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Angry Responses to Infant Challenges: Parent, Marital, and Child Genetic Factors Associated with Harsh Parenting

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Abstract

This study examined genetic and environmental influences on harsh parenting of 9-month-olds. We examined whether positive child-, parent-, and family-level characteristics were associated with harsh parenting in addition to negative characteristics. We were particularly interested in examining evocative gene-environment correlation (*r*GE) by testing the effect of birth parent temperament on adoptive parents' harsh parenting. Additionally, we examined associations among adoptive parents' own temperaments, their marital relationship quality, and harsh parenting. Adoptive fathers' (but *not* adoptive mothers') harsh parenting was inversely related to an index of birth mother positive temperament (reward dependence), indicating evocative *r*GE. Higher marital quality was associated with less harsh parenting, but only for adoptive fathers. Adoptive parents' negative temperamental characteristics (harm avoidance) were related to hostile parenting. Findings suggest the importance of enhancing positive family characteristics in addition to

mitigating negative characteristics, as well as engaging multiple levels of the family system to prevent harsh parenting.

Children have the potential to evoke strong positive and negative affective responses from parents, which then influence and organize caregiving behavior (Dix, 1991). All young children demonstrate challenging behaviors, such as prolonged crying that may be difficult to soothe, uncooperativeness with bathing or dressing, or difficulty with eating or sleeping. The degree to which parental negative emotion is evoked by these challenges and expressed in interactions with children is often characterized as harsh or overreactive parenting. Harsh parenting is a function of a complex interplay of risk and protective factors that operate at multiple levels of the family system (i.e., characteristics of the parent, child, and family environment; Belsky, 1984; Boivin et al., 2005; DiLalla & Bishop, 1996; Neiderhiser et al., 2004, 2007; Towers, Spotts, & Neiderhiser, 2002).

The long-term maladaptive developmental outcomes associated with harsh, negative parenting during infancy (Bayer, Ukoumunne, Mathers, Wake, Abdi, & Hiscock, 2012; Bradley & Corwyn, 2008; Lorber & Egeland, 2009) underscore the need for improved understanding of risk and protective factors associated with early harsh parenting. The current study aims to extend on the research on harsh parenting in infancy in two ways. First, although risk factors for early harsh parenting are well documented, we know little about factors that buffer parents from harsh parenting during infancy; this study examines independent and differential effects of positive and negative characteristics on harsh parenting. Second, although interest in child effects on parenting, including harsh parenting, has been present in the field for decades (Bell, 1979; Bell & Chapman, 1986; Rutter et al., 1997) we know very little about the degree to which the effects found in the literature truly reflect *evocative* effects of infants' genetically influenced characteristics. The current study used an adoption design to test the hypothesis that genetically influenced temperamental characteristics of 9-month-olds would influence adoptive parents' harsh parenting.

Previous research has identified many correlates of harsh parenting, including negative characteristics of the parent (e.g., maternal depression; Lovejoy, Graczyk, O'Hare, & Neuman, 2000), family (e.g., marital hostility, Rhoades et al., 2011), and child (e.g., difficult temperament, Plomin, Loehlin & DeFries, 1985; poor regulation, Bridgett et al., 2009). Previous research has identified risk factors for harsh parenting, but very little is known about how positive parent, child, and family characteristics might mitigate it. For example, a positive marital relationship could buffer the impact of high levels of depressive symptoms on parenting, and thus have implications for prevention and intervention efforts. The current study examined positive *and* negative parent, child, and family factors in association with harsh parenting.

A second emphasis centered on understanding the role of infants' genetically influenced characteristics on harsh parenting. Much of the previous work on child effects on parenting has examined child temperament. In general, child positivity is related to positive parenting, while child negativity is related to negative parenting (Putnam, Sanson, & Rothbart, 2002; Wilson & Durbin, 2012). However, the general lack of genetically sensitive designs in this research makes it impossible to determine whether these associations exist because (1) harsh

parenting *leads to* negative child characteristics, (2) specific child characteristics *evoke* harsh parenting (evocative gene-environment correlation, *r*GE; Plomin, Loehlin & DeFries, 1977; Scarr & McCartney, 1983) or (3) children and parents *share* genes that contribute to *both* parenting and temperament (passive gene-environment correlation). Therefore, genetically-sensitive research designs are needed to disentangle these influences to understand specific *mechanisms* underlying relations between child characteristics and parent behavior.

