

Parent and Sibling Influences on Adolescent Alcohol Use and Misuse: Evidence from a U.S. Adoption Cohort²

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ABSTRACT. *Objective:* Although adolescent alcohol use has been consistently associated with parental drinking behavior, sibling drinking behavior and family functioning, the extent to which these associations owe to genetic or shared environmental influences has not been previously investigated. Using an adoption study design, we sought to determine whether the familial correlates of adolescent alcohol involvement were due to common genetic or common environmental effects. *Method:* The sample consisted of 653 adopted families ascertained through adoption agencies in four US. states. Each family consisted of a target adopted adolescent, an adoptive mother and an adoptive father. In addition, 68 birth adolescents (i.e., biological offspring of the adoptive parents) and 187 second adopted adolescents from these families participated in the study. All participants completed a mail survey that included assessment of drinking behavior and family functioning. *Results:* The relationship between parental problem drinking and adoles-

cent alcohol involvement was moderate and significant among birth offspring (corrected multiple correlation, $R_c = .30$), but small and nonsignificant among adoptive offspring ($R_c = .00$). The relationship between adolescent alcohol involvement and family functioning was substantial for birth offspring ($R_c = .39$), but only modest for adoptive offspring ($R_c = .16$). The nonbiological sibling correlation for involvement with alcohol was significant ($r = .24$) and moderated by sibling pair demographic similarity, such that same-sex, similar-age siblings were substantially more similar ($r = .45$) than opposite-sex, dissimilar-aged siblings ($r = .01$). *Conclusions:* These findings suggest that adolescent alcohol use is affected minimally by the environmental consequences of parent problem drinking and family functioning, but substantially by sibling environmental effects. (*J. Stud. Alcohol*, 57: 8-18, 1996)

FAMILY STUDIES of alcoholics have consistently reported a relationship between parental history of alcoholism and risk of alcoholism in adult offspring (e.g., Cotton, 1979; Pollock et al., 1987). Findings from research on the relationship between parental alcohol abuse and alcohol misuse in adolescent offspring are somewhat less consistent than findings with adult offspring, however, with some studies reporting an earlier age of onset and higher frequency of drinking among the adolescent offspring of alcoholics as compared to the adolescent offspring of nonalcoholics (e.g., Chassin et al., 1993; Hejanic et al., 1977; McCaul et al., 1990; Sher et al., 1991), while other studies have failed to find any effect of parental alcoholism on adolescent drinking behavior (e.g., Alterman et al., 1989; Knop et al., 1985). It may be that parental alcoholism is more predictive of adolescent drinking problems than quantity-frequency of alcohol use (e.g., Pandina and Johnson, 1990; West and Prinz, 1987).

The relationships between adolescent alcohol use and parent alcohol use and between adolescent alcohol use and sibling alcohol use have also been investigated. Brook and Brook (1988), Johnson et al. (1984), Peterson et al. (1994) and Thompson and Wilsnack (1987) all reported a positive,

albeit modest, relationship between alcohol use in parents and their adolescent offspring. Although not as extensively investigated, sibling alcohol use is related to adolescent alcohol involvement and the magnitude of this relationship appears to be stronger than that observed with parental alcohol use (Brook et al., 1986; Rowe and Gullev, 1992). In any case, the strongest predictor of adolescent drinking is not family background, but rather peer group alcohol involvement (e.g., Ary et al., 1993; Kandel, 1985), although this relationship may be due selective association effects as well as direct peer influences.

There are several mechanisms that could account for the relationship between parental alcohol use and abuse and adolescent alcohol use. As compared to nondrinking parents, parents who drink, either socially or abusively, may model or be more accepting of adolescent alcohol use (Webster et al., 1994). Alternatively, the parenting techniques used by parents who drink may, on average, be less effective than the strategies used by parents who do not drink. For example, Peterson et al. (1994) reported that parents who drink were less likely than nondrinking parents to monitor and articulate clear rules governing the behavior of their adolescent offspring. Moreover, these parenting differences were related to adolescent alcohol use: that is, the relationship between parent and adolescent offspring alcohol use was found to be mediated entirely by family management factors.

A third possibility, not always considered in research on the familial contributions to adolescent alcohol use, is

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genetic mediation. Familial resemblance within intact families may be the result of genetic or shared environmental factors. Without control for the confounded effects of genetic and environmental factors, family studies cannot be used to draw unequivocal conclusions about the mechanisms that underlie familial resemblance. Adoption studies provide the most direct method of assessing the separate contributions of genetic and shared environmental factors to familial resemblance. That is, under the assumption of no selective placement, infants placed at or near birth with nonbiologically related adoptive parents share only biological factors with their birth parents and only environmental factors with their adoptive parents.

In the alcohol research field, adoption studies have focused primarily on the extent of genetic and environmental influence on alcoholism and alcohol abuse in adulthood. These studies are consistent in demonstrating an effect of biological background, at least in males, but are somewhat less consistent in demonstrating an effect of rearing circumstances (McGue, 1994). Specifically, in the four studies that have investigated the relationship between a history of alcoholism in adoptive relatives and adoptee risk for alcohol abuse, statistically significant findings were reported in two independent studies by the same investigative team (Cadoret et al., 1985, 1987), but failed to be observed in the remaining two studies (Cloninger et al., 1981; Goodwin et al., 1973). While there are many factors that distinguish these two sets of studies, most significant, perhaps, is that rearing exposure to alcoholism was based on a history of parental alcoholism only in those studies that failed to find an effect, but was based on a history of alcoholism in any adoptive relative (e.g., siblings as well as parents) in those studies that found an effect. Perhaps modeling effects on alcohol abuse are stronger among horizontally as compared to vertically linked relative pairs (McGue, 1993): an hypothesis tested in the present investigation.

