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Marital Adjustment as a Moderator for Genetic and Environmental Influences on Parenting

Jennifer A. Ulbricht,

Department of Psychology, The George Washington University

Jody M. Ganiban,

Department of Psychology, The George Washington University

Tanya M.M. Button,

Institute for Behavioral Genetics, University of Colorado at Boulder

Mark Feinberg,

Prevention Research Center, The Pennsylvania State University

David Reiss,

Child Study Center, Yale University

Jenae M. Neiderhiser

Department of Psychology, Pennsylvania State University

Abstract

Family systems theory proposes that the parent-child relationship is embedded within the broader system of the family, and that other family subsystems can influence the dynamics and quality of the parent-child relationship. The current paper examines marital adjustment as a context for the parent-child relationship during adolescence. Specifically, the extent to which marital adjustment moderates child-based genetic and environmental effects on the parent-child relationship was assessed. Data for this study were from the initial wave of the Nonshared Environment in Adolescent Development study (NEAD), and included 720 families with same-sex sibling pairs, ages 10-18 years. A range of sibling and family types was sampled, with 93 MZ, 99 DZ twin pairs, and 95 sibling pairs from non-divorced families and 182 sibling, 109 half-sibling, and 130 unrelated sibling pairs from stepfamilies. Composite measures of marriage (based on parent reports) and parenting (based child and parent reports and observation ratings) were examined. Results indicate that as marital adjustment declines, evocative child effects on parenting increase, while the role of shared family experiences decline. However, the specific impact of marital

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Correspondence concerning this article should be addressed to Jennifer Ulbricht, 9300 DeWitt Loop, River Pavilion, 2nd Floor, Fort Belvoir, VA, 22060, jaulbricht@gmail.com.

Author Note:

Jennifer A. Ulbricht, Department of Psychology, The George Washington University; Jody M. Ganiban Department of Psychology, The George Washington University; Tanya M.M. Button, Institute for Behavioral Genetics, University of Colorado at Boulder; Mark Feinberg, Prevention Research Center, The Pennsylvania State University; David Reiss, Child Study Center, Yale University; Jenae M. Neiderhiser, Department of Psychology, Pennsylvania State University.

Jennifer A. Ulbricht is now at Child and Adolescent Psychiatry Service, Fort Belvoir Community Hospital.

The authors would like to note that these analyses were originally presented as part of a doctoral dissertation (Ulbricht, 2009) and were collected as part of the Nonshared Environment in Adolescent Development study, which has produced numerous other publications.

adjustment on child-based genetic and child-specific nonshared environmental contributions to parenting differed for mothers and fathers. This study identifies a previously unexplored mechanism through which family subsystems influence each other.

Keywords

marriage; parenting; adolescent; family systems

Parenting has been conceptualized as a dynamic, relational process in which parents and children influence each other, rather than something that is “done” to the child (e.g. Belsky, 1984). Research supports the notion that parents socialize children, and that children influence the way they are parented in a transactional model of development (Ganiban, Ulbricht, Saudino, Reiss, & Neiderhiser, 2011; Neiderhiser, Reiss, Lichtenstein, Spotts, & Ganiban, 2007). The parent-child relationship, however, does not exist within a vacuum. Rather, this relationship is embedded within a broader family system in which disturbances or changes in one family relationship can influence the emotional and behavioral dynamics of other family relationships (Bronfenbrenner & Ceci, 1994; Cox & Paley 1997). This principle suggests that family context can play an important role in determining the magnitude of child-based effects on parenting, though the interrelationships among multiple family subsystems are rarely studied. The current study employs a behavioral genetic research design to examine the degree to which the marital relationship moderates the influence of child-based genetic and environmental influences on parenting.

Understanding Child-based Effects on Parenting

The term “child-based effects” refers to children’s influence on the way they are parented. These effects are frequently described as evocative child effects, emphasizing that children’s behavioral characteristics can elicit reactions from parents or alter parenting styles (Steinberg & Silk, 2002). Previous studies have reported significant associations between child temperament and parenting within cross-sectional and longitudinal designs (Rothbart & Bates, 1998). For example, during adolescence, children’s negative emotionality is positively related to parents’ negativity (e.g., Kim, Conger, Lorenz, & Elder, 2001), but inversely associated with mothers’ and fathers’ positive behaviors (Stice & Gonzales, 1998). Children’s behavioral problems are also associated with more negative parenting during adolescence (Burt, McGue, Krueger, & Iacono, 2005). The effects of children’s characteristics can also extend beyond the parent-child relationship and influence the broader family environment. Previous research suggests that parents of children with different developmental disabilities (e.g. Down syndrome, fragile X, autism, intellectual disability) often demonstrate higher levels of daily stress than in families without intellectual or developmental disabilities (Blacher & Hatton, 2007). In turn, this stress may influence parents’ coping, marital adjustment, and the overall socio-economic position of the family (Blacher & Hatton, 2007).

Behavioral genetic research designs have also been used to estimate child-based genetic effects on parenting. These designs include children who vary in regard to genetic relatedness, including identical and fraternal twin pairs, and/or full siblings, half-siblings,

and genetically unrelated siblings. As such, child-based genetic contributions to children's phenotypes can be estimated by determining if siblings' similarities are a function of their genetic similarity (genetic effects) versus environmental similarity (shared environmental effects). The impact of unique experiences that make siblings different from each other can also be estimated (nonshared environmental effects). These analyses can be extended to understand the *source* of child-based effects on parents' behaviors. For example, genetically informed research designs can be used to determine if parents treat siblings similarly because the siblings' genetic makeup makes them behave similarly (genetic effects) or because parents' behaviors are guided by their own interactive styles (shared environmental effects). It is also possible that shared environmental contributions to parenting are present because the siblings' common experiences (e.g., in the community or broader culture) have made them behave similarly. Last, parents may treat siblings differently for reasons that are unrelated to the children's genetically influenced characteristics. These factors may be based upon their relationship history with each sibling individually or each child's individual experiences (nonshared environmental effects). Therefore, research designs that include siblings who vary in regard to genetic relatedness can be used to understand the source of evocative child effects on parenting. However, it is important to note that child-based designs cannot be used to estimate the impact of parents' own genetic makeup or experiences upon the parent-child relationship. Such effects can only be assessed in designs that include adult siblings who vary in regard to genetic relatedness and have their own offspring.

