Developmental Psychology
2000, Vol. 36, No. 4, 429–437

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0012-1649/00/$5.00 DOI: 10.1037//0012-1649.36.4.429

Are Associations Between Parental Divorce and Children's Adjustment Genetically Mediated? An Adoption Study

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The hypothesis that the association between parental divorce and children's adjustment is mediated by genetic factors was examined in the Colorado Adoption Project, a prospective longitudinal study of 398 adoptive and biological families. In biological families, children who experienced their parents' separation by the age of 12 years exhibited higher rates of behavioral problems and substance use, and lower levels of achievement and social adjustment, compared with children whose parents' marriages remained intact. Similarly, adopted children who experienced their (adoptive) parents' divorces exhibited elevated levels of behavioral problems and substance use compared with adoptees whose parents did not separate, but there were no differences on achievement and social competence. The findings for psychopathology are consistent with an environmentally mediated explanation for the association between parent divorce and children's adjustment; in contrast, the findings for achievement and social adjustment are consistent with a genetically mediated explanation involving passive genotype–environment correlation.

Recent research findings from behavioral genetic investigations raise fundamental questions about the mechanisms by which environmental risks influence behavioral outcomes. In many cases, connections between psychosocial risks and individual differences in adjustment that were previously thought to be entirely environmentally mediated are now thought to be partly genetically mediated. This conclusion is supported by a range of studies, is found across diverse methods, and pertains to a large number of environmental risk processes (see Ge et al., 1996; O'Connor, Deater-Deckard, Fulker, Rutter, & Plomin, 1998; Plomin, 1994). In the current study we sought to contribute to this line of research by examining whether the well-documented phenotypic association between parental divorce and children's adjustment is partly genetically mediated. We tested this possibility by studying the effects of divorce experienced by children in adoptive and biological families.

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This research was supported by Grants HD-10333, HD-18426, and HD36773 from the National Institute of Child Health and Human Development, by Grant MH-43899 from the National Institute of Mental Health, by the William T. Grant Foundation, and by Grants DA05131 and DA11015 from the National Institute on Drug Abuse.

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Mechanisms Explaining the Connection Between Parental Divorce and Children's Adjustment

Children and adolescents in single-parent families exhibit higher rates of behavioral and emotional problems and substance use and lower levels of self-esteem, social competence, and achievement compared with individuals in never-divorced, two-parent families (Amato & Keith, 1991; Hetherington & Clingempeel, 1992). This finding is robust, but it is important neither to overestimate the magnitude of the effects nor to ignore the considerable individual variability in response to divorce.

Despite considerable research attention, basic questions remain about the mechanisms through which parental divorce creates risks for child maladjustment. Several distinct explanations have been proposed. One line of research has emphasized the etiological role of risk factors that directly or indirectly follow from the divorce. A drop in financial well-being, stress and strain associated with single parenthood, loss of support, ongoing conflict regarding coparenting, and changes in the quality of mother–child and father–child relations are among the many negative consequences of divorce that may help explain the rise in postdivorce maladjustment (Amato & Keith, 1991; Hetherington, Bridges, & Insabella, 1998; McLanahan, 1999).

An alternative explanation for children's postdivorce maladjustment focuses on the predictors rather than the consequences of divorce. That is, postdivorce maladjustment in children is thought to be attributable to long-standing, predivorce stresses in the family, notably family conflict and the attendant strains on parent–child relations. For example, two studies reported that families who were later to divorce were distinguished by less optimal parenting, particularly from fathers (Block, Block, & Gjerde, 1986; Shaw, Emery & Tuer, 1993). Furthermore, Amato and Booth (1996) found that the quality of marital relations prior to the

divorce predicted the quality of parent–child relations following divorce and, in the case of mother–child relations, entirely mediated the negative impact of divorce on parent–child relations.

Given that substantial family conflict typically precedes divorce, it is perhaps not surprising that there are predivorce elevations in adjustment problems in children. At least two studies reported that the mean differences in behavioral problems between children in divorced versus two-parent families are considerably attenuated when predivorce behavior problems are statistically controlled (Cherlin et al., 1991; Furstenberg & Teitler, 1994), although another research team found that predivorce levels of behavioral problems did not distinguish families that later divorced from those that did not (Forehand, Armistead, & David, 1997). There is thus some evidence that postdivorce adjustment problems found in children are at least partly attributable to long-standing risks in the family and may well precede the divorce.

It may be that family-process risks that predate divorce are themselves indicators of a more rudimentary causal factor explaining children's maladjustment. That is, adjustment problems of children in divorced families may derive from individual vulnerabilities in the parents that, in turn, give rise to family-process difficulties, such as marital conflict and poor parent–child relations as well as separation and divorce. Findings supporting this model include, on the one hand, a strong connection between psychopathology and poor parenting, marital conflict, marital instability, and divorce or separation (Brody, Neubaum, & Forehand, 1988; Capaldi & Patterson, 1991; Caspi, Elder, & Bem, 1987; Coyne, Downey, & Boergers, 1992; Kiernan & Mueller, 1998; O'Connor, Hawkins, et al., 1998; Robins, Tipp, & Przybeck, 1991; Weissman, Bruce, Leaf, Florio, & Holzer, 1991) and, on the other hand, a robust connection between parental psychopathology and children's maladjustment (Downey & Coyne, 1989; Rutter & Quinton, 1984).