Methodological Challenges

Despite the potential for research on gene-environment correlation to improve the field's understanding of risk and the development of psychopathology, this process has not been widely studied (Knafo & Jaffee, 2013). This may be partially due to the challenges inherent in studying *r*GE: because genetic and environmental influences are confounded in most biological families, special study designs must be used. Adoption designs enable researchers to distinguish evocative from passive *r*GE because children are raised by parents to whom they are not genetically related (if there is any contact between birth parents and adopted children, the amount of contact can be statistically controlled). Consequently, birth parents' characteristics may be used as indices of children's genetically influenced predispositions, while adoptive parent and family-level (e.g. marital quality) characteristics are used to assess children's rearing environments. Relations between measures of adoptive parent characteristics, adoptive family environment, and parenting indicate environmentally-mediated associations, while relations between measures of birth parent characteristics and adoptive parents' parenting indicate evocative *r*GE.

Child Genetic Characteristics as an Influence on Parenting

Although most of the previous research on evocative *r*GE on parenting has been conducted with older children and adolescents (Burt, McGue, Krueger, & Iacono, 2005; Ge et al., 1996; Klahr, Thomas, Hopwood, Klump, & Burt, 2013; Narusyte et al., 2008; Neiderhiser et al., 2004; Neiderhiser et al., 2007; O'Connor, Deater-Deckard, Fulker, Rutter, & Plomin, 1998; Oppenheimer, Hankin, Jenness, Young, & Smolen, 2013), some evidence for evocative *r*GE on parenting during early development exists. Twin studies have shown that children's genetically influenced characteristics predict hostile parenting in mothers of 5- and 30- month-olds (Boivin et al., 2005; Forget-Dubois et al., 2007) and use of corporal punishment with 5-year-olds (Jaffee et al., 2004). The nature of the twin design, however, does not rule out passive *r*GE like adoption designs can. Examination of evocative *r*GE from the Colorado Adoption Project revealed a greater-than-chance number of statistically significant associations between birth mother characteristics (personality, IQ, and psychopathology) and various aspects of the adoptive family rearing environment (e.g., parenting, availability of developmentally-appropriate toys) when infants were 12 and 24 months old (Plomin & DeFries, 1985; Plomin, DeFries, & Fulker, 1988). Deater-Deckard and O'Connor (2000) found evidence for evocative *r*GE on dyadic mutuality, measured as parent-child cooperation and shared positive emotion, between parents and their 3-year-olds by integrating results across twin, biological, and adoptive sibling samples. In families with slightly older children, birth mother ADHD symptoms predicted more hostile parenting with

6-year-old adopted children; this association operated through child impulsivity (Harold et al., 2013). There is also molecular genetic evidence for evocative *rGE* on early parenting: a series of papers from the Durham Child Health and Development Study show that infants and toddlers carrying the “risk” alleles of dopamine receptor polymorphisms types 2 and 4 (DRD2 and DRD4) are associated with the receipt of less sensitive parenting from early infancy through toddlerhood (Mills-Koonce et al., 2008; Propper et al., 2007; Propper et al., 2012). The associations between children’s DRD2/DRD4 and parenting were independent of the effect of maternal DRD2/DRD4 on parenting, confirming the presence of evocative (not passive) *rGE*. Hayden and colleagues (Hayden et al., 2010), showed similar results with a sample of preschoolers (3- to 4-year-old children with the DRD2 “risk” allele received less supportive parenting). However, because the Hayden et al. study did not control for the parents’ genotypes, their findings may have been at least partially due to passive *rGE*.

In sum, previous research suggests that evocative *rGE* operates on parenting in early childhood, but few studies test it directly. This may be due to the methodological challenges of conducting this type of work. One goal of the current study was to extend this research by examining evocative child effects on harsh parenting within the context of an adoption design. We measured associations between dimensions of birth mother temperament and adoptive parents’ reports of harsh parenting in response to challenges with their 9-month-old adopted infants. A statistically significant association between these birth and adoptive parent variables would suggest (1) that birth parents transmitted a genetic predisposition for a certain type of temperament to their infant, and (2) when this predisposition was expressed by infants via behavior or emotionality, it evoked specific types of responses from the adoptive parents.

Because examining child gene-environment correlation on parenting with this approach assumes that a measure of adult temperament (of the birth parent) is relevant to child behavior (of the adopted infant), selecting developmentally sensitive measures is important. We used Cloninger’s dimensions of temperament, which are theorized to be present in early childhood and throughout adulthood (Cloninger, 1993). Due to our interest in identifying positive factors that might mitigate the hostile parenting of infants, we were particularly interested in examining Cloninger’s dimension of *reward dependence* in birth parents. Reward dependence refers to sensitivity to reward and manifests as a tendency toward social attachment, responsiveness to interpersonal signals, emotional warmth, sympathy, and an eagerness to help others (Cloninger, 1987; Cloninger, Svrakic, & Przybeck, 1993). Adaptations of measures of reward dependence to youth suggest that this temperamental construct exists as early as two years of age and is highly correlated ($r > .70$) with well-validated measures of child sociability (Constantino, Cloninger, Clarke, Hashemi & Przybeck, 2002). Adoptive parents were expected to be less reactive in the context of challenging parenting situations if they perceived their baby as generally positive and interactive.