Behavioral genetic research indicates that children's genetic makeup and their environments affect the parenting they receive. Parental negativity, warmth, and support all demonstrate significant child-based genetic, shared and nonshared environmental effects; however, the magnitude of these effects may be influenced by child age (Kendler & Baker, 2007). Specifically, child-based genetic and nonshared environmental contributions to parenting may increase across childhood (e.g., Elkins, McGue, & Iacono, 1997). Consistent with this interpretation, Neiderhiser and colleagues (2004, 2007) found evidence of evocative child-based effects on mothers' and fathers' negativity, and for fathers' warmth during adolescence. In part, these child-based effects during adolescence are explained by the adolescents' temperament characteristics (Ganiban et al., 2011).

Marital Relationship as a Context for Parenting

Family systems and biopsychosocial theories suggest that individuals and family relationships are nested in a hierarchical structure of mutual influence, with the marital relationship often serving as the primary or executive relationship for the family (Cox & Paley, 1997). As such, the quality of the executive relationship can impact the rest of the family system. This concept has been supported in the literature (e.g., Ganiban, et al., 2007; Jockin, McGue, & Lykken, 1996). Generally, higher levels of inter-parental conflict are associated with less-optimal parenting quality (Erel & Burman, 1994; Krishnakumar & Buehler, 2000).

Most previous research, however, has focused upon the main effects of marital adjustment upon parenting. Other mechanisms may be present and account for the interplay between different family subsystems. Specifically, Reiss (1995) hypothesized that one family

relationship could promote or inhibit the expression of genetic and environmental effects within other family relationships. Therefore, marital adjustment could influence the magnitude of child-based genetic and environmental effects on parenting. For example, marital discord could place parents in chronically distressed or angry emotional states. In turn, these states may render parents more sensitive and overreactive to their children's challenging behaviors (e.g., Cummings, Keller, & Davies, 2005). Thus, when marital discord is present, a child who is genetically predisposed to be impulsive, negativistic or aggressive would be more likely to evoke negative parenting than a sibling who demonstrates an easy temperament profile. If so, then heightened marital discord would enhance child-based genetic influences on parenting (e.g., Feinberg, Reiss, Neiderhiser, & Hetherington, 2005). Conversely, the impact of children's genetically influenced characteristics upon parenting may be diminished when there is little marital discord. Within this context, parents with well-adjusted marital relationships may receive more support from their spouse, enabling them to ignore or more-effectively manage their frustration or irritation with aversive child characteristics. This would be expressed as increased shared environmental contributions to parents. Consistent with this latter possibility, studies with families of children with developmental disabilities have found that better marital adjustment predicts lower parenting stress and fewer depressive symptoms for mothers and fathers (Kersh, Hedvat, Hauser-Cram, & Warfield, 2006). Thus, it is plausible that the marital relationship can moderate child-based genetic and environmental effects on parenting.

Previous studies also suggest that social-contextual variables and marital stability may have greater impact on fathers' parenting than mothers' parenting (e.g., Goldberg, Clarke-Stewart, Rice, & Dellis, 2002; Reiss, Neiderhiser, Hetherington, & Plomin, 2000). Additionally, fathering appears to be less influenced by factors like child temperament, partner's parenting skills, and the father's own parenting history than is mothering (e.g., Stoneman, Gavidla-Payne & Floyd, 2006; Woodworth, Belsky, & Crnic, 1996). Last, a series of studies by Neiderhiser and colleagues (2004, 2007) indicates that the mechanisms through which children influence parental warmth may differ for mothers and fathers. Collectively, these findings suggest that the mechanisms that link the marital relationship with the parent-child relationship may be different for mothers and fathers.

Current Study

In the current study we use a gene x environment moderation (GxE) framework, more accurately described in studies like this as moderation of heritability and environmentality, to further understand links between different family relationships. In this framework, the marital relationship represents the environmental context for parenting ("E"), while child-based genetic contributions to parenting represent the "G" in the model. We also explore the degree to which the marital relationship affects shared and nonshared environmental contributions to parenting (CxE or ExE models). Increasingly, researchers have used the GxE framework in exploring psychosocial development and family relationships (e.g., Feinberg, et al., 2005; Ganiban et al., 2011; South, Kruger, Johnson, & Iacono, 2008). Many of these studies have identified changes in genetic and environmental influences on specific phenotypes (e.g., adolescent depression or antisocial behavior) at different levels of a specific environmental context (e.g., parental negativity or monitoring; for a review see

Horwitz & Neiderhiser, 2011). The current study moves the idea of GxE into the realm of family relationships and examines the moderation of child-based genetic and environmental contributions to parenting as a function of the marital relationship. The contributions of environmental and child-based genetic influences on parenting are considered in the context of varying levels of marital adjustment in order to better understand how these two family subsystems – marital and parent-child relationships – may operate together.