The hypothesis that the correlation between divorce and children's behavioral problems is explained by parental vulnerabilities was directly tested by Lahey et al. (1988) in a clinic-referred sample. Lahey et al. reported that divorce did not predict children's conduct disorder once parental psychopathology (in this case, antisocial personality) was statistically controlled. The findings supported the hypothesis that conflict and compromised family processes, including divorce, are associated with children's maladjustment via their association with the presumed direct influence, parental vulnerability. If this is correct, it raises the possibility of a role for genetic factors underlying the association between parental divorce and children's adjustment.

The Role of Genetic Risks in Divorce Research

The possibility that the effects of parental divorce on children's adjustment are genetically mediated follows from several heretofore separate sets of findings. First, recent findings suggest that the likelihood of divorce may be under genetic influence. The genetic influence on divorce is not direct but arises from the genetic influence on personality and the correlation between personality traits and divorce propensity (Jockin, McGue, & Lykken, 1996). Second, genetically influenced personality traits may predict not only divorce itself but also the attendant interpersonal and family conflict that precedes and follows the actual separation (Karney & Bradbury, 1995). Finally, developmental studies highlight the important genetic influences on multiple indices of adjustment in children, particularly behavioral and emotional problems, substance use, achievement, social competence, and self-esteem (McGuire, Neiderhiser, Reiss, Hetherington, & Plomin, 1994; Rutter, Silberg, O'Connor, & Simonoff, 1999). Taken together, the above sets of findings lead to the hypothesis that the behavioral problems in children in divorced families may be a consequence of individual vulnerabilities of parents that are transmitted to their children via a genetic route rather than, or in addition to, environmental channels such as conflict and divorce.

Studies of biological families are unable to disentangle genetic and environmental sources of influence because parents provide both genes and environment for their biological children. However, it is possible to assess the extent to which the predictor–outcome association, such as that between parental divorce and child adjustment, is environmentally mediated by examining parents and children who do not share genes, that is, adoptive families. In a sample of adoptive families, if adoptees who experienced their adoptive parents' divorce exhibit higher rates of adjustment difficulties than do adoptees who did not experience a parental divorce, then it is possible to conclude that the effects of divorce are at least partly environmentally mediated. Further leverage on differentiating and testing environmental and genetic hypotheses regarding the divorce/child-outcome association is gained by the additional inclusion of biological families. That is, if the magnitude of the divorce/child-outcome association is significantly greater in biological families than in adoptive families, then some degree of genetic influence is suggested. More specifically, passive genotype–environment correlation (Plomin, 1994)—the index of genetic influence in this design—is indicated. In contrast, if the magnitude of the divorce/child-outcome association is comparable in biological and adoptive families, then passive genotype–environment correlations are ruled out and environmental risk processes are implicated.

The opportunity to examine whether the effects of parental divorce on children's adjustment are genetically mediated was possible in the Colorado Adoption Project (CAP), a prospective longitudinal investigation of adoptive and biological families. The CAP began studying families from the birth or adoption of a target child (proband) and has followed children and families through the transition into adolescence and beyond. The current study includes data up to age 12, the latest period for which child adjustment data are available. Consistent with sociodemographic trends, a sizable minority of adoptive and biological families had divorced by the probands' 12th birthdays.

Using the natural experiment of the adoption design, the current study examines the extent to which the connection between parental divorce and children's adjustment is genetically mediated. Outcome measures were selected that assessed each of the key domains included in previous studies of divorce and children's adjustment, including behavioral problems, substance use, self-esteem, social competence, and achievement.

Method

Sample

The CAP (DeFries, Plomin, & Fulker, 1994) is an ongoing, prospective longitudinal study of adoptive and nonadoptive (i.e., biological) families.

Adoptive families were recruited through two large adoption agencies in Colorado from 1975 to 1982. The adopted children's mean age at placement in their adoptive homes was 29 days. Adoptive parents were generally middle class and well educated. Adoptive mothers' average age was 33 years; adoptive fathers' average age was 34. The number of years of education was 14.7 for mothers and 15.7 for fathers. Over 95% of the adoptive families were Caucasian. The occupational status of the adoptive families, based on National Opinion Research Center ratings of the father's job, was slightly higher than that of a random sample of families in the Denver metropolitan area that was based on census data (Plomin, DeFries, & Fulker, 1988). The biological mothers of adopted-away children were, on average, younger (mean age = 20 years) than the adoptive mothers (mean age = 33 years) and had completed fewer years of education (12.1 and 14.7 years, respectively). As detailed in Plomin et al. (1988), there was minimal selective placement between biological and adoptive parent characteristics.

Nonadoptive or biological families were recruited through local hospitals and were matched to the adoptive families on several criteria, including fathers' age, education, and occupational status (Plomin et al., 1988). Biological mothers' average age was 30 years; biological fathers' average age was 32. The number of years of education was 14.9 for mothers and 15.6 for fathers. Over 95% of the biological families were Caucasian (Plomin et al., 1988).