The present study is an investigation of the effect of family factors on adolescent use and misuse of alcohol in a sample of adoptive families. Specifically, we sought to identify those family factors that are associated with adolescent alcohol use; determine whether these associations were due to genetic mediation, environmental mediation or both; and, finally, investigate whether adolescent alcohol involvement was more strongly related to sibling, as compared to parent, alcohol use and misuse. The study is an extension of a recent study by McGue et al. (submitted for publication) in which we showed, in the same sample of adoptive families as studied here, that characteristics of adoptees' rearing circumstances were minimally related to all but one of the multiple indicators of adolescent adjustment we investigated (including indicators of both internalizing and externalizing disorder). The single exception involved a factor analytically derived scale we termed Licit Drug Use, for which we observed significant sibling, but not parent, effect (accounting for more than 25% of the variance). The present investiga-

tion differs from the previous study by focusing on one specific aspect of adolescent adjustment, drinking behavior (the previous study investigated effects for the aggregated measure of adolescent drug use that included not only items assessing involvement with alcohol, but also those dealing with tobacco and marijuana use), as well as by including a broader range of relevant familial factors (e.g., the effects of adoptive parent problem drinking and family socioeconomic background are investigated here but were not in the previous study). The present study is notable on several accounts. First, it includes one of the largest samples of adoptive families ever studied in the U.S.; most adoption research has been undertaken in Scandinavian countries where the availability of public registries has provided researchers with relatively easy access to large cohorts of adoptees. Second, to our knowledge, ours is the only adoption study in the alcohol research field to focus specifically on adolescent alcohol use. Finally, and perhaps most significantly, an adoption study can be used to unconfound the separate influences of biological background and rearing circumstances: previous research on familial contributions to adolescent alcohol involvement has been limited by its focus on the study of intact nuclear families where genetic and environmental effects are hopelessly confounded.

Method

Sample

The sample consisted of 653 adoptive families identified through a target adoptee who had been placed for adoption with nonrelatives prior to the age of 15 months and who was between the ages of 12 and 18 years at the time of assessment. Target adoptees were identified from an 8% random sample ($N = 1,651$ adoptees) of records at 37 private and eight public adoption agencies in four U.S. states (Colorado, Illinois, Minnesota and Wisconsin). The current location of 1,436 (87%) of the 1,651 adoptees could be determined, and at least one member in the families of 715 (50% of those located) of these adoptees participated in the survey. The present sample of 653 families includes only those families where the target adoptee provided information on the alcohol use and abuse portions of the survey. The sample thus differs slightly from those used in earlier reports from this study (e.g., McGue et al., submitted for publication; Sharma et al., submitted for publication), where an individual's failure to provide answers to the alcohol use portion of the survey did not necessarily lead to his/her being excluded from the sample.

In those families having more than one offspring between the ages of 12 and 18 years living in the home, we solicited the participation of a second adolescent. The second participating adolescent was a biological child of the adoptive parents in 68 families (designated as birth offspring here) and a second adopted child in another 187 families. Table 1 gives

TABLE 1. Descriptive statistics for the adoptive and birth offspring samples

	Adoptive		Birth	
	Male (<i>n</i> = 285)	Female (<i>n</i> = 368)	Male (<i>n</i> = 32)	Female (<i>n</i> = 36)
Adolescent demographics				
Age in years (mean ± SD)	11.9 ± 1.9	15.0 ± 2.0	13.7 ± 1.9	14.8 ± 2.1
Grade in school (mean ± SD)	9.4 ± 2.1	9.8 ± 2.2	8.4 ± 1.9	9.1 ± 2.1
Nonwhite (%)	24.6	36.4	6.3	10.0
Family background (%)				
College grads				
Mothers	45.4	40.9	34.5	11.3
Fathers	54.4	55.0	54.8	57.5
Family income >\$50,000	52.8	49.7	41.9	50.0
Single parents	8.2	9.7	0.0	3.5
Alcohol use measures				
Ever used (%)	64.6	64.4	59.1	55.6
Problem use (%)	12.6	11.7	0.0	3.6
Alcohol involvement (mean ± SD)	14.8 ± 8.3	15.4 ± 8.6	11.5 ± 1.9	13.0 ± 7.2
Mother's problem drinking (mean ± SD)	3.8 ± 1.5	3.6 ± 1.4	3.5 ± 0.8	4.4 ± 1.3
Father's problem drinking (mean ± SD)	4.3 ± 1.8	4.2 ± 1.6	4.2 ± 1.5	4.4 ± 2.2
Family functioning				
Authoritarian orientation (mean ± SD)	19.0 ± 3.1	18.4 ± 2.7	19.6 ± 2.8	19.1 ± 3.2
Cohesive (mean ± SD)	39.5 ± 6.0	39.3 ± 6.1	39.6 ± 6.8	37.3 ± 7.5
Democratic orientation (mean ± SD)	33.9 ± 1.6	34.0 ± 4.3	33.3 ± 5.2	32.8 ± 4.1
Intellectual/cultural orientation (mean ± SD)	17.0 ± 3.2	17.1 ± 3.1	16.6 ± 3.7	16.9 ± 3.3
Organization (mean ± SD)	11.9 ± 2.4	11.7 ± 2.1	11.7 ± 3.2	11.1 ± 2.5
Religious orientation (mean ± SD)	16.1 ± 3.3	16.0 ± 3.4	16.7 ± 2.9	17.2 ± 2.8