By using a sample of adolescents that vary in genetic relatedness, our analytic model examines whether child-based influences on parenting change as a function of interparental conflict and marital adjustment. Furthermore, we examine if these effects are similar for mothers' and fathers' parenting. We hypothesize that higher levels of discord will moderate child-based genetic influences and environmental influences on parenting. Specifically, we propose that when there is poorer adjustment within the marital relationship, parents will be more sensitive and reactive to their children's genetically influenced characteristics (e.g., negative emotionality or aggressiveness). Another possibility is that a parent may single out one child as the "problem child" and treat this child more negatively for reasons that are independent of the child's genetically influenced characteristics. For example, one sibling may simply be more similar to the spouse than the other sibling. This would lead to increased nonshared environmental effects on parenting when there is more marital discord. In contrast, when there is less conflict and better adjustment within the marital relationship, we hypothesize that parents will treat siblings more similarly. This effect would be expressed as higher shared environmental contributions to parenting in the presence of better marital adjustment.

The findings of these analyses have potential implications for family systems theory and, ultimately, intervention programs. Generally, evidence of moderation of the child-based genetic effects on parenting by the marital relationship would support family systems theory which conceptualizes relationships as inter-related. Such results would also contribute to our understanding of differences in families' responses to marital conflict. For example, if child-based genetic effects on parenting increase as a function of interparental conflict, then treatment may consist of helping parents develop effective coping strategies for managing their children's more challenging temperament characteristics.

Methods

Sample

Data for this study were drawn from the initial wave of the Nonshared Environment in Adolescent Development (NEAD) study; participants were recruited through random digit dialing of 10,000 U.S. phone numbers and a national market survey of 675,000 households (Reiss, et al. 2000). The nationwide sample consisted of a total of 720 families with same-sex sibling pairs (48.4% female) ages 10-18 ($M = 14.5 \pm 2.2$), and no more than four years apart in age ($M = 1.61 \pm 1.29$ years). A range of family types was sampled, with 93 MZ, 99 DZ twin pairs, and 95 sibling pairs from non-divorced families and 182 sibling, 109 half-sibling, and 130 unrelated sibling pairs from stepfamilies. Parents gave written consent, and children gave written assent to participate in the study, which was monitored through the Institutional Review Board (IRB) at George Washington University. To ensure that none

of the stepfamilies were in the unstable early phases of family formation, the families were required to be in existence for at least 5 years prior to the first wave of data collection ($M = 8.9 \pm 3.7$ years of marriage). Parents were generally around age 40 years ($M = 38.1$ and $M = 41.0$ for mothers and fathers, respectively) and Caucasian (94% of mothers; 93% of fathers). Parents had a median income of \$25,000-\$35,000 in 1988 and had received at least a high school education (only 7% did not complete high school). Families were interviewed, filled out questionnaires, and were videotaped during two home visits conducted by trained interviewers. In order to determine zygosity, twins were rated for physical similarity (e.g., eye and hair color) with self-reports and interviewer ratings. The questionnaire technique of assigning zygosity has been found to be 90-96% accurate when compared to DNA samples (Spitz, et. al. 1996). Zygosity was unclear for 10 twin pairs in the NEAD sample; therefore, those twin pairs were excluded from all analyses. Detailed descriptions of this study's sample, methods, and measures can be found elsewhere (Hetherington, et al., 1999; Reiss et al., 2000).

Measures

Parenting.—Parental negativity in the NEAD sample was measured by means of five scales completed by both parents and children: the Parent-Child Disagreement, Punitiveness, and Yielding to Coercion Scales of the Parent Discipline Behavior Inventory (Hetherington & Clingempeel, 1992); the symbolic aggression subscale of the Conflict Tactics Scale (Strauss, 1979); and four items from the Parent-Child Relationship Inventory (Hetherington & Clingempeel, 1992) relating to the frequency of conflict and fights. Additionally, observers rated 10-minute videotaped parent-child interaction during a problem-solving discussion task addressing identified issues of disagreement (e.g. bedtime). The interactions were rated on Anger and Rejection, Coercion, and Transactional Conflict using the Global Coding Scale (Hetherington, et al., 1999). The Chronbach's alpha values for parent reports on each subscale ranged from .68 to .90. For child reports on each subscale alphas ranged from .59 to .90, and weighted kappas for observer reports on each subscale ranged from .69 to .74. Factor analyses of all study variables confirmed the inclusion of these subscales in the domain of parent negativity (Plomin, Reiss, Hetherington, & Howe, 1994). Composite ratings of parental negativity were created by standardizing and summing unit weights for all reporters. A separate score was created for each parent-child dyad (i.e. mother-child 1, mother-child 2, father-child 1, father-child 2 etc.) to allow for comparison between siblings. Intercorrelations, validity, and reliability of the resulting measures have been found to be acceptable (alpha's range from .70 - .81); further detail on these measures and composite construction can be found in previous NEAD reports (e.g., Feinberg et al., 2001).

Marital adjustment.—Two constructs addressing aspects of marital quality were used. The first was the Locke-Wallace Marital Adjustment Test (Locke & Wallace, 1987). In previous literature, the Locke-Wallace Total Marital Adjustment scale has been scored such that a higher score indicates more agreement and satisfaction. However, in order to be comparable to the other marital adjustment variable in this study, the scale was reverse scored such that higher scores reflect a more poorly adjusted marriage. Because higher scores reflect overall poorer adjustment, the measure will be referred to as Global Marital Maladjustment for the remainder of the study. Global Marital Maladjustment is a composite

constructed by summing fifteen items that ask the individual to rate aspects of disagreement and the overall quality in their current marriage on a 6-point likert scale. This construct addresses a family-wide quality of the marital relationship that is the same for child 1 and child 2, but varies for each parent. The Chronbach's alpha values for Global Marital Maladjustment were .86 and .84 for mothers and fathers, respectively. The current sample's mean scores of 16 to 17 suggest predominantly well-adjusted, satisfied marriages.