The initial CAP sample included 245 adoptive and 245 biological families when the probands were 1 year of age. For the current study, which is based on the proband's adjustment at the age of 12 years, data were included from 188 of the 197 available adoptive families and 210 of the 226 available biological families. Families were excluded from the present study if there was a maternal or paternal death, if divorce could not be ascertained, or because it was known that the parents separated soon after the proband was 12 years of age. The latter group of families was excluded because the relevant behavioral data were not available on the complete sample (i.e., age 12 was the oldest age at which behavioral outcome analyses could be conducted) and we wanted to avoid the problem of including families that were soon to separate because these children might be exhibiting predivorce levels of maladjustment. The *n*s reported in the tables differ because of missing data, particularly for teacher reports.

Procedure

At the age 12 assessment, probands and their families visited the lab for a comprehensive assessment. Parents and probands were interviewed and asked to complete questionnaires and standardized tests. Teacher reports on behavioral questionnaires were collected by mail. In addition to this information, interviewers rated the proband's social behavior at the conclusion of the assessment. The measurement strategy was based on a multimethod, multirater approach. The constructs assessed are those examined in previous studies (Amato & Keith, 1991).

Measures

Divorce. Whether or not a divorce or separation occurred and the age of the proband at the time of his or her parents' divorce, if applicable, were recorded. In many cases, a separation preceded a divorce; in these cases, the age at separation was used in analyses. Whether or not the proband's custodial parent remarried was also recorded.

Self-concept. Self-concept (self-esteem) was measured with Harter's (1982) Perceived Competence Scale for Children (PCSC), a widely used index of positive self-view with distinct Scholastic, Social Acceptance, Athletic, Attractiveness, Good Conduct, and Self-Acceptance subscales. Validity and reliability for individual scales have been reported on extensively. The internal consistencies (alphas) in the current sample ranged from .57 to .70. Following Harter (1982), we examined each individual component of self-concept rather than a summary score. The correlations among the scales ranged from .48 (Attractiveness with Self-Acceptance) to .06 (Social Acceptance with Good Conduct).

Social competence. Social competence was measured with the Social Competence subscale from the parent report of the Child Behavior Checklist (CBC; Achenbach & Edelbrock, 1981). The other indices of social competence were based on interviewer ratings of the proband's behavior throughout the course of the intensive assessment. Two scales were adapted from the inventory on the basis of principal-components analyses. The first factor, termed Positive Assertiveness, was defined by five items (e.g., "approaches new experiences confidently," "shows decisiveness during interview"). The internal consistency (alpha) of this scale was .83. A second factor, termed Social Responsibility, also consisted of five items (e.g., "is polite and courteous with adults," "carries out tasks and directions responsibly"). The internal consistency (alpha) of this scale was also .83. The two rater-reported scales were moderately correlated with each other (r = .52) and overlapped little with the parent-report measure (rs < .2).

Academic achievement. Academic achievement was measured with three separate indices. Performance was measured with the Reading Recognition scale from the Peabody Individual Achievement Test (PIAT), a widely used index of standardized achievement (see Sattler, 1988). A second index of achievement was based on the children's self-reports of five attitudes about achievement, based on the work of Jessor, Donovan, and Costa (1991). Each item was rated on a 5-point scale according to how important the child viewed the statement (e.g., "being near the top of the class," "getting good grades for college"). The alpha for this five-item scale was .71. A third measure of academic achievement was based on the parent report on the School Competence scale from the CBC (Achenbach & Edelbrock, 1981). Correlations among the scales ranged from .51 (parent CBC with PIAT) to .07 (parent CBC with self-rated achievement).

Child behavioral and emotional problems. The CBC (Achenbach & Edelbrock, 1981) is a widely used measure of general behavioral and emotional problems in children and has well-established reliability and validity. The CBC was completed by parents (most often the mother) and teachers when the children were 12 years of age. CBC reports were standardized using the 1991 norms reported by Achenbach (1991). The CBC consists of eight subscales. The current study examined the two broadband factors, Externalizing and Internalizing behavioral problems, as well as Total Problems. The Externalizing factor is made up of the Aggression and Delinquency scales; the Internalizing factor is made up of the Depression/Anxiety, Withdrawn, and Somatic Symptom scales; the Total Problem scale is a summary index of behavioral and emotional problems.

Loneliness. An index of self-reported loneliness was based on a loneliness scale developed by Asher and colleagues (Asher & Wheeler, 1985). Probands rated eight items on a 5-point scale. Example items included "I have nobody to talk to" and "I feel alone." For the current sample, the alpha for this scale was .86.

Substance use. The proband's substance use and his or her friends' substance use were measured with self-report items adapted from Jessor et al. (1991). Substance use was measured with a summary scale defined by three items: whether or not the child ever (a) smoked cigarettes, (b) used alcohol, or (c) used chewing tobacco (each coded 1 = *yes* or 0 = *no*). Use of marijuana and harder drugs was too infrequent in this relatively young group to provide any variance. Given the relatively young age of the participants, the substance use scale is best viewed as an indicator of early onset of substance use rather than as an indicator of severity of substance use. Children also reported how many of their friends ever (a) used alcohol or (b) smoked cigarettes. Each of these two items was coded on a 5-point scale (1 = *none*, 2 = *1–2*, 3 = *several*, 4 = *most*, 5 = *all*). The mean of the two items was included in the analyses below. As in the case of the proband's own use, friends' use of other substances was too infrequent to add meaningful variance to this scale. The correlation between the child's own use and friends' use was .34.