Note: Family functioning ratings are based on mothers' reports.

a demographic breakdown of the adoptive and birth offspring samples (the former including target adoptees only). The two samples are demographically quite similar, with two exceptions. First, the birth offspring sample is on the average somewhat younger than the adoptive offspring sample (and therefore also has completed somewhat fewer years of education, on the average). This age difference is not unexpected given that, while infertility is a major factor in adoption, a small percentage of adoptive parents give birth to a biological child after adoption placement. Second, the adoptive offspring sample was ethnically more diverse than the birth offspring sample; 31.2% of target adoptees but only 2.9% of birth offspring were nonwhite. The adoptee sample included a relatively large number of adolescents ($N = 131$) who had been born in Asia (primarily Korea) and placed for adoption in the U.S. with white couples; the remainder of those who were nonwhite included eight black, 21 Hispanic, eight native-American and 36 mixed-ethnic-background adoptees.

Procedure

Participating families were located and recruited by adoption agency staff. Once an adoptive family had agreed to participate in the survey, their current address and the names of eligible family members were released to our research staff. Each family received a single mailing which included a separate packet for each participating family member (i.e., target adoptee, mother, father, and, when relevant, a second adolescent). Each packet included that individual's self-report survey, a business reply envelope, and a letter that

described the study and stated that it was important that each family member complete his or her survey independently and in private. If 6 weeks after the initial mailing the completed survey had not been received, a prompting letter was sent. Each participating family member received \$10 for completing the survey and was mailed a copy of a report summarizing research findings when the study was completed. Additional details of the sampling and assessment procedures used in this study can be found in Benson et al. (1994).

Measures

The parent and adolescent surveys included sections on adoption dynamics, family environment, adolescent functioning and demographics. We estimate that it took adolescents approximately 90 minutes and parents about 2 hours to complete their surveys. A complete description of the different forms of the survey can be found in Sharma et al., submitted for publication. We focus here on those aspects of the survey that are directly relevant to the current report.

Family background. Adoptive family background was assessed using four indicators derived from the parent survey. Mothers' and fathers' education level was coded on a three-point scale (1 = less high school, 2 = high school graduate, 3 = college graduate or more). Family income (in 1991, the year the survey was mailed) was coded on a four-point scale (1 = \$25,000 or less, 2 = \$25,001 to \$50,000, 3 = \$50,001 to \$75,000, 4 = more than \$75,000). Single-parent family was coded on a two-point scale (1 = adolescent currently in a two-parent family, 2 = adolescent currently in a one-

parent family). Descriptive statistics on the four family-background indicators are given in Table 1.

As those families with a participating birth child constitute a subset of the total sample of adoptive families, minimal differences in parental characteristics between the birth and adoptive offspring samples is to be expected. Except for the much higher rate of college education among the fathers of female birth offspring as compared to the fathers in the other groups (an anomaly as best as we can tell), the expectation of minimal differences in family background for the offspring samples appears to have been met. In both samples, the parents are predominately white, have intact marriages, are on average relatively well educated, and have a combined median 1991 family income of approximately \$50,000. It is important to note, however, that, while the average participating adoptee or birth child was being reared in a home that was relatively economically advantaged, there was variability in the adolescent participants' socioeconomic background; some were being reared in single-parent families having incomes below poverty levels while others were being reared in intact professional families with 1991 annual incomes exceeding \$100,000.

Self-reported alcohol use. Three measures of alcohol use, two qualitative and one quantitative, were derived from the adolescent self-reports. *Ever used alcohol* was coded positive if the respondent indicated having used alcohol at least once in his or her lifetime; the lifetime use question did not explicitly rule out drinking small amounts of alcohol under parental supervision. *Problem alcohol use* was derived from the two survey items that dealt with problem alcohol use and was coded positive if the respondent reported having drunk five or more drinks in a row at least twice in the past week, or reported having driven a car while drinking at least twice in the past year. Finally, the major dependent variable in all analyses reported here was the Alcohol Involvement scale, computed as the sum of responses to the eight items on the adolescent survey that dealt with either the frequency of drinking (three items assessing frequency of drinking during lifetime, past year and past month), problem drinking (two items dealing with frequency of drinking five or more drinks in a row during past 2 weeks, and frequency of driving after drinking during past year), and affiliation with drinking peers (three items dealing with frequency of attending parties where there was drinking by age mates, frequency of riding in a car with someone who had been drinking and frequency with which best friend drinks). The internal consistency reliability coefficient for the eight-item Alcohol Involvement scale was estimated as .94 in the adolescent sample. Prior to all analyses reported here, scores on the Alcohol Involvement scale were adjusted for the effects of age (both linear and quadratic) using regression analysis. Adolescent ethnicity was significantly associated with lifetime use of alcohol ($\chi^2 = 6.41, 2 \text{ df}, p < .05$), with lifetime drinking frequency being lower among Asian-American adolescents (55.7%) as compared to either white adolescents (67.5%) or adolescents

of other ethnicity (61.6%). Moreover, Asian-Americans adolescents scored somewhat lower on the alcohol involvement scale (mean [\pm SD] = 14.1 ± 8.4) than either white adolescents (mean = 15.5 ± 8.6) or adolescents of other ethnicity (mean = 14.5 ± 7.9), although these latter differences were not statistically significant ($F = 1.66, 2/650 \text{ df}, p > .10$), thus obviating the need to adjust scores on our primary outcome measure of adolescent alcohol involvement for the effects of ethnicity.