The second marital adjustment scale assesses a child-specific measure of the amount of inter-parental conflict. The Conflict about the Child subscale of the Child Rearing Issues questionnaire determines the amount of conflict between parents about each child (Hetherington & Clingempeel, 1992; Reiss, et al. 2000). Each parent answered 39 questions about the frequency and degree to which they disagreed with their spouse over the previous month about issues pertaining to each child. Mother and father ratings were standardized and summed so that the score reflects combined husband and wife reports of conflict about *each* child. The Chronbach's alpha values for Conflict about the child were .87 and .88.

Analyses

Biometric model.—Biometric models partition phenotypic (P) variance into additive genetic (A), shared environmental (C), and nonshared environmental (E) components: ($Var(P) = A + C + E$). Because the current study includes children who vary in regard to genetic relatedness, additive genetic effects encompass all *child*-based genetic influences on parenting. Examples of genetically influenced traits include aspects of temperament like sociability and irritability. Nonshared environmental effects also reflect child effects on parenting. However, these effects are not genetically based, but relate to child-specific experiences that explain differences in the way parents treat siblings. For example, different attachment histories may contribute to parents' differential treatment (i.e., consistently different levels of positivity and negativity for each sibling). It is important to note however, that estimates of nonshared environmental effects also contain the measurement error. Last, within the current study, shared environmental effects capture experiences siblings have in common that make them similar to each other. In other words, shared environmental effects reflect family-wide influences on parenting of both siblings.

Previous analyses of parent negativity in the NEAD sample (Reiss, et al., 2000; Plomin et al., 1994) found significant genetic, shared environmental, and nonshared environmental influences for both mothers and fathers. Specifically, child-based genetic factors accounted for 59% of variance in maternal negativity, while shared and nonshared environmental factors explained 22% and 18% of the variance, respectively. Likewise, estimates of child-based genetic contributions to negative fathering were 49%, shared environment about 29%, and nonshared environment about 22% (Reiss, et al., 2000). For marital conflict about the child, estimates of child-based genetic contributions to variance were 28%, shared environment 66%, and nonshared environment 6% of variance.

The current study extends previous analyses by examining the degree to which marital adjustment moderates genetic, shared environmental and nonshared environmental contributions to parenting. The specific biometric moderation model used is depicted in Figure 1 (Purcell, 2002). This model controls for the main effect of the moderator

(M, marital adjustment) on the target variable (parenting), and estimates genetic and environmental contributions to the residual variance in parenting. Thus, child-based influences on marriage (which would be gene-environment correlation or r_{GE} in this model) are statistically controlled, and the degree to which marital adjustment moderates genetic and environmental contributions to the remaining variance in parenting is estimated (Purcell, 2002). This residual variance is computed as: $\text{Var}(P) = (a + \beta_X M)^2 + (c + \beta_Y M)^2 + (e + \beta_Z M)^2$, where a =residual additive genetic variance, c =residual shared environmental variance, and e =residual nonshared environmental variance. In this equation the moderating effects of marital adjustment on additive genetic effects is captured by the term $\beta_X M$. Similarly, the moderating effects of marital quality on shared and nonshared environmental effects are accounted for by $\beta_Y M$ and by $\beta_Z M$, respectively.

The biometric moderation model carries several fixed paths and assumptions. First, the path between A for siblings 1 and 2 was set to 1.0 for MZ twins, .50 for DZ twins and full siblings, .25 for half siblings, and 0 for unrelated siblings. These set values reflect the presumed genetic similarities of the different sibling types. Second, the path between C for siblings 1 and 2 was set to 1.0, consistent with the definition of shared environmental effects as common experiences that make siblings similar to each other.

Model fitting.—Genetic and environmental influences have been found to vary by child age and gender; therefore, prior to model fitting, the effects of sibling age difference, child age, child gender, and the interaction of child age and gender were residualized from marital adjustment and parenting measures using Proc Reg in SAS 9.1. The data were then standardized and output into raw data files for modeling in Mx, a structural equation model-fitting package (Neale, Boker, Xie, & Maes, 2003). The full model estimates seven parameters that relate to: the main effect of marital conflict (β_M) on parent negativity, the linear contributions of a , c , and e to residual variance; and moderation terms for a , c , and e (β_X , β_Y , β_Z). The significance of each parameter can be tested by comparing the fit (-2Log Likelihood ; $-2LL$) of the full model to that of nested models in which each parameter is sequentially dropped. The difference in $-2LL$ for nested models follows a χ^2 distribution. A significant worsening of model fit ($p > .05$) when dropping a path indicates that the path or term is statistically significant and should be kept in the final model.

Results

Means and standard deviations and intercorrelations amongst the study variables are reported in Table 1. All correlations were significant ($p < .0001$) and similar in magnitude and direction for mothers and fathers. Marital conflict and maladjustment are positively correlated with negative parenting. These correlations, however, provide no information about the underlying genetic and environmental mechanisms that link the marital relationship with the parent-child relationship.

Biometric Modeling

The next set of analyses examined the extent to which the marital relationship moderates child-based genetic and environmental contributions to parenting. In all, four sets of analyses were conducted. In the first set, the full moderation model included Global Marital

Maladjustment as the moderator of genetic and environmental contributions to maternal negativity (Table 2; Model A). The next set of analyses examined Marital Conflict About the Child as a moderator of genetic and environmental contributions to maternal negativity (Table 2; Model B). The third and fourth sets of analyses, found in Table 3, focused on the extent to which Global Marital Maladjustment (Model C) or Marital Conflict About the Child (Model D) moderated genetic and environmental contributions to fathers' negativity. Tables 2 and 3 summarize the fits and parameter estimates for the most parsimonious of each of the models, in addition to the relative fits of nested models that set specific terms to "0". For all models, path estimates β_M , a , c , and e were statistically significant. However, the moderation effects varied by marital dimension and by parent. The specific results are described below.