Data Analysis

The central analyses are presented in two sections. In the first section, we examine the rate of divorce and the characteristics of the divorce in adoptive and biological families. In the second section, we examine the association between parental divorce and child outcomes with the use of multivariate analyses of variance (MANOVAs) involving three factors: divorce status, adoptive status, and the interaction between divorce and adoptive status. A significant interaction between adoptive or biological family status and divorce history is one index or definition of genetic mediation. We also report the effects of divorce on children's outcomes in biological and adoptive families separately based on the effect size *d* (Cohen, 1968), defined as the difference between the two group means divided by the pooled standard deviation. As a general rule, effect size values of .2, .5, and .8 indicate small, medium, and large effects, respectively. This is a standardized scale from which it is possible to compare the effects of divorce on adjustment in biological and adoptive families. We provide the effect within each family type for two reasons. First, we wished to examine the association (a) within the biological families in order to compare our results with those of previous studies and (b) within adoptive families in order to examine "pure" environmentally mediated effects. Second, we had limited power to detect significant interactions even within our relatively large sample, and we wanted to determine if the magnitudes of divorce were similar for children raised by adoptive parents and children raised by biological parents.

The child outcome variables were grouped conceptually into five categories used in previons research on children's postdivorce adjustment (e.g., Amato & Keith, 1991): (a) self-esteem or self-concept, (b) social competence, (c) achievement, (d) parent- or teacher-rated and self-rated psychopathology, and (e) substance use. Correlations among the outcome measures (not presented) revealed several important findings. First, correlations between measures from separate outcome dimensions were for the most part modest ($r = .3$ or less); the few exceptions were explained by shared rater variance. Second, correlations within dimensions were generally modest to high; not surprisingly, however, within-dimension correlations were lower when different measures from different sources were considered. Third, the psychopathology and competence measures were not mirror images of each other. Given that the measures are widely used (with the exception of the two observational measures) and define well-established constructs, we chose to analyze the measures according to the five conceptual groupings.

For each domain, we sought, as much as possible, to include multiple measures and sources of data because previous research indicated variation in effects across both domain and reporter. MANOVAs are reported for each domain, followed by analyses of variance (ANOVAs) for significant effects. Given the sample size, there was adequate (> .80) power to detect a small effect of divorce in the total sample at $p < .05$. However, the power to detect an effect of parental divorce was reduced within each family type, and there was adequate power to detect only moderate to large effects.

Missing Data

Teacher report data at age 12 years were available for 70% of the children in the study. Although 30% is not an uncommon rate of missing data from teachers in studies of this sort, it was a concern given the initially small number of adoptive children who experienced parental divorce. Therefore, when they were available, we included teacher data from the age 11 assessment if the age 12 data were missing. This inclusion increased the percentage of available teacher report data to 85%. Missing data were also a concern for self-reported substance use (28% missing). However, we did not have data from another source or age period; analyses of this variable are therefore based on a reduced *N*. The rate of missing data for drug use was significantly higher in the adoptive families than in the biological families (36% vs. 22%) but was unassociated with divorce history. Only 1 of the 19 outcome measures was associated with missing data on the drug use measures (children who did not supply such data reported lower levels of self-acceptance than did children who did report on substance use), a rate that might be expected by chance alone. Thus, if the substance use data were biased because of missing data, the effect would be to underestimate the connection between divorce history and substance use.

Results

Characteristics of Divorce in Adoptive and Biological Families

By the proband's 12th birthday, adoptive families were significantly less likely to divorce or separate than were biological families (24/188, or 13%, in adoptive families compared with 50/210, or 24%, in biological families), $\chi^2(1, N = 398) = 8.2, p < .01$. However, there were no differences in the features of divorce between the two groups. For example, the average age of the child at divorce was nearly identical in the two groups (7.4 years and 7.2 years in the adoptive and biological families, respectively), the likelihood of a subsequent remarriage of the custodial parent was similar (33% in adoptive families compared with 32% in biological families), and there was no association between the child's gender and likelihood of divorce (e.g., in the overall sample, the rate of separation was 17% when the proband was male compared with 21% when the proband was female; 49% of divorces involved a male proband, and 51% involved a female proband).

In those families in which there had been a divorce or separation, the child's age at the time of separation was not significantly associated with any of the age 12 outcome variables noted above. However, given that a family had divorced, subsequent remarriage of the custodial parent was significantly negatively correlated with one of the outcome variables, self-reported substance use ($r = -.30, p < .05$ in the total sample, which suggests less substance use in cases in which the single parent later remarried; the correlation was essentially identical within the two family types). Given that the likelihood of remarriage was not different between the two family types, these findings do not influence the main analytic question concerning the environmental and genetic mediation of the effect of divorce on children's adjustment.

There were no interactions between divorce and child gender in predicting outcomes. Boys and girls were therefore combined in the analyses that follow.