To more rigorously test the unique effect of positive characteristics on parenting, we also examined a negative characteristic. Specifically, we examined the effect of birth parent-reported harm avoidance (an estimate of genetically-influenced infant negative temperament) on adoptive parent harsh parenting. Individuals high in harm avoidance are

fearful, cautious, and negativistic, and tend to be inhibited and shy in social situations (Cloninger, 1987; Cloninger, Svrakic, & Przybeck, 1993). In early childhood, harm avoidance is highly correlated with measures of infant negative emotionality and shyness (r 's = .57 & .82, respectively; Constantino et al., 2002). We reasoned that stronger support for protective factors would be made if positive infant characteristics were predictive of harsh parenting even in the presence of negative characteristics in the model.

Parent- and Family-Level Influences on Parenting

Even when focusing on evocative child effects on parenting, it is critical to remember that parents' own characteristics affect the family system. Belsky's (1984) classic paper on the determinants of parenting behavior emphasized parent characteristics and environmental sources of stress and support, in addition to child characteristics, as critical contributors to parenting behavior. Parent personality is one characteristic noted by Belsky (1984) as an important influence on parenting quality, and a wealth of empirical work supports this expectation. A meta-analysis (Prinzle, Stams, Dekovic, Reijntjes, & Belsky, 2009) of 30 studies examining the links between Big Five personality traits and parenting behavior concluded that higher levels of parent agreeableness and openness and lower levels of neuroticism were associated with greater parental warmth, behavioral control, and autonomy support. Additionally, higher levels of extraversion and conscientiousness were associated with greater warmth and behavioral control (Prinzle et al., 2009). Although the meta-analysis spanned families in infancy to the late teenage years, it showed that the associations between agreeableness and neuroticism and warmth were stronger for younger than older children (Prinzle et al., 2009). Consistent with this finding, studies of families with toddlers have shown that parental extraversion and neuroticism are associated with more parent responsiveness (Wilson & Durbin, 2012) and more intrusive/directive parenting (Smith, 2010), while higher levels of extraversion and openness to experience are related to more use of symbolic play (Bornstein, Hahn, & Haynes, 2011). As for harsh parenting in particular, a recent meta-analysis showed that more hostile-coercive parenting of infants, preschoolers, and school-aged children was associated with greater parental neuroticism/trait negative affect and less parental extraversion/trait positive affect (Rueger, Katz, Risser, & Lovejoy, 2011). To examine the effects of adoptive parents' own personality on their angry responses to infants, we examined adoptive mothers' and fathers' self-reports of reward dependence (comparable to extraversion and trait positive affect) and harm avoidance (comparable to neuroticism and trait negative affect). In accordance with previous research, we expected higher levels of harsh parenting to be associated with greater harm avoidance and lower reward dependence.

Another important contributor to parenting behavior is the quality of the marital relationship. Regardless of child age, more harmonious marriages are associated with more sensitive and developmentally appropriate parenting, while strained spousal relationships are likely to co-occur with parenting that is intrusive, insensitive, and ineffective (see Erel & Burman, 1995 for a review; Cummings & Davies, 2002; Gable et al., 1992; Harold et al., 2013; Stover et al., 2012). Based on research demonstrating differential impact of the marital relationship on parenting by gender (Almeida et al., 1999; Belsky, Gilstrap, & Rovine, 1984; Belsky, Youngblade, Rovine, & Volling, 1991; Blair, Wenk, & Hardesty, 1994; Gable et al., 1992),

we expected its association with harsh parenting to be greater in magnitude for adoptive fathers than mothers.

Hypotheses

Using the adoption design, we examined three sources of influences on adoptive parents' harsh parenting: (1) child-based evocative effects on parenting (indexed by birth parent temperamental characteristics: reward dependence and harm avoidance), (2) adoptive parents' own temperament, and (3) adoptive parents' marital quality. We had three main hypotheses:

1. There will be evidence for multiple sources of influence on adoptive parents' harsh parenting, including:
 - a. Evocative gene-environment correlation (*rGE*)/child effects: Greater adoptive parent harsh parenting will be predicted by greater birth mother harm avoidance and lesser birth mother reward dependence.
 - b. Parent Characteristics: Greater adoptive parent harsh parenting will be associated with each adoptive parent's own greater harm avoidance and lesser reward dependence.
 - c. Family Environment Characteristics: Greater adoptive parent harsh parenting will be associated with lesser adoptive parent marital warmth and greater marital hostility, but these associations will be stronger for adoptive fathers than mothers.
2. Positive influences (birth parent and adoptive parent reward dependence and marital warmth) will show unique variance in harsh parenting, even when negative influences (birth and adoptive parent harm avoidance and marital hostility) are included in the model.
3. Evocative *rGE* will be *mediated* by infants' tendency to express positive emotion and negative emotion in social situations.