Mothers.—As summarized in Table 2 (Model A), when Global Marital Maladjustment was included in the model as the moderator, the moderation terms for shared and nonshared environmental effects could be set to '0' without any worsening of model fit. However, the moderation term for additive genetic effects was statistically significant. Consequently, the most parsimonious model was the $ace-\beta_X$ model. The unstandardized parameter estimates for this model are also summarized in Table 2, and these estimates were used to compute genetic (Var_A), shared environmental (Var_C), and nonshared environmental (Var_E) variance in mothers' negative parenting at different levels of Global Marital Maladjustment presented in Table 4. In these computations: $Var_A = (a + \beta_X M)^2$, $Var_C = (c + \beta_Y M)^2$, and $Var_E = (e + \beta_Z M)^2$, where M is the level of the moderator. The values of Var_A , Var_C , and Var_E at levels of Global Marital Maladjustment at 1 standard deviation (SD) below to 1 SD above the sample mean are depicted in Figure 2a and in Table 4. The line graphs provide a visual representation of how each contribution to parenting changes within the context of marital discord. As marital dissatisfaction increased, the total variance in maternal negativity increased due to an increase in the absolute contributions of genetic factors. When mothers' rating of marital maladjustment was 1 SD above the mean, additive genetic factors explained 67% of the variance of maternal negativity, i.e., $Var_A / (Var_A + Var_C + Var_E) = (0.71/1.06)$. Additive genetic factors, however, explained 58% of the variance in maternal negativity when mothers reported marital maladjustment scores 1 SD below the sample mean (i.e., $0.49/.84$). In contrast, the relative importance of shared environmental and nonshared environmental factors declined slightly from low to high levels of mothers' marital maladjustment. These standardized estimates are presented in Table 4.

When Conflict about the Child was included in the model as M , only the moderating term for c (β_Y) was statistically significant (see Table 2). The unstandardized parameter estimates for the $ace-\beta_Y$ model are summarized in Table 2, and were used to estimate Var_A , Var_C , and Var_E at different levels of Conflict. As illustrated in Figure 2b, as marital conflict about the child increased, the absolute value of shared environmental factors (Var_C) decreased. Even though the moderation terms for A and E were non-significant and their absolute values did not change, as Var_C declined at higher levels of Conflict about the Child, the relative importance of additive genetic and nonshared environmental factors to maternal negativity increased. Specifically, genetic factors accounted for 75% of the variance in maternal negativity when mothers' reported conflict levels 1 SD above the sample mean,

and 54% of the variance when they reported conflict levels 1 SD below the sample mean. Nonshared environmental factors explained 24% of the variance in maternal negativity when marital conflict was 1 SD above the mean, and 17% at 1 SD below the mean (Table 4).

Fathers.—Model fitting for fathers' negative parenting with global marital maladjustment as M revealed significant moderation of the shared environmental and nonshared environmental contributions to father negativity (see Table 3). Unstandardized estimates for the $ace-\beta_Y\beta_Z$ model are presented in Table 3, and were used to estimate Var_A , Var_C and Var_E at different levels of global marital maladjustment. As depicted in Figure 2c, the absolute and relative magnitude of shared environmental influence (Var_C) decreased in the context of increasing marital maladjustment, while absolute and relative magnitude of nonshared environmental influence (Var_E) increased. When fathers reported marital maladjustment levels 1 SD above the sample mean, nonshared environmental factors explained 43% of the variance in paternal negativity, while shared environmental factors explained 7% of the variance. However, when fathers reported marital maladjustment levels 1 SD below the sample mean, nonshared environmental factors explained 19% of the variance in paternal negativity, while shared environmental effects accounted for 28%. Likewise, the influence of nonshared environmental factors increased from 19% at the lowest maladjustment levels to 43% of the residual variance at the highest levels of maladjustment.

For fathers' negative parenting in the context of marital conflict about the child, the most parsimonious model indicated significant moderation of the nonshared environmental factor ($ace-\beta_Z$; see Table 3). Unstandardized estimates for this model are presented in Table 3. These estimates were used to compute the absolute contributions of genetic and environmental factors to parenting as a function of marital conflict based. As depicted in Figure 2d, nonshared environmental factors explained relatively more variance in paternal negativity when fathers reported levels of conflict 1 SD above the sample mean (36%), than when they reported levels 1 SD below the sample mean (20%). The absolute magnitude of additive genetic and shared environmental variance did not change. However, these factors explained proportionately less variance in father negativity as marital conflict increased. Specifically, when fathers reported conflict levels 1 SD below the sample mean, genetic and shared environmental factors respectively accounted for 45% and 35% of variance in father negativity. At 1 SD above the sample mean for marital conflict, genetic and shared environmental factors respectively accounted for 36% and 28% of variance in father negativity.

Discussion

Previous research suggests that the quality of the marital relationship has an impact upon parenting (Erel & Burman, 1995; Krishnakumar & Buehler, 2000). In the current study, moderate correlations were again found between negative parenting and marital adjustment such that greater maladjustment and conflict was associated with more negative parenting. In addition, marital conflict about the child was more highly correlated with negative parenting than was general marital maladjustment. The central question of this study, however, was whether marital adjustment alters the magnitude of child-based genetic or environmental influences on parenting, beyond any shared variance between marriage and parenting. In

each model tested, child-based genetic, shared environmental, and nonshared environmental factors accounted for variance in mothers' and fathers' negativity. In addition, the magnitude of genetic and environmental contributions varied for mothers and fathers, and depended on the specific marital dimension examined.