Association Between Divorce and Adjustment in Adoptive and Biological Families

Tables 1 and 2 present the means and standard deviations of the child outcome variables according to adoptive and biological family type and divorce status. Tables 1 and 2 also display the main effects of divorce and family type (adoptive or biological) and their interaction based on MANOVA procedures. These analyses are complemented by the effect size (*d*) of divorce for each measure, which is reported separately for adoptive and biological families.

Self-concept or self-esteem. MANOVA procedures indicated an effect of divorce (at trend level), $F(6, 381) = 2.09, p < .06$, and adoption status, $F(6, 381) = 2.17, p < .05$; the interaction was not significant, $F(6, 381) = 1.04$. Follow-up ANOVA procedures indicated that divorce was a consistent predictor of self-concept.

Table 1
Means, Standard Deviations, and Effect Sizes (d) of Adjustment Measures According to Family Type and Divorce History: Positive Adjustment

	Adoptive families					Biological families					
	Divorced		Nondivorced			Divorced		Nondivorced			
Adjustment measure	*M*	*SD*	*M*	*SD*	*d*	*M*	*SD*	*M*	*SD*	*d*	ANOVA effects
					Self-esteem						
Harter: Scholastic	15.0	3.8	15.2	3.4	.03	14.2	3.5	16.1	2.8	.61	Divorce
Harter: Social Acceptance	17.3	3.0	16.6	3.5	−.21	15.7	3.4	15.6	3.8	−.02	Adoption
Harter: Athletic	13.7	3.6	13.3	3.7	−.10	12.7	3.8	12.7	3.8	−.01	
Harter: Attractiveness	15.4	4.2	15.8	3.8	.08	14.0	3.8	15.2	3.5	.34	
Harter: Good Conduct	13.6	3.8	14.2	3.3	.19	13.8	3.5	15.1	3.7	.34	Divorce
Harter: Self-Acceptance	17.7	2.0	17.7	2.4	.04	16.2	3.2	17.7	2.5	.53	Divorce, adoption
n	23		160–162			49–50		158–159			
					Social competence						
Social Responsibility	4.1	0.6	4.2	0.6	.14	4.0	0.7	4.3	0.6	.47	Divorce
Positive Assertiveness	3.7	0.7	3.6	0.7	−.03	3.6	0.8	3.8	0.6	.28	
n	22		144			44		146			
Parent CBC Social Competence	7.0	2.3	7.7	1.8	.33	7.2	1.8	7.9	1.8	.35	Divorce
n	23		151			45		150			
					Achievement						
Parent CBC School Competence	4.8	1.2	4.9	1.2	.09	5.0	1.2	5.3	0.8	.37	Adoption
n	22		147			43		150			
PIAT Reading Recognition	54.3	8.1	57.0	9.5	.29	58.0	9.0	59.6	8.4	.19	Adoption
n	23		163			48		159			
Achievement motivation	21.2	3.7	21.7	3.0	.16	21.0	3.9	22.4	2.6	.47	
n	23		161			49		157			

Note. The effects reported are based on the analysis of variance (ANOVA) following a significant multivariate ANOVA for the construct (see text). Harter refers to Harter's (1982) Perceived Competence Scale for Children; CBC = Child Behavior Checklist; PIAT = Peabody Individual Achievement Test.

Across adoptive and biological families, a significant effect of divorce was obtained for the Scholastic, $F(1, 390) = 5.18, p < .05$, Good Conduct, $F(1, 387) = 3.85, p < .05$, and Self-Acceptance, $F(1, 390) = 4.95, p < .05$, subscales of the PCSC. In addition, ANOVAs indicated two main effects of adoptive status, on the Social Acceptance, $F(1, 389) = 6.92, p < .01$, and Self-Acceptance, $F(1, 390) = 4.17, p < .05$, subscales; in both cases, adoptees scored higher than nonadoptees.

The absolute and relative magnitudes of the effects of divorce in biological and adoptive families are also given in Table 1. Whereas the effect size in adoptive families was generally close to zero, the effect size in biological families was moderate for four of the six self-concept subscales (see columns headed by *d*). The effect sizes computed separately for biological and adoptive families therefore clarify the MANOVA in highlighting the consistently stronger effects of divorce in biological families. This was confirmed by exploratory post hoc analyses on the individual scales, which indicated a significant interaction between family type and divorce for Scholastic competence, $F(1, 390) = 4.04, p < .05$, and (at trend level) Self-Acceptance, $F(1, 390) = 3.83, p < .06$.

Social competence. MANOVA procedures indicated a significant effect of divorce, $F(3, 326) = 3.40, p < .05$; neither adoption, $F(3, 326) = 0.45$, nor the interaction between divorce and adoption, $F(3, 326) = 0.48$, was significant at $p < .05$. Follow-up ANOVAs indicated a significant effect of divorce for two of the three measures of social competence: observer reports of Social Responsibility on the CBC, $F(1, 352) = 4.66, p < .05$, and parents' reports of Social Competence on the CBC, $F(1, 368) = 5.96, p < .05$.