Method

Participants

Data used in the current analyses were drawn from a prospective, longitudinal adoption study consisting of 561 "linked-sets," or, adoption triads (adopted child, adoptive parents, birth parents; Leve, Neiderhiser, Shaw, Ganiban, Natsuaki & Reiss, 2013). Families were recruited through adoption agencies in the Northwest, Midwest, Southwest, and Mid-Atlantic regions of the United States. The mean infant age at adoption placement was 6.2 days. Exclusionary criteria included: relative or international adoptions, placement after 3-months of age, major medical illnesses in the adoptive child, and birth and/or adoptive parent reading ability below an 8th grade level. Refusal rates for the study were low: 2% of birth mothers (BMs), 8% of birth fathers (BFs) and 17% of adoptive families declined to participate when contacted by study staff (after being successfully recruited by adoption agencies). However, the total number of BFs who participated ($N = 193$) was lower than the

number of BMs ($N = 554$). Therefore, the current analyses used only BM measures as an index of the genetic contribution to infant characteristics.

Birth and adoptive parents identified themselves as White or Caucasian (BM, 70%; adoptive mothers, or AMs, 92%; adoptive fathers, or AFs, 90%), Black or African-American (BM, 13%; AM, 4%; AF, 5%), Asian (BM, 2%; AM, .9%; AF, .5%), Hispanic or Latino (BM, 7%; AM, 2%; AF, 2%), Native Hawaiian or Pacific Islander (BM, .2%; AM, 0; AF, .5%), American Indian or Alaskan Native (BM, 3%; AM, .2%; AF, 0), or more than 1 race (BM, 5%; AM, .9%; AF, 1%). On average, BMs had completed trade school and AMs and AFs had completed college. Median annual household income was \$14,000 for BMs and \$119,000 for adoptive families. At the first assessment, parents' average age was: BMs, 25; AMs, 38; AFs, 39. On average, adoptive parents had been married 18 years. Fifty-seven percent of infants were male.

The current sample includes 49 families in which the adoptive parents are of the same sex (2-mother families $N=18$; 2-father families $N=31$). Because hypotheses regarding parenting and the marital relationship were based on research examining two-parent families in which one parent was male and one was female, only separate-sex, two-parent families were included in the following models, bringing the sample size to 503 families.

Procedure

All participants completed in-person interviews, and mailed and computer-assisted questionnaires. Assessment included a wide variety of domains including temperament, psychosocial adjustment, life events, family relationships, and adoption-specific issues. All interviews were audio- or video-recorded and feedback was provided by a trained evaluator for at least 15% of the interviews to ensure adherence to interview protocols. Further details on study recruitment procedures, sample, and assessment methods can be found in Leve et al., (2013). The current study uses questionnaire data from the 3- to 6-month postpartum visit of birth parents and the 9-month postpartum assessment of adoptive families.

Measures

Harsh parenting—Harsh parenting was measured using the overreactivity subscale of The Parenting Scale (Arnold, O'Leary, Wolff, & Acker, 1993), which was completed separately by AMs and AFs when infants were 9 months of age. The scale was designed to index parent displays of anger, meanness, and irritability in response to child challenges, (e.g., "When my baby misbehaves..."). Each item was designed so that responses were rated on a 7-point Likert scale anchored at one end by a purportedly adaptive parenting response (e.g., "...I handle it without getting upset") and at the other end by a harsh, overreactive response (e.g., "...I get so frustrated or angry that my child can see I'm upset"). To make this measure (developed using a sample of parents of 18- to 48-month-olds) developmentally appropriate for parents of 9-month-olds, 3 of the original 10 items from this subscale were removed (Lipscomb et al., 2011). Internal reliabilities were good (both AMs and AFs $\alpha = .71$).

Birth and adoptive parent reward dependence and harm avoidance—As an index of infants' inherited temperamental characteristics, birth parents completed the

Temperament Character Inventory (TCI; Cloninger et al., 1993) at 3- to 6-months postpartum. Adoptive parents completed this measure at infant age 9-months to provide a measure of their own temperaments. The 15-item reward dependence subscale (BMs $\alpha = .63$; AMs $\alpha = .67$; AFs $\alpha = .70$) and the 20-item harm avoidance subscale (BMs $\alpha = .87$; AMs $\alpha = .83$; AFs $\alpha = .83$) were used in the current study. Reward dependence sample items include: "I like to discuss my experiences openly with friends instead of keeping them to myself," and "If I am feeling upset, I usually feel better around friends than when left alone." Harm avoidance sample items include: "I often feel tense and worried in unfamiliar situations, even when others feel there is little to worry about," and "I have less energy and get tired more quickly than most people." Items are answered as "True" or "False."