For fathers, the absolute and relative contributions of nonshared environmental influences on variability in negative parenting increased with higher levels of marital maladjustment and marital conflict about the child. Furthermore, when there were higher levels of marital conflict about the child, shared environmental contributions to fathers' negativity were lower than when there were lower levels of marital conflict about the child. This pattern of findings suggests that nonshared environmental effects on father negativity increase in the presence of interparental conflict. There are several potential explanations for such a finding. As previously described, one possibility is when there are high levels of marital discord, fathers may increase positive attention to the child perceived to be least problematic, while directing more negative attention to a child perceived as difficult—a dynamic similar to “parental salvaging” (Reiss & Neiderhiser, 2000). The designation of a specific child as the “problem child” may be influenced by as the unique relationship history between a father and each child or for reasons that are independent of the child, e.g., the child is more physically similar to the spouse. This interpretation is consistent with previous research that suggests that fathers are more affected by environmental factors than mothers (Goldberg, Clarke-Stewart, Rice, & Dellis, 2002; Reiss, et al., 2000). In contrast to these findings, analyses indicated that the absolute magnitude of the genetic effects on fathers' negativity remained steady across all levels of marital maladjustment and conflict. This finding suggests that fathers are equally sensitive and responsive to their children's genetically influenced characteristics both in the presence and absence of marital conflict.

For mothers, the absolute and relative contributions of child-based genetic factors to mothers' negativity were greater at higher levels of global marital maladjustment. In addition, consistent with findings for fathers, the absolute contribution of shared environmental factors to variance in mothers' negativity decreased with higher levels of marital conflict about the child. This pattern suggests that when their marriages are under stress, mothers are more sensitive to their children's genetically influenced characteristics, and less influenced by a mother's general tendencies (e.g., personality) or by family-wide factors (e.g., socioeconomic status or culture). It may be that children's genetically influenced characteristics become more salient to mothers than family-wide norms when the marriage is distressed. For example, stress may increase parent overreactivity, leading mothers to act more harshly towards temperamentally difficult children (e.g., Fish & Crockenberg, 1981). The tendency for mothers, but not fathers, to become more attuned to children's genetically influenced characteristics is also in keeping with previous research that indicates that fathers are less influenced by their children's temperament than mothers (Stoneman, Gavidia-Payne & Floyd, 2006; Woodworth, Belsky, & Crnic, 1996). Results of this study further suggest that marital discord may enhance this difference.

In summary, results suggest that mothers and fathers become more sensitive and reactive to their children's individual characteristics (i.e. evocative behavior) when in the context of marital conflict. However, mothers and fathers react to marital distress in different ways

that may have different implications for parenting. As marital distress increases, mothers' negative parenting appears to be more driven by genetically influenced child characteristics, while fathers' negative parenting is increasingly influenced by nonshared environmental factors. The reasons for these differences between mothers and fathers are unclear, but are generally consistent with previous research.

Despite specific differences, the broad picture of how the marital relationship moderates environmental influences on parental negativity is similar for mothers and fathers. All findings are consistent with an evocative model of parenting in that child-based genetic characteristics and environmental factors can affect the parenting the child receives, and some of these effects are enhanced in the context of marital maladjustment and conflict. These findings are also consistent with a family systems model which proposes that family subsystems influence each other. In recent studies of adolescent twins and their families, Ganiban and colleagues (2011) found that genetic and/or environmental influences on the parent-child relationship varied as a function of several different aspects of a child's personality. Thus, adolescent personality and family relationships reinforce one another through bidirectional processes. The current study expands these findings by illustrating the impact of the marital relationship on the parent-child relationship.

Last, the absolute contributions of shared environmental factors to parenting were moderated by different marriage variables for mothers and fathers. However, it should be noted that the relative contributions of shared environmental factors to both mothers' and fathers' negative parenting declined as marital maladjustment and conflict about the child increased. Thus, across all models tested, we found that higher levels of marital stress were associated with increased sensitivity of parental negativity to children's characteristics and diminished sensitivity to either family-wide factors (e.g., family climate, community, and culture) or a parent's own general tendencies which contribute to shared environmental factors. This finding is also consistent with previously reported increases in differential parenting in times of marital stress (Kan, McHale, & Crouter, 2008).

There are several limitations to the current study that are important for interpretation of these results as well as providing guides for future research. First is the cross-sectional nature of the data presented here; because concurrent measures of parenting and marital adjustment are utilized, directionality cannot be conclusively stated. Though directionality is inferred theoretically through the frame of the marital relationship as primary to the parent-child relationship in the family system, it cannot be ruled-out that the influence travels in both directions. Negativity in the parent-child relationship may be driving the changes in marital adjustment (particularly in the case of child-specific conflict). Relatedly, the origins of shared and nonshared environmental contributions to parenting are unclear. Consistent with the child effects model, environmental contributions could be explained by children's characteristics that have been shaped by the environment. However, they could also reflect the impact of factors unrelated to the child such as culture or, perhaps, the parents' personality and general social interactive styles. Obtaining repeated measures throughout development would help to more clearly establish a causal chain of influence. Furthermore, though the current study's sample size is large and contains the full range of

genetic relatedness among siblings, more nuanced analyses of the genetic and environmental interplay within family relationships may be possible with an even greater sample size.