The absolute and relative magnitudes of the effects of divorce computed separately for adoptive and biological families complement the MANOVA findings. Specifically, the effect size of divorce on Social Responsibility was substantially greater in biological families than in adoptive families (in which case the absence of a significant interaction may be attributable to low power), but the effect of divorce was the same for parent reports of Social Competence (see Table 1).

Achievement. MANOVA procedures indicated a significant effect of adoption status, $F(3, 348) = 3.13, p < .05$; neither divorce, $F(3, 348) = 1.67$, nor the interaction between divorce and adoption, $F(3, 348) = 1.67$, was significant at $p < .05$. Follow-up ANOVAs indicated a significant effect for Reading Recognition on the PIAT, $F(1, 389) = 6.64, p < .01$, and parent reports of School Competence on the CBC, $F(1, 358) = 4.38, p < .05$.

The absolute and relative magnitudes of the effects of divorce, computed separately for each family type, complemented the above findings in revealing a comparable effect of divorce in adoptive and biological families for Reading Recognition but

Table 2
Means, Standard Deviations, and Effect Sizes (d) of Adjustment Measures According to Family Type and Divorce History: Psychopathology

Adjustment measure	Adoptive families					Biological families					ANOVA effects
	Divorced		Nondivorced			Divorced		Nondivorced			
	M	*SD*	*M*	*SD*	*d*	*M*	*SD*	*M*	*SD*	*d*	
Behavioral and emotional problems											
Parent reports											
Externalizing	7.1	6.8	8.6	7.6	−.19	7.5	7.3	6.2	5.5	.22	
Internalizing	5.6	5.4	6.1	5.5	−.09	5.7	5.5	5.8	5.1	−.03	
Total Problems	18.5	17.6	22.5	18.2	−.23	19.3	16.0	17.1	13.1	.16	
n	23		148			45		149			
Teacher reports											
Externalizing	6.6	8.7	6.3	8.5	.04	6.5	8.2	4.0	6.2	.37	
Internalizing	10.1	12.9	5.4	6.2	.65	6.7	7.1	6.3	6.8	.06	Divorce × Adoption
Total Problems	27.8	25.2	21.6	20.9	.29	23.6	22.9	17.1	17.3	.35	
n	16		139			39		141			
Child self-reports											
Loneliness	10.5	3.5	10.9	4.2	.10	12.7	5.5	11.1	5.1	.32	
n	23		161			50		158			
Substance use											
Child use	0.87	1.1	0.31	0.6	.81	0.50	0.8	0.21	0.5	.47	Divorce, adoption
n	15		106			38		126			
Friends' use	2.5	0.9	2.2	0.6	.50	2.5	0.9	2.3	0.8	.21	Divorce
n	15		105			38		126			

Note. The effects reported are based on the analysis of variance (ANOVA) following a significant multivariate ANOVA for the construct (see text).

somewhat disparate effect sizes for self-reported achievement motivation and parent-reported School Competence (see Table 1).

Behavioral and emotional problems: Parent reports. There was no main effect of divorce, $F(3, 359) = 0.20$, or adoption status, $F(3, 359) = 1.11$, and no interaction between the two, $F(3, 359) = 2.00$, in the MANOVA for parent report of Externalizing, Internalizing, and Total Problems. Table 2 reveals that the effect size of divorce was small in biological families; in adoptive families, the effect was small and in the unexpected direction.

Behavioral and emotional problems: Teacher reports. For teacher reports, MANOVA procedures indicated a significant interaction between adoption status and divorce, $F(3, 329) = 3.02$, $p < .05$; neither the divorce, $F(3, 329) = 1.79$, nor the adoption, $F(3, 329) = 0.62$, main effect was significant at $p < .05$. Follow-up ANOVAs of the interaction revealed that the significant interaction was attributable to Internalizing, $F(1, 331) = 3.63$, $p < .06$; for neither Externalizing nor Total Problems was there a suggestion of an interaction. Contrary to expectations, the effect of divorce on Internalizing was greater in adoptive than in biological families (effect sizes of .65 and .06, respectively; see Table 2). The other subscales did not reflect this pattern, and for Externalizing, the effect of divorce was somewhat greater in biological families than in adoptive families (effect sizes of .37 and .04, respectively).

In addition to the analysis of mean differences in the teacher data, we also examined extreme scores and outliers because of the skewed nature of the data and the small number of cases in the divorce groups. Two findings are noteworthy (details are available from Thomas G. O'Connor). First, there was no evidence that the group differences were influenced by outliers. Second, when we reexamined the data using cutoff scores, the same pattern of results was obtained. For example, nearly one third (31%) of the adoptees who experienced parental divorce were rated in the top 15% of the sample on Internalizing, compared with 12% of the adoptees who did not experience parental separation. The extreme scores analyses also suggest that the effect size for Internalizing in the adoptive families is not accounted for by outliers.

Self-reported loneliness. ANOVA procedures revealed a trend for nonadoptees to report higher levels of loneliness, $F(3, 388) = 3.43$, $p < .07$; neither the main effect of divorce, $F(3, 388) = 0.91$, nor the interaction between divorce and adoption, $F(3, 388) = 2.63$, was significant. The absolute and relative magnitudes of the effects of divorce (see Table 2) complemented the above analyses in revealing that the effect size of divorce on self-reported loneliness was greater in biological families than in adoptive families.

