problems ($\text{cov}_A = 0.01$) and relative support ($\text{cov}_A = 0.09$). There were common environmental influences that were shared between alcohol problems and romantic conflict ($\text{cov}_C = 0.03$), romantic warmth ($\text{cov}_C = 0.03$), friend problems ($\text{cov}_C = 0.07$) and friend support ($\text{cov}_C = 0.03$). Alcohol problems and friend problems had overlapping unique environmental influences ($\text{cov}_E = 0.01$).

Bivariate model fitting

Model-fitting results for the a_{21} , c_{21} and e_{21} parameters corresponding to the overlapping genetic, common environmental and unique environmental influences among the alcohol consumption and problems, romantic quality and social support variables are presented in Table 4 and summarized below. The alcohol consumption models are shown in the top panel, and the alcohol problems models are shown in the bottom panel. Formal model fitting proceeded only in instances where there was a significant zero-order association between variables.

Alcohol consumption model fitting

There was significant genetic covariance (model 1/drop $a_{21} - \chi^2 = 4.71, p < 0.05$) and unique environmental covariance (model 1/drop $e_{21} - \chi^2 = 4.74, p < 0.05$) between alcohol consumption and romantic conflict^{1†}. In total, genetic influences accounted for the majority (64%) of this covariance, with unique environmental influences accounting for the balance (36%). The latent genetic and environmental correlations for these effects were positive and moderate to modest in size ($r_A = 0.37, p = 0.03$; and $r_E = 0.09, p = 0.03$), indicating that some of the same genetic and unique environmental influences contributed to higher alcohol consumption and higher romantic conflict. Significant covariation that is attributable to unique environmental influences could also be consistent with the causal hypothesis that high levels of alcohol consumption cause romantic conflict (or vice versa) (Prescott & Kendler, 1999). The results from supplemental analyses (see online Supplementary material) suggested that there may be a causal pathway from alcohol consumption to romantic conflict.

Tests of genetic covariance (a_{21}), common environmental covariance (c_{21}) and unique environmental covariance (e_{21}) between alcohol consumption and romantic warmth (model 2); alcohol consumption and friend problems (model 3); and alcohol consumption and relative support (model 6) were not statistically significant. This may be attributable to the

¹In supplementary analyses, we found that these effects were robust after statistically adjusting for age, years of education, current marital status and whether the participant was still in the relationship on which they were reporting [romantic quality data were collected on participants who were married or in marriage-like cohabiting relationships for at least 6 months in the past year; accordingly, some participants (<1%) reported on a relationship that had ended].

[†]The notes appear after the main text.

low phenotypic correlations among these variables (Table 1), and hence limited power to discriminate statistically between genetic or environmental sources of covariance.

Alcohol problems model fitting

There was significant genetic covariance (model 7/drop $a_{21} - \chi^2 = 6.35, p < 0.05$) between alcohol problems and romantic conflict¹. There were no significant differences in the fit between submodels in which common environmental covariance (c_{21}) and unique environmental covariance (e_{21}) were set to zero and the full bivariate model, suggesting that overlapping genetic factors accounted for 100% of the covariance between alcohol problems and romantic conflict. The latent genetic correlation for alcohol problems and romantic conflict was large and positive ($r_A = 0.50, p < 0.001$), indicating that some of the same genetic influences contributed to higher levels of alcohol problems and romantic conflict.

There was significant common environmental covariance (model 9/drop $c_{21} - \chi^2 = 4.38, p < 0.05$) and unique environmental covariance (model 9/drop $e_{21} - \chi^2 = 5.05, p < 0.05$) between alcohol problems and friend problems. In total, common environmental influences accounted for the majority (61%) of the covariance, with unique environmental influences accounting for the balance (39%). The common environmental correlation between alcohol problems and friend problems was large ($r_C = 1.00, p = 0.02$). The latent unique environmental correlation was modest ($r_E = 0.07, p = 0.02$). Thus, some of the same common and unique environmental influences contributed to high levels of alcohol problems and friend problems. Overlapping unique environmental influences could also be consistent with a causal association among alcohol problems and friend problems. We conducted supplementary analyses to evaluate this possibility (see online Supplementary material), and our results indicated that a causal explanation was unlikely.

Tests of genetic covariance (a_{21}), common environmental covariance (c_{21}) and unique environmental covariance (e_{21}) between alcohol problems and romantic warmth (model 8), and alcohol problems and relative problems (model 11) were not statistically significant. As noted above, this may be attributable to the low phenotypic correlations (Table 1) and limited power to discriminate sources of covariance.