Another potential limitation is that the current study included never divorced families and families who have experienced divorce. Research has suggested that there are qualitative and quantitative differences in the effect of marital discord on children for married families vs. divorced families such that the effect size for marital discord on child adjustment is 2/3 larger for married families (Krishnakumar & Buehler, 2000). As a consequence, marital history may also moderate the impact of child based effects on parenting. Likewise, research has indicated that the effects of interparental discord may differ based on race/ethnicity and socioeconomic status: the families in the NEAD sample were predominantly white, European American, and middle class. Finally, the current study uses a child-based design and thus examines the changing influence of the child's genetic and environmental factors on negative parenting. Such designs cannot be used to estimate the impact of parent-based genetic factors on parenting, and a parent-based design may yield additional information.

Clinical Implications

Many studies examining the effects of marriage do so in the context of the impact on child adjustment, and findings generally report an association between marital discord and child behavior problems (for review see Cummings & Davies, 2002). For example, Kacyznski, Lindahl, Malik, and Laurenceau (2006) found that the impact of parental conflict on child externalizing was completely mediated by measures of parenting behavior. The current study provides an important additional perspective to clinical thinking. Clinicians should be alert to a potential negative cycle in family dynamics: marital distress not only has serious implications for the physical and mental well-being of the spouses, but it may also lead them to be more sensitive to evocative effects of the children. Such sensitivity of negative parenting to differences between children may lead to increased differential parenting, scapegoating, and other divisive family dynamics, that may in turn lead to increased family conflict. It is also possible that parents' heightened reactivity to children's characteristics may feed back into the marital problems. For example, in a sample of families with children with disabilities, Stoneman and colleagues (2006) found that mothers (but not fathers) viewed the marital relationship as more positive when fathers engaged in more problem-focused coping strategies. Thus, for the clinician, an important point of entry into this cycle may be to help parents more effectively monitor not only their responses to one another but also to the evocative behaviors of their children. For instance, when addressing a family in treatment, the clinician may find it useful work with the mother on managing reactions to each child's temperament or personality, with the father on managing response to the children's peer interactions, and with the both parents on employing parenting skills motivated by their own goals and childrearing principles, rather than by the fluctuations of children's behavior.

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Figure 1:

Path diagram for the GxE interaction model: a, c, and e= unmoderated genetic, common environment, and nonshared environment components; β_X , β_Y , and β_Z = moderated components of a, c, and e, respectively. β_M = main effect of the moderator; μ = grand mean; M= level of moderator variable (marital adjustment). Correlations between genetic terms (A) is assumed to be $r = 1$ for MZ twins, $r = .5$ for DZ twins and full siblings, $r = .25$ for half siblings, and $r = 0$ for unrelated step-sibling. Correlations between shared environmental terms (C) are 1.0 for all sibling types.

a. Mothers' Negative Parenting and Global Marital Maladjustment

b. Mothers' Negative Parenting and Marital Conflict About the Child

c. Fathers' Negative Parenting and Global Marital Maladjustment

d. Fathers' Negative Parenting and Marital Conflict about the Child

Figure 2:

Unstandardized contributions of genetic (A), shared environmental (C), and nonshared environmental (E) influences to variance in negative parenting graphed as a function of increasing standard deviations of marital quality. Total residual variance is amount of variance in negative parenting not accounted for by main effects of the moderator variable (marital quality).

Table 1.

Sample size (N), Mean, Standard Deviation (sd), and Intercorrelations* between Study Variables for Mothers and Fathers

Variable	N	M	SD	Correlation					
				1	2	3	4	5	
Mothers									
1. Negative Parenting of C1	686	−0.02	2.18	--					
2. Negative Parenting of C2	679	−0.01	2.13	.49	--				
3. Marital Conflict about C1 **	701	0.00	1.62	.46	.26	--			
4. Marital Conflict about C2	701	0.00	1.59	.29	.35	.76	--		
5. Global Marital Maladjustment	716	16.74	7.71	.21	.23	.17	.19	--	
Fathers									
1. Negative Parenting of C1	678	−0.01	2.10	--					
2. Negative Parenting of C2	683	−0.01	2.06	.48	--				
3. Marital Conflict about C1 **	701	0.00	1.62	.41	.26	--			
4. Marital Conflict about C2	701	0.00	1.59	.25	.36	.76	--		
5. Global Marital Maladjustment	718	17.06	7.23	.18	.25	.17	.18	--	

* all correlation values are significant at $p < .01$ level

** Marital conflict about each child combines both mother and father report, thus mothers and fathers have the same Sample Size, mean, and standard deviation.

Table 2.

Fit Statistics for full ACE and nested moderation models for Mother Negativity, and Marital Maladjustment and unstandardized path estimates for final models.

Model A: Moderator: Global Marital Maladjustment								
Final Model Estimates								
Model Tested	-2LL	df	-2LL	df	p	Path	Estimate	95%CI
ace- β_X β_Y β_Z - β_M	3556.83	1342	--	--		a	0.77	0.69-0.85
ace- β_Y β_Z - β_M	3562.61	1343	5.78	1	.02 *	c	0.41	0.27-0.52
ace- β_X β_Z - β_M	3556.88	1343	0.05	1	.83	e	0.43	0.38-0.50
ace- β_X β_Y - β_M	3559.08	1343	2.25	1	.13	β_X	0.07	0.02-0.13
ace- β_X β_Y β_Z	3603.24	1343	46.41	1	.00 *	β_Y	[0]	[0]
<i>ace- β_X -β_M</i>	<i>3559.29</i>	<i>1344</i>	<i>2.46</i>	<i>2</i>	<i>.29</i>	β_Z	[0]	[0]
						β_M	0.23	0.16-0.29
Model B: Moderator: Marital Conflict About the Child								
ace- β_X β_Y β_Z - β_M	3366.81	1322	--	--	--	a	.74	0.68-0.80
ace- β_Y β_Z - β_M	3370.43	1323	3.63	1	.06	c	.23	0.09-0.34
ace- β_X β_Z - β_M	3372.49	1323	5.69	1	.02 *	e	.41	0.36-0.47
ace- β_X β_Y - β_M	3372.17	1323	0.37	1	.54	β_X	[0]	[0]
ace- β_X β_Y β_Z	3496.28	1323	129.47	1	.00 *	β_Y	-0.32	-0.43- -0.17
<i>ace- β_Y -β_M</i>	<i>3370.65</i>	<i>1324</i>	<i>3.85</i>	<i>2</i>	<i>.15</i>	β_Z	[0]	[0]
						β_M	.41	0.35-0.47