Substance use. MANOVA procedures indicated a significant effect of divorce, $F(2, 279) = 8.29$, $p < .001$, and, at trend level, of adoption status, $F(2, 279) = 3.00$, $p < .06$; the interaction was not significant, $F(2, 279) = 0.78$. ANOVAs indicated that both the child's own use and the friends' use of substances were greater among children who experienced a parental divorce: $F(1, 281) = 16.30$, $p < .001$, and $F(1, 280) = 4.03$, $p < .05$, respectively. A main effect of adoptive status was also found for substance use, $F(1, 281) = 5.05$, $p < .05$, indicating that adoptees were more likely to have engaged in drinking alcohol and smoking than were nonadoptees.

The absolute and relative magnitudes of the effects of divorce (see Table 2) indicated that, for both measures, the effect size was greater in adoptive than in biological families. Specifically, the effect sizes were moderate to large in adoptive families for the

child's own use (.81) and for friends' use (.50) and small to moderate in biological families (.47 for the child's own use and .21 for friends' use).

Discussion

To date, research into the frequently observed association between divorce and children's outcomes has assumed an exclusively environmentally mediated process. Rarely is there a consideration that the connection between divorce and children's adjustment may reflect shared genetic effects on parents' and children's behavior. To test the possibility of a genetically mediated link, we studied the association between divorce and children's adjustment in biological and adoptive families. The rationale for this design is that in biological families, parents and children share both genes and environment, whereas in adoptive homes parents and children share only their environment. Thus, in biological homes the association between divorce and children's adjustment can be mediated or transmitted environmentally and genetically, but in adoptive homes this association can be mediated only by environmental processes. If the connection between divorce and children's adjustment was the same in biological and adoptive families, there would be little reason to doubt the impact of environmental processes. However, if the associations were much stronger in biological families, then there would be reason to suspect genetically mediated processes. The results suggest that whereas the associations between parental divorce history and indicators of self-esteem, social competence, and academic competence may be partly genetically influenced, the connections between divorce and children's psychopathology may be attributed to environmentally mediated processes.

Phenotypic Findings

The absolute rate of divorce (28%) in this relatively well-educated middle-class sample of biological families approximates that found in other studies. For example, Baydar (1988) found that 25% of families divorced by the time children were aged 14. The rate of divorce in adoptive families, 13%, may therefore be viewed as a reduced risk. Why adoptive families may experience a reduced risk of divorce is not clear, but it may be attributable to the fact that divorce-prone couples may have been screened out by adoptive agencies prior to placement. It is unlikely that the different rate of divorce could be attributable to child factors, because the current study indicates comparatively higher rates of problem behavior (substance use) *and* competence (e.g., self-concept) among adoptees. Whatever the reason for the lower rate of divorce in adoptive families, the critical finding for this study is that the features of divorce in adoptive and biological families were comparable.

Quite apart from the genetically sensitive design, the current study complements the existing research on the association between divorce and family transitions and children's adjustment. The finding that the effect is nonspecific is consistent with previous studies (Amato & Keith, 1991); the medium effect sizes obtained differ from some reports but not others (Hetherington & Clingempeel, 1992) and are especially noteworthy given the low-to-normal risk status of the biological families (e.g., as indexed by low levels of parental psychopathology and middle-class setting). The comparability with previous studies also provides an important backdrop for interpreting differences between biological and adoptive families.

Genetic and Environmental Risks Associated With Parental Separation

This is the first study to examine whether associations between divorce and children's adjustment are mediated genetically, but it has much in common with a growing research base that assesses genotype–environment correlations (O'Connor, Deater-Deckard, & Plomin, 1998). The current design assesses passive genotype–environment correlations. Passive genotype–environment correlations arise because biological parents transmit their genes to their offspring and also provide their children with environmental experiences (Plomin, DeFries, & Loehlin, 1977). Studies that include only biological families are consequently unable to distinguish environmental from genetic influences on children's development. Adoptive families are therefore an especially useful comparison group because they can provide a natural experiment in which environmental factors are unconfounded (i.e., uncorrelated) with genetic factors. Thus, the current research design is an example of a parent–offspring design—with the exception that the specific environmental variable is not a specific measure such as parenting (McGue, Sharma, & Benson, 1996) but a somewhat more complex and multiply determined risk, divorce.

Conclusions regarding the environmental and genetic mediation of the effects of divorce on children's adjustment depend on three considerations. A first consideration is the data analytic approach used. An interaction between divorce and adoptive status in ANOVAs provides the strongest evidence for genetic mediation. In no case was there a significant Divorce × Family Type interaction in the MANOVAs; furthermore, for only two individual measures (self-reports of scholastic competence and, at $p < .10$, self-acceptance) was the association between divorce history and child adjustment significantly greater in biological families than in adoptive families. A somewhat more liberal approach, based on the comparison of effect sizes when adoptive or biological families were analyzed separately, suggests a slightly stronger case for genetic mediation. As illustrated by the effect sizes (see Table 1) for a range of positive adjustment measures, the effects of divorce in biological families are consistently greater than those found in adoptive families—with the exception of parent-reported social competence and reading recognition performance on the PIAT. This pattern of findings suggests that passive genotype–environment correlations play some role in accounting for the association between divorce and these outcome measures. That is, the association between divorce-related psychosocial risks and outcomes depends on co-occurring genetic factors.