Discussion

We tested whether the associations between alcohol consumption and problems, romantic quality and social support were attributable to overlapping genetic or environmental factors using a genetically informative population-based male–male twin sample. Consistent with past literature, we found that higher alcohol consumption was associated with higher romantic conflict, lower romantic warmth and more friend problems. Additionally, alcohol problems were also associated with these measures of interpersonal relationships. Unexpectedly, higher alcohol consumption was also associated with higher relative support, although this effect was small. Alcohol consumption and problems were not significantly related to friend support, which is inconsistent with prior studies. This discrepancy may reflect differences in how social support was measured, or the fact that we used an all-male sample.

Bivariate genetic analysis indicated that alcohol consumption and alcohol problems had overlapping genetic influences with romantic conflict. Our findings complement the previous literature examining the associations between alcohol consumption and problems and romantic relationship quality (Renne, 1970; Kearns-Bodkin & Leonard, 2005; Humbad *et al.* 2010; Cranford *et al.* 2011) and further suggest that some of the genetic influences that contribute to alcohol consumption and problems also contribute to conflictual romantic relationships. These findings are consistent with the proposal of South *et al.* (2011) that there is a temperamental core (which is likely to be heritable; Loehlin, 1992) underlying the covariance among externalizing spectrum problems and marital distress, and with previous findings suggesting that some of the same familial influences (which may be in part genetic) contribute to both alcohol consumption and marital instability (Prescott & Kendler, 2001). It is notable that genetic influences involved in alcohol consumption and problems were associated with higher levels of conflict. However, these factors did not contribute to warmth in a relationship, highlighting the importance of distinguishing negative and positive relationship quality dimensions (Fincham *et al.* 1997) when examining the associations between alcohol and romantic relationship factors in genetically informative studies.

We also found that alcohol consumption and romantic conflict had overlapping unique environmental influences. It is possible that the alcohol consumption of one's romantic partner may be a unique environmental influence that contributes to participants' alcohol consumption and perception of romantic conflict. This possibility is interesting to consider in view of previous 'drinking partnership' findings, whereby husbands report low levels of marital intimacy when they are heavy drinkers and their wives are not (Roberts & Leonard, 1998). Thus, one heavy-drinking twin in a discordant drinking partnership may have a more conflictual relationship with his romantic partner compared with his co-twin who is in a harmonious, concordant moderate-drinking partnership

Our supplementary analyses also indicated that this unique environmental covariance could also reflect a causal pathway from alcohol consumption to romantic conflict. Relatively few studies have attempted to tease apart the causal associations between alcohol use and interpersonal problems; however, our findings map onto laboratory-based experiments that find that alcohol consumption increases negative couple behavior (for a review, see Marshal, 2003). Unlike a previous prospective longitudinal study of marital satisfaction and AUDs (Whisman *et al.* 2006), we did not find evidence that romantic conflict causes alcohol consumption.

Alcohol problems had overlapping common environmental influences with friend problems. This result dovetails nicely with recent findings that common environmental influences account for a modest but significant proportion of variation (3–16%) in AUDs (Verhulst *et al.* 2014), and that common environmental influences that contribute to higher friend support also contribute to lower alcohol problems (Jarnecke & South, 2014). Early caregiving experiences, which predict both later peer competence (Groh *et al.* 2014) and externalizing spectrum behavior (Lorber & Egeland, 2009) may explain these effects. We also found that alcohol problems had overlapping unique environmental influences with friend problems. Our supplementary analyses indicated that it was unlikely that this unique environmental covariance reflected a causal association between these variables. Therefore,

it is likely that a third variable that differs between co-twins (e.g. work stress) also contributes to alcohol problems and friend problems.

There were several instances where there was a significant phenotypic correlation between alcohol consumption and problems and one or more of the interpersonal dimensions (e.g. higher alcohol consumption was associated with lower romantic warmth), but that formal tests of whether this covariance was attributable to genetic or environmental influences were not statistically significant. This may be due to the fact that the correlations between the variables were quite small, and in some cases barely reached statistical significance. As a result, there was little variance to parse in the formal twin model, limiting our ability to discriminate among the sources of covariance at a statistically significant level.

Limitations

Our findings should be interpreted in terms of several limitations. First, we only examined white adult males from Virginia, which may preclude generalizing the findings to females or other races. Second, we relied on self-report measures of romantic quality and social support; replicating and extending these findings with dyadic and observational relationship data is important. Third, there are a number of ways to operationalize romantic quality and social support, and the factors driving their covariance with alcohol consumption and problems may differ. Fourth, because the unique environmental component of the romantic quality and social support environmental variables (which are modeled on the left in Fig. 1) in our bivariate models also contains associated measurement error, it is possible that the effects of the e_{21} parameters are attenuated. We ran additional analyses where we reparameterized the bivariate model and partitioned the covariance between the variables such that each was allowed to have specific A, C and E components. The pattern of findings (available upon request from the first author, J.E.S.) from these analyses mirrored those from our original bivariate models; thus, it does not appear that measurement error in the interpersonal variables substantially attenuated the e_{21} parameters in the results presented here.