For each parent, a single index of problem drinking was computed by summing responses to the following three items from the Bell Global Psychopathology Scale (Bell, 1979) that we had included in the survey (each item was rated on a scale that ranged from 1 = never to 5 = all the time): (1) "How often has drinking caused any trouble or problems for you?" (2) "How often do you think you drink too much for your own good?" and (3) "How often would you say you use alcohol to help you face your problems?" Internal consistency reliability for the three-item parental problem drinking index was estimated as .86 for mothers and .83 for fathers.

Table 1 gives descriptive statistics for the alcohol use measures in the adoptive and birth offspring samples. For the three adolescent measures, there were no significant sex differences. While many studies report greater frequency and density of alcohol use among male as compared to female adolescents, gender differences in adolescent alcohol use have not been consistently observed (for review, see Johnstone, 1994). Therefore, our failure to observe significant gender differences, although surprising, is not altogether exceptional. The mean Alcohol Involvement score was significantly higher among adoptive, as compared to birth, offspring, although this difference was no longer significant once the age difference in the two samples was partialled out statistically. In the parent sample, as expected fathers reported significantly higher rates of problem drinking than did mothers.

Family functioning. Assessment of family functioning was based on responses to the 75-item Colorado Self-Report Measure of Family Functioning (CSMFF) developed by Bloom (1985) from a factor analysis of four widely used measures of family functioning. After consulting with Bloom (personal communication, 1993) we factor analyzed the 75 items of the CSMFF, using the principal axes method with varimax rotation, and based upon the eigenvalue distribution and interpretability of the factor loadings we decided on the nine-factor solution. Scale scores for each of the factors were computed by summing items with factor loadings of .40 or greater on that factor. Six of the family-functioning scales, those judged to be most directly relevant to adolescent adjustment, were used in the present investigation. These scales, along with the number of items on each scale and its internal consistency reliability estimate in parentheses, are: Cohesiveness (13 items, .89), Democratic Orientation (11 items, .82), Intellectual/Cultural Orientation (6 items, .70), Religious Orientation (5 items, .79), Organization (4 items,

.70) and Authoritarian Orientation (8 items, .56). Additional description of the characteristics of the family-functioning scales can be found in McGue et al. (submitted for publication). In some cases, respondents skipped one or more of the family-functioning items. A prorated scale score was used whenever a respondent skipped a single item on any of the six scales. If a respondent skipped two or more items on a scale, however, that individual's score for that scale was coded as missing. Consequently, sample sizes varied somewhat for analyses with different family-functioning scales.

Although the CSMFF was completed by both adoptive mothers and adoptive fathers, our primary analyses are based on the ratings provided by the mothers. The CSMFF assesses overall family functioning rather than specific relationships among family members. Consistent with this characterization, mother and father ratings on the individual scales of the CSMFF were moderately to substantially correlated in our sample (scale correlations ranged from .41 to .77 with a median of .53). Because our sample of mothers ($n = 620$) was larger than our sample of fathers ($n = 540$) and because the relationship between ratings of parental caregiving and offspring externalizing behavior appears to be greater when family functioning is rated by the mother rather than the father (see Rothbaum and Weisz, 1994, for a recent meta-analysis), we decided to focus on the mothers' reports. For completeness, we report correlations based on the fathers' ratings. Table 1 reports the means and standard deviations for the six mother-rated family-functioning scales; there were no significant differences in means across the adoptive and birth adolescent samples.

Results

Two related sets of analyses are reported. The first involves the prediction of adolescent alcohol involvement from indicators of family background, family functioning and parent problem drinking. The second involves assessment of resemblance among nonbiologically related sibling pairs for the Alcohol Involvement scale.

Prediction of adolescent alcohol involvement

Prediction analyses were completed separately for adoptive and birth offspring, and, within these two groups, separately for sons and for daughters as well as for the combined sample of sons and daughters. The significance of the birth versus adoptive offspring distinction warrants comment. Birth offspring share with their parents both a genetic background and features of their rearing background. Consequently, both genetic and shared environmental factors can contribute to correlations observed in the birth offspring sample. In contrast, in the absence of selective placement, adoptive offspring share with their adoptive parents features of their rearing environment only (Plomin et al., 1990). That is, only shared environmental factors can contribute to cor-

relations in the adoptive offspring sample. Consequently, greater correlation among birth, as compared to adoptive, offspring would be consistent with at least partial genetic mediation of the relationship between family functioning or parent problem drinking and adolescent adjustment, while equal correlation in the two samples would support pure environmental mediation.