An interpretation of the genetic mediation effect must balance the ANOVA interaction approach alongside the limited power to detect interactions (Wahlsten, 1991) and the consistency of effect size differences. We would not wish to overinterpret the genetic mediation or passive genotype–environment results, but we would equally not wish to ignore the consistent pattern displayed in the effect sizes for positive adjustment.

Although the pattern of results provides some evidence for genetic mediation, nongenetic factors might also explain the differential effects of parental divorce on biological and adopted children's adjustment. For example, we cannot rule out the possi-

bility that adoptees would be less adversely affected by their adoptive parents' separation, although this explanation is inconsistent with the marked effect of divorce on teacher-reported problem behavior and children's reports of their own use of substances.

A second consideration regarding the environmental and genetic mediation of the effects of divorce is the domain-specific nature of the findings. In contrast to the findings for positive outcomes, the associations between divorce history and psychopathology measures were not consistently stronger in biological than in adoptive families, and in some cases, the opposite pattern was obtained. Given the relatively pervasive genotype–environment correlations in development (see Plomin, 1994), it is especially noteworthy to find correlations that are strongly environmentally mediated; that is, the correlation between divorce and children's well-being was evident in adoptive (as well as biological) families.

It is not clear why the self-esteem and the social and academic competence measures displayed the passive genotype–environment correlation pattern whereas the psychopathology measures were uninfluenced by such factors. The difference in the degree of genetic mediation cannot be accounted for by a markedly differential impact of genetic factors on these outcome measures, because available evidence indicates a moderate genetic influence on both measures of competence and psychopathology in childhood and adolescence (McGuire et al., 1994; Rutter et al., 1999). It may be that the disparate pattern of genetic mediation implies that distinct environmental risks, which may be differentially influenced by passive genotype–environment processes, underlie the development of psychopathology and competence following divorce. Further research is needed to examine whether the psychosocial risks connecting divorce with deficits in positive adjustment are the same as those that increase levels of psychopathology. It is also possible that postdivorce processes, such as the amount of contact with, or monitoring by, the nonresidential parent may differ between adoptive and nonadoptive families and place the former at greater risk for psychopathology and substance use. Further information on the antecedents and sequelae of divorce in adoptive families is needed in order to address this possibility. Alternatively, it may be that the association between divorce and negative outcomes found in adoptees—which exceeds that found in most other studies—is attributable to the relatively small sample available for analysis.

A third consideration in interpreting the findings is the source of information on children's outcomes. In this regard, it is especially interesting that divorced parents of adoptees reported lower levels of psychopathology than did nondivorced parents of adoptees (although the difference was not significant). The unexpected negative effect of divorce according to parent reports of psychopathology contrasts sharply with the findings for both teacher and child self-reports and suggests that divorced adoptive parents may downplay behavioral and emotional difficulties in their children. A further, more general methodological consideration is that the association between parental divorce and children's adjustment depends, to some degree, on the source of the information, a point illustrated in the detailed results reported by Amato and Keith (1991). In the current study, connections between divorce and child outcome were observed for child, parent, teacher, and observer reports as well as on standardized tests, but it is possible that different perceptions and method effects explain the diversity of findings within each outcome domain.

Limitations

Several limitations of the study should be highlighted. First, we are unable to identify which of the environmental variables indexed by divorce and that confer risk for maladjustment may be genetically mediated (Hetherington et al., 1998). Unpacking the risk factors indexed by divorce and assessing the degree to which their impact as a mediator between divorce and child adjustment is genetic and/or environmental is clearly a next major step in this line of investigation. Second, because of the limited number of divorced families and the variation in age at which divorces occurred, it was not possible to determine with much certainty whether the adjustment difficulties associated with divorce preceded divorce or whether divorce predicted an increase in children's subsequent adjustment problems (Cherlin et al., 1991). Third, although the adoption study design such as the one used in this report is a powerful natural experiment for testing genetic hypotheses, a number of methodological caveats have been raised that require consideration (Stoolmiller, 1998). However, it is important to weigh the above limitations against the considerable strengths of the current study, including the prospective longitudinal design and the multidomain, multimeasure, and multirespondent assessment strategy.

Conclusions and Implications

Key questions for divorce research no longer center on whether parental divorce increases the likelihood of children's adjustment difficulties. Instead, attention is now focused on the multiple mechanisms by which divorce-related factors confer risk. Recent research findings have been especially provocative in suggesting that significant variation in children's maladjustment in divorced families may be explained by long-standing family conflict, parental maladjustment, and the frequency of parents' relationship transitions (Cherlin et al., 1991; Dunn et al., 1998). The current study sought to integrate the growing list of hypotheses explaining the association between parental divorce and children's adjustment with the increasing developmental emphasis on genetic factors in children's adjustment. Further follow-up of this sample will examine the possible genetic mediation of long-term life-course outcomes associated with divorce, including premature termination of education and the likelihood of divorce in adulthood.

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Received January 11, 1999
Revision received January 19, 2000
Accepted January 19, 2000 ■