Implications and future directions

Our findings suggest that behavioral couples therapy interventions for substance use (McCrady, 2012) may be effective because they address problems that, in part, have an overlapping genetic and environmental etiology. Recent evidence from a randomized trial found that alcohol treatment outcomes were more favorable using alcohol behavior couples therapy compared with alcohol behavior individual therapy (McCrady *et al.* 2009). Our findings suggest that there is also likely to be value in capitalizing on social support networks to promote alcohol treatment outcomes (Beattie & Longabaugh, 1999).

Identifying the factors that contribute to these latent genetic and environmental covariances is an important direction for future research in this area. For example, approaches informed by the neurobiology of social bonding and substance use may be a fruitful way to understand overlapping genetic influences. A recent study found that marital satisfaction mediated the association between variation in *AVPR1A* (arginine vasopressin 1A receptor, a gene implicated in social bonding) and drug use disorder diagnoses (Maher *et al.* 2011). It is

equally important to identify overlapping common and unique environmental influences among alcohol problems, friend problems and romantic conflict. Childhood adversity (a common environmental factor) or work stress (a unique environmental factor) may increase risk for higher alcohol consumption and problems as well as interpersonal problems in adulthood (Doucet & Aseltine, 2003; Umberson *et al.* 2005; Keyes *et al.* 2011).

Conclusions

In summary, our analyses build and expand on studies documenting the associations among alcohol use and problems and interpersonal relationships. We examined the genetic and environmental sources of these associations. Overlapping genetic and unique environmental influences accounted for the covariance between alcohol consumption and romantic conflict. Further, overlapping genetic influences accounted for the covariance between alcohol problems and romantic conflict. Finally, overlapping common and unique environmental influences account for the covariance between alcohol problems and friend problems. These results suggest opportunities for therapeutic interventions to address both interpersonal and alcohol-related liabilities. Furthermore, we raise new questions regarding specific genes and environments that give rise to this shared etiology.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Fig. 1. Illustrative full bivariate model for romantic conflict (RC) and alcohol consumption (AC). MZ, Monozygotic; DZ, dizygotic; A, additive genetic factors; C, common environmental factors; E, unique environmental factors; T1, twin 1; T2, twin 2. Genetic, common environmental or unique environmental factors contribute to the covariance between romantic conflict and alcohol consumption if the model fit is worsened when the a_{21} , c_{21} or e_{21} parameters (respectively) are removed. Mean values were estimated but are not shown.

Table 1

Descriptive statistics and zero-order correlations^a

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Mean	6.94	2.56	27.53	1.34	0	0.11	5.21	7.08	5.56	7.36
S.D.	8.57	2.86	58.55	1.92	0.98	0.90	1.71	1.00	1.99	1.02
<i>n</i>	2465	2465	2465	2577	1842	1842	2549	2549	2566	2566
[1] Alcohol frequency										
[2] Alcohol quantity	0.40**									
[3] Alcohol consumption	0.83**	0.72**								
[4] Alcohol problems	0.21**	0.28**	0.23**							
[5] Romantic conflict	0.13**	0.16**	0.17**	0.14**						
[6] Romantic warmth	-0.04	-0.09**	-0.07**	-0.06**	-0.59**					
[7] Friend problems	0.09**	0.12**	0.14**	0.10**	0.17**	-0.04				
[8] Friend support	0.00	-0.07**	-0.03	-0.02	-0.11**	0.17**	-0.07**			
[9] Relative problems	0.03	0.04	0.03	0.08**	0.22**	-0.11**	0.37**	-0.03		
[10] Relative support	0.01	0.01	0.04*	-0.01	-0.09**	0.20**	-0.06**	0.29**	-0.19**	

S.D., Standard deviation; *n*, sample size.^a Means and standard deviations are reported in their original metrics. Logarithm-transformed versions of the alcohol consumption, alcohol problems, romantic warmth and relative support variables were used for correlations.* $p < 0.05$,** $p < 0.01$.

Table 2Twin correlations for alcohol, romantic quality and social support variables^a

Variable	MZ (df)	DZ (df)
Alcohol consumption	0.46 ^{**} (635)	0.21 ^{**} (450)
Alcohol problems	0.43 ^{**} (692)	0.23 ^{**} (480)
Romantic conflict	0.20 ^{**} (399)	0.03 (267)
Romantic warmth	0.17 ^{**} (399)	0.04 (267)
Friend problems	0.20 ^{**} (674)	0.19 ^{**} (470)
Friend support	0.11 ^{**} (674)	0.01 (470)
Relative problems	0.34 ^{**} (685)	0.23 ^{**} (475)
Relative support	0.20 ^{**} (685)	0.20 ^{**} (475)

MZ, Monozygotic; df, degrees of freedom; DZ, dizygotic.