Table 2 gives the zero-order correlations between adolescent alcohol involvement and each indicator of family functioning, family background and parental problem drinking in both the birth and adoptive offspring samples (correlations between adolescent alcohol involvement and fathers' ratings of family functioning are given in Table 3). Correlations are given separately for the male and female samples as well as for the total sample of adoptive or birth offspring. The table also reports the multiple correlation and the corrected multiple correlation (i.e., the multiple correlation corrected for the number of independent variables relative to the size of the sample used in the regression analysis; Neter et al., 1985) between each of the three sets of indicators and offspring alcohol involvement. Statistically significant (one-tailed) zero-order and multiple correlations are indicated by an asterisk. Zero-order correlations in the birth and adoptive offspring samples were compared statistically using the Fisher's z -transform method. In order to minimize the multiple-testing problem, these correlations were compared in the total sample only. One-tailed p values for these comparisons are given in the last column of Table 2. As there is no direct procedure for statistically comparing two multiple correlations, no statistical comparison of the multiple correlations is reported in the table.

The observed correlations between adolescent alcohol involvement and indicators of family functioning were generally similar in the male and female offspring samples and will restrict our description of family functioning correlates to findings based on the total sample of either adoptive or birth offspring. For birth offspring, there was a moderate association between adolescent alcohol involvement and mothers' ratings of family functioning; four of the six individual correlations and the multiple correlation were moderate in magnitude and statistically significant. The pattern of correlation in the birth offspring sample is generally consistent with that which has been reported in previous family research. That is, adolescents who scored high on the Alcohol Involvement scale tended to come from families that were perceived as being noncohesive and not characterized by a strong intellectual, religious or democratic orientation.

The degree of correlation between family functioning and adolescent alcohol involvement was, however, much weaker for adoptive as compared to birth offspring. Indeed, although the pattern of statistically significant correlations is the same in the total adoptive and total birth offspring samples (the former sample being nearly 10 times larger than the latter), all six of the zero-order correlations were larger, and two of these were significantly larger, in the birth as compared to the

TABLE 2. Correlations between family functioning, family demographics, parental problem drinking and adolescent alcohol involvement in adoptive and birth offspring

	OFFSPRING GROUP						r ^a
	Male		Female		Total		
	Adopted	Birth	Adopted	Birth	Adopted	Birth	
Family functioning							
Authoritarian	-.01	.53*	-.03	-.15	-.02	.13	.14
Cohesive	-.12*	-.32*	-.14*	-.30*	-.13*	-.29*	.10
Democratic	-.15*	-.31*	-.09*	-.33*	-.12*	-.30*	.07
Intellectual/cultural	-.02	-.30	-.11	-.34*	-.07*	-.32*	.03*
Organization	.04	-.18	-.04	-.01	-.00	-.06	.02
Religious	-.06	-.21	-.17*	-.41*	-.11*	-.33*	.05*
Multiple R	.21	.67*	.21*	.61*	.19*	.48*	
Corrected multiple R	.15	.54	.16	.48	.16	.39	
Family background							
Mother's education	.03	-.28	-.10	.06	-.04	-.09	.38
Father's education	-.01	-.40	-.04	.11	-.03	.22	.07
Family income	-.02	-.09	-.04	-.15	-.03	-.13	.22
Single parent	.02	nc	-.01	.18	.00	.13	.17
Multiple R	.05	.41	.10	.25	.05	.28	
Corrected multiple R	.00	.26	.00	.00	.00	.11	
Parental drinking index							
Mother's	.00	.16	.01	.33*	.01	.28*	.02*
Father's	-.00	.64*	.07	-.01*	.04	.10	.11
Multiple R	.00	.65*	.07	.37*	.04	.30*	
Corrected multiple R	.00	.61	.00	.27	.00	.24	

Note: nc = correlation not computable because of no variability in independent variable. Family functioning ratings are based on mother's reports.
 *Correlation significantly different from zero at $p < .05$. Note that significance of corrected multiple correlation is same as significance of uncorrected multiple correlation.
^aOne-tailed p value comparing adoptive offspring correlation with birth offspring correlation: not computable for multiple correlations.
^bAdoptive offspring correlation significantly greater than birth offspring correlation at $p < .05$.

adoptive offspring sample. That is, while correlations in the adoptive offspring sample indicate that, like their birth offspring counterparts, adopted adolescents who scored high on the Alcohol Involvement scale tended to come from families that were not cohesive, democratic, religious or intellectually oriented, the strength of this tendency is clearly much weaker for the adoptive, compared to the birth, offspring.

As is evident in Table 2, in the total samples as well as in the male and female subsamples we found no significant correlation between adolescent alcohol involvement and any of our four measures of family background. While lower so-

cioeconomic status has been consistently associated with elevated levels of problem drinking in adults (Bucholz and Robins, 1989), parental socioeconomic status has not been found to be either a consistent or powerful predictor of adolescent alcohol use (e.g., Bucholz, 1990; Johnstone, 1994).

Finally, Table 2 reports correlations between adolescent alcohol involvement and parental reports of problem drinking. In the adoptive offspring sample, there were no statistically significant correlations between adolescent alcohol involvement and parent problem drinking. Indeed, this was true when sons and daughters were analyzed separately as

TABLE 3. Relationship between adolescent alcohol involvement and fathers' ratings of family functioning

	OFFSPRING GROUP						r ^a
	Male		Female		Total		
	Adopted	Birth	Adopted	Birth	Adopted	Birth	
Family functioning							
Authoritarian	-.01	.04	-.03	.08	.01	.09	.28
Cohesive	-.07	-.13	-.10*	-.40*	-.09*	-.26*	.00
Democratic	-.00	-.11	-.05	-.47*	-.03*	-.34*	.01
Intellectual/cultural	-.03	-.27	-.12*	-.00	-.08*	-.11	.41
Organization	.04	-.10	-.06	.17	-.01	.06	.37
Religious	.00	-.10	-.16*	-.40*	-.09*	-.28*	.08
Multiple R	.13	.30	.19	.69*	.13	.48*	
Corrected multiple R	.00	.00	.13	.59	.08	.38	

*Correlation significantly different from zero at $p < .05$. Note that significance of corrected multiple correlation is same as significance of uncorrected multiple correlation.
^aOne-tailed p value comparing adoptive offspring correlation with birth offspring correlation: not computable for multiple correlations.
^bAdoptive offspring correlation significantly greater than birth offspring correlation at $p < .05$.