Marital quality—Adoptive mother and father marital quality was assessed during a 20-minute videotaped interaction task during the 9-month in-home assessment. Parents were provided with cards that prompted them to discuss a variety of topics about their relationship, both positive and negative. After data collection, the videotaped observations were coded based on the Iowa Family Interaction Rating Scales—Marital Interaction Codes (Dogan et al., 2004; Melby et al., 1990). Approximately 20% of the sample was double-coded to assess reliability, which was good (weighted percent agreement range = .89 to .99). Each partner in the dyad received a single global code on several subscales, some of which were then collapsed to create an overall Warmth/Support scale (made up of Warmth/Support, Assertive Communication, and Listener Responsiveness subscales) and Hostility scale (made up of Hostility, Antisocial Behavior, Angry Coercion, Reciprocate Hostile subscales). Each global code was based on a 1-9 scale, with "1" being "not at all characteristic," and "9" being "mainly characteristic." In addition to the Warmth/Support and Hostility scales, we examined the Relationship Quality scale, which characterized the overall quality of the relationship (from a score of 1 for negative, and a score of 9 for positive). Ultimately, we used this scale because the overall Warmth/Support and Hostility scales were highly correlated ($r = -.59$); the Relationship Quality code allowed us to use a variable that took into account both the warmth *and* hostility in the marital relationship while avoiding the problem of multicollinearity. In order to obtain *dyadic* measures of warmth and hostility, we averaged the scores for adoptive mothers and fathers on this scale.

Infant temperament—To assess adoptive parents' perception of infants' temperaments, the Infant Behavior Questionnaire (IBQ; Rothbart, 1981) was completed separately by AMs and AFs when infants were 9 months old. The current analysis used three subscales. The 15-item Smiling & Laughter subscale, which indexes the amount of positive emotion typically expressed by infants during general caretaking and play situations (AMs $\alpha = .83$; AFs $\alpha = .86$), was thought to reflect a developmentally analogous measure of reward dependence (based on Matheny, Riese, & Wilson, 1985). The 20-item Distress to Limitations subscale (AMs $\alpha = .85$; AFs $\alpha = .85$) and the 16-item Distress to Novel Stimuli subscale (AMs $\alpha = .73$; AFs $\alpha = .71$), both representative of infant temperamental negative affectivity, were used as developmentally appropriate proxies of harm avoidance. AM and AF report of these variables were averaged.

Demographic and perinatal control variables—Demographic characteristics, such as the degree of openness in the adoption, infant sex, and adoptive parent age were controlled for in major analyses. Additionally, the McNeil-Sjöström Scale for Obstetric Complications (McNeil, Cantor-Graae & Sjöström, 1994) was used to create an index of perinatal risk (i.e., maternal pre-eclampsia, prenatal substance use, prematurity, low birth weight) based on self-report of pregnancy and neonatal events. Although self-report was retrospective, recall was assisted via use of a Life History Calendar (Caspi et al., 1996) adapted for the perinatal period. Events meeting a minimum threshold of being at least potentially harmful/relevant to infant outcome were summed to form a total score. The total score was used as a covariate in analyses to prevent the misinterpretation of perinatal influences as genetic effects.

Results

Descriptive Statistics and Correlations

Descriptive statistics and bivariate correlations are reported in Tables 1 and 2. Square-root transformations were used to normalize the distributions of AMs' and AFs' hostile parenting, which were positively skewed. The untransformed data for adoptive parents' observed relationship quality was used despite being somewhat negatively skewed, because square-root and log transformations worsened the distribution.

Structural Equation Models

Structural equation modeling (SEM) was used to test hypotheses. Prior to the SEM analysis, each variable of interest was regressed onto the demographic and perinatal variables with which it was at least marginally significantly associated (correlation coefficient $p < .10$). A separate multiple regression analysis was conducted for each variable and residuals were saved; residualized variables were then used in SEM.

SEM was conducted in Mplus 7, with full information maximum likelihood estimation to handle missing data. We used the BOOTSTRAP function in Mplus to conduct all SEMs with 1,000 draws of the data. The hypothesized model fit the data very well ($\chi^2 = 3.24$, $df = 6$, $p > .10$; CFI = 1.00; RMSEA = .00, 90% CI = .00-.04). Figure 1 shows the results for hypothesis testing (pathways that were significant at the $p < .05$ level are black; nonsignificant pathways are grey).