Abbreviations: a, c, and e= residual genetic, shared, and nonshared environmental components; β_X , β_Y , and β_Z = moderated components of a, c, and e; -2LL = fit statistic; M=moderator; -2LL= difference in 2LL between the nested and full model. Final models indicated with bold italics.

* denotes and significant worse fit than the full model ($p < .05$).

Table 3.

Fit Statistics for full and nested moderation models for Father Negativity, and Marital Maladjustment and unstandardized path estimates for final models.

Model C: Moderator: Global Marital Maladjustment									
Final Model Estimates									
Model	-2LL	df	-2LL	df	p	Path	Estimate	95%CI	
ace- $\beta_X \beta_Y \beta_Z - \beta_M$	3570.91	1336	--	--	--	a	0.72	0.61-0.81	
ace- $\beta_Y \beta_Z - \beta_M$	3571.06	1337	0.15	1	.70	c	0.39	0.19-0.54	
ace- $\beta_X \beta_Z - \beta_M$	3577.40	1337	6.49	1	.01	e	0.49	0.42-0.58	
ace- $\beta_X \beta_Y - \beta_M$	3585.15	1337	14.25	1	.00	β_X	[0]	[0]	
ace- $\beta_X \beta_Y \beta_Z$	3583.19	1337	12.28	1	.00	β_Y	-0.13	-0.22- -0.05	
ace- $\beta_Y \beta_Z - \beta_M$	3571.06	1337	0.15	1	.70	β_Z	0.17	0.11-0.24	
						β_M	0.14	0.06-0.21	
Model D: Moderator: Marital Conflict About the Child									
ace- $\beta_X \beta_Y \beta_Z - \beta_M$	3334.69	1316	--	--	--	a	0.59	0.46-0.68	
ace- $\beta_Y \beta_Z - \beta_M$	3336.19	1317	1.50	1	.22	c	0.52	0.43-0.60	
ace- $\beta_X \beta_Z - \beta_M$	3334.70	1317	0.004	1	.95	e	0.49	0.43-0.57	
ace- $\beta_X \beta_Y - \beta_M$	3339.99	1317	5.30	1	.02 [*]	β_X	[0]	[0]	
ace- $\beta_X \beta_Y \beta_Z$	3505.32	1317	170.63	1	.00 [*]	β_Y	[0]	[0]	
ace- $\beta_Z - \beta_M$	3338.17	1318	3.48	2	.18	β_Z	0.09	0.04-0.13	
						β_M	0.44	0.38-0.50	

Abbreviations: a, c, and e= residual genetic, shared, and nonshared environmental components; β_X , β_Y , and β_Z = moderated components of a, c, and e; -2LL = fit statistic; M=moderator; -2LL= difference in 2LL between the nested and full model. Final models indicated with bold italics.

* denotes and significant worse fit than the full model ($p < .05$).

Table 4.

Unstandardized and standardized estimates of the contributions of genetic (A), shared (C), and nonshared environmental (E) contributions to parent negativity as a function of marital adjustment.

Marital adjustment variable	Dependent Variable: Mother Negativity- Model A						
	Variance components				Proportions of variance		
	Var _A	Var _C	Var _E	Total residual variance	A	C	E
Mothers' global marital maladjustment							
-1	0.49	0.17	0.18	0.84	58%	20%	21%
-0.5	0.54	0.17	0.18	0.89	61%	19%	20%
0	0.59	0.17	0.18	0.94	63%	18%	19%
0.5	0.65	0.17	0.18	1.00	65%	17%	18%
1	0.71	0.17	0.18	1.06	67%	16%	17%
Mother Negativity- Model B							
Mothers' conflict about the child							
-1	0.55	0.30	0.17	1.02	54%	29%	17%
-0.5	0.55	0.15	0.17	0.87	63%	17%	20%
0	0.55	0.05	0.17	0.77	71%	6%	22%
0.5	0.55	0	0.17	0.72	76%	0%	24%
1	0.55	0.01	0.17	0.73	75%	1%	24%
Father Negativity- Model C							
Fathers' global marital maladjustment							
-1	0.52	0.27	0.18	0.97	54%	28%	19%
-0.5	0.52	0.21	0.23	0.96	54%	22%	24%
0	0.52	0.15	0.24	0.91	57%	16%	26%
0.5	0.52	0.11	0.25	0.88	59%	13%	28%
1	0.52	0.07	0.44	1.03	50%	7%	43%
Father Negativity- Model D							
Fathers' conflict about the child							
-1	0.35	0.27	0.16	0.78	45%	35%	20%
-0.5	0.35	0.27	0.20	0.82	43%	33%	24%
0	0.35	0.27	0.24	0.86	41%	31%	28%
0.5	0.35	0.27	0.29	0.91	38%	30%	32%
1	0.35	0.27	0.34	0.96	36%	28%	36%