TABLE 4. Hierarchical regression analysis predicting offspring alcohol involvement from family measures

Step #	Variable set	# Variables entered	Change		Total	
			R ²	p	R ²	p
ADOPTIVE OFFSPRING						
1	Family functioning	6	.036	.01	.036	.01
3	Family background	4	.003	.78	.039	.03
3	Parent problem drinking	2	.001	.73	.040	.06
BIRTH OFFSPRING						
1	Family functioning	6	.229	.03	.229	.03
2	Family background	4	.062	.38	.291	.05
3	Parent problem drinking	2	.031	.35	.322	.06

Note: R² values are uncorrected. Family functioning ratings are based on mothers' reports.

well as when they were analyzed together, and true when the effect of mother's and father's problem drinking were considered separately as well as when the effects of the two parents were considered jointly in a multiple regression analysis. For adoptees, all corrected multiple correlations between parental problem drinking and adolescent alcohol involvement equaled zero.

For the birth offspring, however, the pattern of correlation between parent problem drinking and adolescent alcohol involvement differed markedly from that observed with the adoptive offspring. In the birth offspring sample, significant correlations were observed with both sons and daughters; the pattern of correlation suggesting that parent-offspring resemblance is stronger for same-sex compared to opposite-sex pairs. Although this pattern of sex-specificity has been observed in other parent-offspring studies of alcohol use (e.g., Thompson and Wilsnack, 1987) and is consistent with behavioral genetic research that suggests sex differences in the inheritance of alcoholism (McGue, 1993), other large family studies of alcohol use have failed to find sex-specificity in parent-offspring resemblance (e.g., Weinberg et al., 1994), and the number of birth sons (32) and daughters (36) in the present sample may not be large enough to discern correlation differences within the birth offspring sample.

Based upon previous research suggesting that the effects of parental problem drinking on offspring alcohol involvement may be mediated by family functioning (e.g., Peterson et al., 1994), we completed a hierarchical multiple regression where the six indicators of family functioning were entered first, the four indicators of family background were entered second and the two measures of parental problem drinking were entered last. For each of the three steps in the hierarchical multiple regression analysis, Table 4 gives the total squared multiple correlation (uncorrected) as well as the change in squared multiple correlation from the previous step. As before, results are given separately for the adoptive and birth offspring samples.

In both the birth and adoptive offspring samples, family functioning was significantly associated with adolescent alcohol involvement. Also in both samples, neither family

background nor parental problem drinking contributed to the prediction of adolescent alcohol involvement once the family-functioning measures had been entered. As before, the strength of association is much larger in the birth as compared to the adoptive offspring sample. The squared multiple correlations indicate that approximately 23% of the variance in birth offspring alcohol involvement, but less than 2% of the variance in adoptive offspring alcohol involvement, is predictable from mothers' ratings of family functioning.

Resemblance among nonbiologically related sibling pairs

Included in the adoptive family sample were 255 pairs of nonbiologically related siblings, 68 adoptee-birth and 187 adoptee-adoptee pairs. This relatively large sample of nonbiological siblings allowed us to assess the effect of common rearing on adolescent alcohol involvement. Assuming no selective placement, the correlation between nonbiologically related siblings provides a direct estimate of the percentage of variance in the outcome measure associated with the siblings' common rearing (Plomin et al., 1990). If there is selective placement, the adoptive sibling correlation overestimates the effect of common rearing.

The nonbiological sibling correlation for alcohol involvement was estimated in the total sample of 255 pairs as well as separately for same-sex ($n = 99$) versus opposite-sex ($n = 156$) sibling pairs, for similar age (within 2 years of age, $n = 148$) versus dissimilar age (greater than 2 years difference in age, $n = 107$) sibling pairs, and for same-ethnicity ($n = 206$) versus different-ethnicity ($n = 49$) sibling pairs. The moderating effect of sibling pair gender, age and ethnicity was assessed by statistically comparing the two relevant correlations using the Fisher z-transform method. Correlation estimates and associated p values are reported in Table 5.