Hypothesis 1a—As shown in the figure, there was some evidence for evocative *rGE* on adoptive parent harsh parenting. AFs who rated themselves as relatively *higher* in harsh parenting had adopted infants whose birth mothers had rated themselves relatively *lower* in reward dependence (our index of infants' genetically influenced sociability; $\beta = -.13$, $p < .01$; lower 95% CI = $-.22$, upper 95% CI = $-.05$). For AMs, however, this association was close to zero ($\beta = -.02$, $p > .10$; lower 95% CI = $-.12$, upper 95% CI = $.08$). We tested the significance of the difference in the effect of BM reward dependence on harsh parenting for AMs versus AFs by testing an alternative model in which pathways between BM reward dependence and each parents' harsh parenting were constrained to be equal. The degradation in the fit of the model ($\chi^2 = 5.77$, $df = 1$, $p < .05$) was significant, indicating that the

association between BM reward dependence and AF harsh parenting was *significantly different* from that for AM harsh parenting.

Hypothesis 1b—As for associations between adoptive parents' reports of their own temperaments and harsh parenting, only harm avoidance was statistically significant (for AMs, $\beta = .26, p < .01$, lower 95% CI = .17, upper 95% CI = .33; for AFs, $\beta = .16, p < .01$, lower 95% CI unstandardized $b = .02$, upper 95% CI = .06).

AM and AF reward dependence were associated with observed marital relationship quality (for AMs, $\beta = .10, p < .05$, lower 95% CI = .01, upper 95% CI = .20 and for AFs, $\beta = .20, p < .01$, lower 95% CI = .11, upper 95% CI = .29). The difference in the magnitude of AM and AF associations between reward dependence and observed relationship quality was not statistically significant ($\chi^2 = 2.12, df = 1, p > .10$), suggesting that one parents' reward dependence does not drive the quality of the marital relationship. The association between relationship quality and adoptive parents' own harm avoidance approached significance for AFs ($\beta = -.08, p = .08$), but was non-significant for AMs ($\beta = .07, p > .10$); this difference in magnitude was not statistically significant ($\chi^2 = 3.40, df = 1, p > .10$).

Hypothesis 1c—As predicted, marital relationship quality was inversely associated with AFs' harsh parenting ($\beta = -.15, p < .01$, lower 95% CI = $-.23$, upper 95% CI = $-.06$). It was not, however, associated with AMs' parenting ($\beta = -.04, p > .10$), consistent with our expectation that marital relationship quality would more strongly predict AF parenting than AM parenting. Importantly, the difference between AF and AM parenting only approached statistical significance ($\chi^2 = 3.48, p < .10$), suggesting a modest difference at best.

Hypothesis 2—We expected that birth parent and adoptive parent reward dependence and marital warmth would predict unique variance in harsh parenting, even in the presence of birth parent and adoptive parent harm avoidance. We found support for this hypothesis for rGE in that BM reward dependence, but not harm avoidance, predicted AF harsh parenting. Furthermore, the difference in effects was significant ($\chi^2 = 7.30, df = 1, p < .05$). However, for adoptive parent personality only harm avoidance (not reward dependence) was associated with harsh parenting.

Hypothesis 3—Finally, we predicted that rGE between birth mother reward dependence and adoptive parent harsh parenting would be mediated by adoptive parents' reports of their infants' smiling and laughter (i.e., their perception of infants' positive sociability). Similarly, we predicted that the rGE between BM harm avoidance and adoptive parent harsh parenting would be mediated by adoptive parents' reports of their infants' distress to limitations and novel stimuli (i.e., their perception of infant negative emotionality). We added these infant variables into our SEM and examined both direct and indirect effects.

Direct effects: BM reward dependence was associated with AP-report of infant smiling and laughter as predicted ($\beta = .14, p < .05$), however, BM harm avoidance was not associated with either measure of negative infant temperament (β 's = $-.01$ and $.01, p$'s $> .10$). Infant smiling and laughter was inversely related to AMs' harsh parenting ($\beta = -.16, p < .01$), but not AF's ($\beta = -.07, p > .10$). Infant distress to limitations was significantly associated with

AFs' harsh parenting ($\beta = .15, p < .01$) and marginally with AMs' ($\beta = .08, p = .08$). Infant distress to novel stimuli was not associated with either (β 's $< .06, p$'s $> .10$).

Indirect effects: Despite some direct associations between APs' reports of their parenting and their infants' temperament, none of the indirect effects were significant (all indirect effects $< |.01|$, all p 's $> .10$), with the exception of BM reward dependence, infant smiling and laughter, and AM harsh parenting. Although the direct effect of BM reward dependence on AM harsh parenting was small and nonsignificant, this effect was accounted for by infant smiling and laughter ($-.02, p < .05$).