^aComparison of twin correlations across zygosity groups gives an estimate of the degree to which genetic, common environmental and unique environmental influences account for variance in a variable. When the MZ correlation for a variable is larger than the DZ correlation, this suggests that there are genetic influences. When the DZ correlation for a variable is approximately half of the MZ correlation or lower, this suggests that there are no common environmental influences. Finally, when the DZ correlation for a variable is more than half of the MZ correlation, this suggests the presence of common environmental influences.

^{**}
 $p < 0.01$.

Table 3

Specific and overlapping variance components for alcohol consumption and problems derived from full bivariate models^a

	A	C	E
Variance in alcohol consumption accounted for by specific/overlapping variance components			
Romantic conflict	0.40/0.06	0.00/0.00	0.53/0.01
Romantic warmth	0.44/0.02	0.00/0.01	0.53/0.00
Friend problems	0.09/0.38	0.00/0.00	0.53/0.00
Friend support ^b	0.47/0.00	0.00/0.00	0.53/0.00
Relative problems ^b	0.45/0.01	0.00/0.01	0.53/0.00
Relative support	0.45/0.00	0.00/0.02	0.53/0.00
Variance in alcohol problems accounted for by specific/overlapping variance components			
Romantic conflict	0.26/0.14	0.00/0.03	0.57/0.00
Romantic warmth	0.40/0.01	0.00/0.03	0.56/0.00
Friend problems	0.12/0.24	0.00/0.07	0.56/0.01
Friend support ^b	0.41/0.00	0.00/0.03	0.56/0.00
Relative problems	0.41/0.01	0.02/0.00	0.56/0.00
Relative support ^b	0.33/0.09	0.02/0.00	0.56/0.00

^a Specific variance components refer to the proportion of the total variance in alcohol consumption and problems attributable to genetic (A), common environmental (C) or unique environmental (E) influences that are specific to alcohol consumption and problems. Overlapping variance components are the A, C and E components that overlap with the respective romantic quality or social support variable for each model. Standardized variance components are presented; thus, unique and overlapping variance components sum to 1 for each bivariate model.

^b No significant zero-order association between the variables (e.g. alcohol consumption and friend support); variance decomposition estimates are provided for completeness.

Table 4

Model-fitting results examining bivariate relationships among romantic quality; social support; and alcohol consumption and problems

Model	Full bivariate			Drop c ₂₁			Drop c ₂₁			Drop c ₂₁				
	-2LL	AIC	χ ²	-2LL	AIC	χ ²	-2LL	AIC	χ ²	-2LL	AIC	χ ²		
Alcohol consumption														
1. Romantic conflict	10 174.09	1582.09	10 178.80	1584.80	2.71	4.71*	10 174.09	1580.09	-2.00	0.00	10 178.83	1584.83	2.74	4.74*
2. Romantic warmth	4137.28	-4454.72	4138.50	-4455.50	-0.78	1.21	4137.33	-4456.67	-1.95	0.04	4138.11	-4455.89	-1.17	0.82
3. Friend problems	14 986.74	4980.74	14 990.09	4982.09	1.35	3.34	14 986.93	4978.93	-1.81	0.19	14 989.06	4981.06	0.32	2.32
4. Friend support														
5. Relative problems														
6. Relative support	4467.77	-5572.23	4467.78	-5574.22	-1.99	0.01	4468.79	-5573.21	-0.98	1.02	4467.84	-5574.16	-1.93	0.07
Alcohol problems														
7. Romantic conflict	6270.06	-2545.94	6276.41	-2541.59	4.35	6.35*	6270.10	-2547.90	-1.96	0.04	6270.07	-2547.93	-1.99	0.01
8. Romantic warmth	227.94	-8588.06	228.25	-8589.75	-1.69	0.31	227.97	-8590.03	-1.97	0.03	229.74	-8588.26	-0.20	1.80
9. Friend problems	11 095.07	865.07	11 096.24	864.24	-0.83	1.18	11 099.44	867.44	2.37	4.38*	11 100.11	868.11	3.04	5.05*
10. Friend support														
11. Relative problems	11 875.96	1611.96	11 876.52	1610.52	-1.44	0.56	11 876.02	1610.02	-1.94	0.06	11 876.35	1610.35	-1.61	0.39
12. Relative support														

a₂₁, Genetic covariation; c₂₁, common environmental covariation; e₂₁, unique environmental covariation; -2LL, -2 log likelihood model fit; AIC, Akaike information criterion; AIC, change in AIC (AIC-reduced model - AICfull bivariate model); χ^2 , χ^2 test statistic (1 degree of freedom) evaluating the loss in -2LL model fit (i.e. -2LL-reduced model to -2LLfull bivariate model) as a result of dropping the respective parameter.

^aWe did not fit bivariate twin models in instances where there was no zero-order association between the variables (e.g. alcohol consumption and friend support).

* $p < 0.05$.