In the total sample, the nonbiological sibling correlation for alcohol involvement was moderate and statistically significant ($r = .239$). Because it provides a direct estimate of the percentage of variance in sibling alcohol involvement scores attributable to environmental factors shared by siblings reared in the same home, this correlation indicates that approximately 24% of the variance in adolescent alcohol use and misuse is associated with common rearing effects. The nonbiological sibling correlation was significantly moderated by sibling demographic similarity. The sibling correlation was significantly greater among pairs whose members were near ($r = .349$) as compared to distant ($r = .047$) in age and nearly significantly greater among pairs who were same-sex ($r = .356$) as compared to opposite-sex ($r = .182$). Sibling pair same ethnicity had no apparent effect on sibling similarity for alcohol involvement. Based upon these results, we constructed samples of the demographically most similar (same-sex and age difference within 2 years, $n = 66$ pairs) and least similar (opposite-sex and age difference greater than 2 years, $n = 74$ pairs) siblings. The alcohol involvement correlation for the former sample was substantial ($r = .446$)

TABLE 5. Adoptive sibling correlation for alcohol involvement overall and by pair sex, age and ethnicity

By sex		By age			By ethnicity			Total	η^2	
Same sex	Opposite sex	r	Similar age	Dissimilar age	p	Same ethnicity	Different ethnicity			p
.356 ($n = 99$)	.182 ($n = 156$)	.07	.349 ($n = 148$)	.047 ($n = 107$)	<.01	.205 ($n = 206$)	.396 ($n = 49$)	.10	.239 ($n = 255$)	<.01

Note: p values by sex, age and ethnicity are used to test the hypothesis that the two correlations are equal; p value for total tests the significance of the total correlation. All p values are one-tailed.

and significantly larger (at $p < .01$) than the correlation for the latter sample ($r = .047$).

Discussion

The major findings from this study are: (1) parent problem drinking was significantly related to adolescent alcohol involvement in the birth offspring sample, but was statistically unrelated to adolescent alcohol involvement in the adopted offspring sample; (2) mothers' ratings of family functioning were moderately related to birth offspring alcohol involvement, but only modestly associated with adopted offspring alcohol involvement; and (3) nonbiologically related siblings were moderately similar in their level of alcohol involvement, with the magnitude of sibling similarity being moderated by sibling pair demographic similarity. These findings, if replicable, have substantial implication for understanding the nature of familial influence on adolescent alcohol use.

The effect of parent problem drinking

In the birth offspring sample, a significant correlation was observed between mother's problem drinking and adolescent daughter's alcohol involvement, and between father's problem drinking and adolescent son's alcohol involvement. Parent-offspring correlations for opposite-sex pairs were not significant. In the alcohol research field, findings like these have been characteristically interpreted as indicating that adolescents model the drinking behavior of their parents (e.g., Webster et al., 1994). This standard interpretation is challenged, however, by our findings with the adoptive offspring sample. When there is no biological relationship between parents and offspring, the correlations between parental problem drinking and adolescent alcohol use were all trivial and effectively zero. We believe the most reasonable interpretation of these findings is that genetic, and not familial environmental, factors mediate the relationship between parental drinking and adolescent alcohol use. Although there appears to be a general appreciation that genetic factors might mediate familial associations when the outcome of interest is alcoholism in adult offspring (e.g., Sher, 1991), the possibility of genetic mediation when the outcome is adolescent alcohol use may not be as widely recognized. It is hoped that findings like ours will encourage researchers to consider the full range of mechanisms that might underlie familial associations for alcohol-related behaviors.

The effect of family functioning

Perhaps even more striking than our findings with parental problem drinking are those relating family functioning to adolescent alcohol use. In the birth offspring sample, we observed a moderate relationship between mothers' ratings on six dimensions of family functioning and their adolescent offsprings' ratings of involvement with alcohol (corrected multiple correlation equaled .54 for sons and .48 for daughters). Adolescents who scored high on our Alcohol Involvement scale tended to come from homes that their mothers rated as being relatively noncohesive, nondemocratic, nonreligious, and nonintellectually oriented. The standard interpretation of findings like these has been that adolescent alcohol use and misuse is a consequence, at least in part, of poor family functioning (e.g., Barnes et al., 1994; Molina et al., 1994; Peterson et al., 1994).

Our findings with the adoptive offspring sample give reason to question the standard interpretation. For adoptive offspring, the relationships between family functioning and adolescent alcohol involvement were consistent (modest and lower than those observed with the birth offspring corrected multiple correlation equaled .15 for sons and .16 for daughters). We believe that the most reasonable explanation for the observed differences in correlation between the birth and adoptive offspring samples is that, as was the case of parental problem drinking, genetic factors may mediate the relationship between ratings of family functioning and adolescent alcohol involvement. Although it might seem paradoxical to propose that the relationship between an indicator of adolescent adjustment and an indicator of the family environment may be genetically mediated, there is a growing behavioral genetic research literature documenting the heritability of standard measures of the family environment (Plomin and Bergeman, 1991). That is, measures that have been assumed to reflect environmental variation appear to be partially genetically influenced. Our findings provide further support for the multifactorial nature of indicators of the family environment, and we hope they will lead alcohol researchers to recognize that any familial correlation may be genetically mediated. Family studies can help to identify the existence of familial associations, but, because they confound genetic and environmental effects, studies of intact nuclear families are inherently limited in their ability to identify the mechanisms that underlie those associations.

Resemblance among nonbiologically related siblings

To the best of our knowledge, ours is the largest sample of nonbiologically related sibling pairs ever investigated in the alcohol research field. We observed a moderate nonbiologically sibling correlation for our primary outcome measure of adolescent alcohol involvement ($r = .239$). Because the nonbiological sibling correlation provides a direct estimate of the proportion of variance in that outcome attributable to environmental influences shared by the sibling pair (Plomin et al., 1990), this correlation, although moderate in magnitude, suggests that approximately 24% of the variance in adolescent alcohol use and misuse is associated with environmental factors shared by adolescents growing up in the same home. Since we found no evidence that parent problem drinking or family functioning exerted a strong influence on adolescent alcohol use, however, we, like Rowe and Gulley (1992), conclude that characteristics of the rearing parents are not a likely source for the shared environmental factors that influence adolescent alcohol use.