Due to the unexpected direct association between AF harm avoidance and BM reward dependence, we adjusted the model so that we could test the associations from BM reward dependence \rightarrow AF harm avoidance \rightarrow AF parenting, to ensure that the direct association between BM reward dependence and AF harsh parenting was not simply due to shared variance with AF harm avoidance. The analyses showed that only $-.01$ of BM reward dependence's total effect of $-.14$ on AF harsh parenting was mediated by AF harm avoidance ($p = .07$).

Model replicability—In addition to using conducting the SEM with 1,000 bootstrapped draws of the data, we used a split-half procedure in which we divided our dataset into two random halves and conducted the analysis separately with each. As shown in Table 3, the pattern of associations was consistent across different portions of the sample. Although some of the effects were no longer significant in the half-samples, it is notable that the effect sizes (.10 and .11) would have been statistically significant in the full sample; therefore, the drop to non-significance was due to decreased N rather than a truly significant decrease in effect size. Finally, it is notable that a previous examination of these hypotheses conducted with only one cohort of the current sample ($N=361$ linked sets; Hajal, Neiderhiser, Shaw, Moore, Leve & Reiss, 2011) yielded the same pattern of results.

Discussion

In light of theory and research indicating that harsh parenting during infancy is associated with downstream maladaptive outcomes (Bayer, Ukoumunne, Mathers, Wake, Abdi, & Hiscock, 2012; Bradley & Corwyn, 2008) that persist into adulthood (Lorber & Egeland, 2009), this study aimed to identify family factors that may exacerbate or buffer parents' tendency to respond to infant challenges with anger, irritation, and hostility. We explored two specific research gaps in the area of harsh parenting during infancy. First, we examined the *evocative* effect of infant temperament on harsh parenting. As most studies of child effects on parenting during early childhood have not used genetically sensitive designs, this study is among the first to examine the extent to which these effects are due to genetically inherited characteristics of the child, versus passive gene-environment correlation. Second, we tested the hypothesis that positive child, parent, and family characteristics would have unique and differential effects on adoptive mothers' and fathers' harsh parenting, over and above those of negative characteristics.

Evocative *rGE*

A primary hypothesis of the study, that birth mother temperament would predict adoptive parents' harsh parenting, was supported for AFs, suggesting that fathers may be more sensitive to children's genetically-influenced temperament than AMs. The *rGE* for AFs was only present when considering measures of birth mothers' reward dependence, not harm avoidance. This finding suggests that BMs transmit to their infants a genetic predisposition toward reward dependence (measured in this study as an index of sociability), which is expressed by the infant during the first months of life. This infant behavior then elicits specific types of responding from AFs. In this particular case, one possibility is that AFs whose babies are higher in general sociability may perceive challenging situations with the infant (e.g., prolonged crying, fussiness) as context-dependent and short-lived, thus mitigating their tendency to respond irritably. However, the infant characteristic through which we expected inherited sociability to operate (infants' tendency to smile and laugh in everyday social contexts) was not a significant mediator. In other words, while there seems to be a real genetic effect on infant behavior operating on AF parenting for these families, that effect is not evident in our measure of smiling and laughter.

Our *rGE* finding is consistent with previous behavioral and molecular genetic studies which report evocative *rGE* on parenting (e.g., Mills-Koonce et al., 2008; Plomin & DeFries, 1985), and extends results from twin studies that suggest effects of infant genes on parenting (e.g. Boivin et al., 2005; Forget-Dubois et al., 2007) by obviating the confound of passive *rGE*. Furthermore, like the Colorado Adoption Project (Plomin & DeFries, 1985), we found that genetically-influenced aspects of temperament may affect parenting as early as the first year of life. However, previous studies only examine evocative *rGE* for mothers—not fathers. Therefore, while this study provides further evidence for evocative *rGE* on parenting in infancy, specifically in fathers, it adds complexity by demonstrating that it may operate differently for parents in the same family.

Why did the current study find *rGE* for adoptive fathers', but not adoptive mothers' harsh parenting of 9-month-olds based on infants' inherited sociability? One explanation for these differences could be related to how inherited reward dependence expresses itself in infancy, and how that might play into mothers' and fathers' dissimilar affective styles with their infants. Previous research has shown that while positive affect in mother-infant play tends to be of low- to medium-intensity, father-infant positive play is characterized by high arousal and peaks of high intensity emotion (Feldman, 2003). Perhaps in infancy, reward dependence is expressed as the type of high-intensity pleasure that is more characteristic of father-infant than mother-infant interaction. It is possible that our measure of birth mother reward dependence, but not AP-reported infant smiling and laughter, captured the high-intensity pleasure to which fathers respond. Future research should examine whether infant high-intensity pleasure, as measured by newer versions of the IBQ (Gartstein & Rothbart, 2003) mediates the relation between inherited reward dependence and adoptive father harsh parenting.