Our observation that sibling pair demographic similarity moderated sibling similarity for alcohol involvement implicates direct sibling effects as a major source of shared environmental influence. The nonbiological sibling correlation for alcohol involvement was significantly greater among sibling pairs who were similar ($r = .349$) as compared to dissimilar ($r = .047$) in age, and was nearly significantly greater among same-sex ($r = .356$) as compared to opposite-sex ($r = .182$) sibling pairs. We hypothesize that the mechanism that underlies this pattern of nonbiological sibling correlation is social modeling or facilitation of adolescent alcohol use. That is, adolescents who have a same-sex, similar-aged, alcohol-using sibling may be more likely to become involved with alcohol than adolescents not having a sibling with these characteristics because the alcohol-using sibling either provides a model of adolescent alcohol use or facilitates the adolescent's access to alcohol.

Although rarely used in the alcohol research field, sibling studies, and in particular nonbiological sibling studies, provide a powerful methodology for identifying influences on adolescent alcohol use. For example, while peer group usage is the single best predictor of adolescent alcohol use (Kandel, 1985), the basis for this association is uncertain given that correlations with peer group characteristics may reflect selective association, peer group influence, or, in all likelihood, some complex combination of these two factors. Adolescents are not free to select their siblings, however, so that sibling similarity in alcohol use cannot be attributed to selective association. Moreover, since genetic factors cannot mediate associations among nonbiological siblings, studies like ours control for genetic contributions to sibling similarity and thus allow the researcher to focus on environmental influences on adolescent alcohol use. In the present case, the nonbiological sibling correlation suggests that be-

ing reared with a sibling who uses alcohol can influence adolescent alcohol involvement.

Lest we be misunderstood, it is important to emphasize that our findings question the nature, but not the existence, of familial environmental influences on adolescent alcohol use. By failing to take into account genetic mediation, we believe that some may have overestimated the *environmental* influence of parent drinking and family functioning on adolescent alcohol involvement. Moreover, failure to control for genetic factors in family studies of alcohol use may have misdirected alcohol researchers' attention towards, what we feel is, the relatively insignificant environmental effect of parents and away from the more substantial environmental effects of siblings. Indeed, as we stated earlier, there are remarkably few studies of sibling similarity in alcohol use and abuse in adolescent samples.

Limitations

Although we feel our results are noteworthy, we also recognize that our findings need to be replicated. The need for replication is heightened by limitations in our research design, several of which are sufficiently significant to warrant comment here. First, our sample of adoptive families is selective, not only in terms of those who agreed to participate in the study but also in terms of those who qualify to become adoptive parents. With respect to the former, approximately 50% of those families we asked agreed to participate in the study. We do know that participating families did not differ from nonparticipating families in gender of target adoptee and in parental ethnicity and marital status. Although we cannot make claims about the representativeness of the sample beyond these known demographic characteristics, it seems to us that the most likely effect of nonparticipation is quantitative (i.e., on estimating the magnitude of effects) rather than qualitative (i.e., on the overall pattern of results). More significant we believe is the likelihood that adoptive parents are selected for mental health, marital stability and financial security as part of the adoption process. Such selection could lead to restriction of range on rearing environmental circumstances and consequent attenuation of correlations in the adoptive families. Although some attenuation seems likely, we note that the restriction in range was not so severe as to obscure relationships in the birth offspring sample, where we observed correlations comparable to those that have been reported in other family studies, or among the nonbiological sibling pairs, where significant correlations implicating family environmental effects were observed. In any case, the generalizability of our findings is certainly limited to families like those who participated in our study. We suspect that, if we had been able to sample families at the extremes of environmental deprivation that exist within our society (e.g., adolescents who are homeless or are growing up in abusive homes, circumstances that are less likely to occur among

adoptive as compared to nonadoptive families), we would have found more evidence for parent and family functioning effects. Our findings, like most of those in developmental psychological research (e.g., Feldman and Elliott, 1990; Graham, 1992), apply only to the broad middle class within our society.

A second significant limitation concerns the nature of our assessment of alcohol use and misuse. The study from which the data we report derive was designed to explore the adjustment of adopted youths. Although involvement with alcohol is an important aspect of adolescent adjustment, it is but one of the many facets of adolescent adjustment investigated in the original study. As a consequence, our assessment of alcohol use and abuse is not nearly as comprehensive as it would have been had our research been primarily focused on adolescent alcohol use. Particularly noteworthy in this regard is the limited nature of our assessment of adoptive parent problem drinking. This assessment was based on only three items, and these items did not explicitly differentiate current from past drinking problems. It may be that a more thorough assessment of parental drinking that includes determination of whether the adolescent had been exposed to parental problem drinking may result in the finding of greater parent effects than we observed.

Finally, it is worth noting that, while our sample of adoptees is large, our sample of birth offspring is small. Moreover, our birth adolescents are atypical in that they are all being reared in a home with at least one adopted adolescent. While we do not see why birth adolescents growing up with adoptees should differ from birth adolescents growing up with non-adoptees (and indeed our results with the birth offspring sample appear to be consistent with those that others have reported), there is a clear need to extend our findings using a larger and more representative sample of birth adolescents.

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