It is also possible that inherited reward dependence was expressed earlier in infancy, contributing to interactional patterns between babies and fathers that began prior to our 9

month assessment. For example, perhaps infants with higher reward dependence showed earlier or more frequent social smiles, contributing to more positive early father-infant interactions. Future research should examine infant behaviors even earlier in development.

The Influence of Positive Parent, Child, and Family Characteristics

Another contribution of the current study is its consideration of associations of harsh parenting with both positive *and* negative factors across multiple levels of the family system. Infant positive characteristics were more predictive of parenting (for fathers) than infant negative characteristics; however, the same was not true for adoptive parents' own temperaments. For both AMs and AFs, higher harm avoidance, an index of negative emotionality, was associated with greater harsh parenting. This is consistent with other studies that have found larger effects for neuroticism/negativity than extraversion, agreeableness, or positivity on controlling, intrusive, or otherwise negative parenting (Clark, Kochanska, & Ready, 2000; Lovejoy et al., 2011; Smith, 2010). Taken together, these studies' findings suggest that, for parent personality and parenting, negative *is* more influential than positive when predicting negative parenting.

Reward dependence, however, was related to observed marital relationship quality. It is not surprising that the measure of adult reward dependence (sociability) in parents was related to an adult social relationship (the marital relationship) rather than to parenting. It brings to the forefront the issue of what exactly reward dependence means in infancy versus adulthood, and how it might differ in relation to social relationships between two adults versus a parent-child dyad. Our findings suggest that reward dependence is present across the life span and, in an infant, evokes a certain type of fathering. Yet, it may be that an adult's *own* reward dependence is more influential in their adult relationships than parent-child interactions.

Although we did not expect marital relationship quality to be unrelated to AM parenting, we did expect it to be more highly related to AF parenting. That higher marital relationship quality predicted less harsh parenting for AFs is consistent with previous literature showing the importance of the marital relationship on fathers' parenting. Overall, the results suggest that fathers who are higher in sociability are more likely to have marital relationships that are more positive, which may buffer negative responding in the face of parenting challenges. This finding underscores the importance of assessing and formally addressing the marital relationship in families seeking intervention for their children, consistent with Cowan and Cowan's (1990) work.

Limitations

The findings reported here must be considered in the context of limitations. The adoptive parent temperament, harsh parenting, and marital relationship quality data used in this study were collected during one assessment, making it difficult to draw inferences about directionality, much less causality. This is was a particular limitation for the mediation analyses, given that both mediators and outcomes were assessed at the same time. Additionally, children were assessed at 9 months of age, when stability of behavior is likely to be short-lived. It remains to be seen whether these measures will be associated with meaningful variability in parenting and child outcomes during the preschool period and

beyond. Similarly, parenting roles may change as children get older and differential findings for mothers' and fathers' parenting may shift. Future research on this study will examine how influences on AM and AF parenting and their interactions may change over time. Finally, another significant limitation is that multiple constructs were measured via adoptive parent self-report, possibly leading to shared method variance. However, the differential associations across variables (e.g., adoptive mother harm avoidance and harsh parenting were related to one another but not reports of negative infant characteristics) suggest that this was not a pervasive issue in our model. Future research examining early gene-environment correlation and the impact of positive factors on harsh parenting should supplement self-report questionnaires with observational methods.

Conclusion

The results from the current study begin to fill gaps in our understanding of the mechanisms involved in harsh parenting of infants. Our results support a model of transactional relations among various influences on parenting, highlighting the role that positive family factors may have in preventing parents from responding angrily to challenging situations with their 9-month-olds. We provided evidence that, for fathers, child effects on harsh parenting are partially driven by infants' inherited characteristics, thus constituting true evocative child effects. Furthermore, by illuminating both similar and dissimilar ways in which adoptive mothers and fathers respond to parenting challenges, the findings offer information that can inform future research, and ultimately prevention and early intervention in at-risk families. Overall, it represents an early step in an attempt to disentangle the genetic, environmental, and family effects on harsh parenting in infancy in order to contribute to the promotion of positive parenting practices and optimal child development.

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References

- Almeida DM, Wethington E, Chandler AL. Daily transmission of tensions between marital dyads and parent-child dyads. *Journal of Marriage and the Family*. 1999; 61:49–61.10.2307/353882
- Arnold DS, O'Leary SG, Wolf LS, Acker MM. The Parenting Scale: A measure of dysfunctional parenting in discipline situations. *Psychological Assessment*. 1993; 9:137–144.10.1037/1040-3590.5.2.137
- Bayer JK, Ukoumunne OC, Mathers M, Wake M, Abdi N, Hiscock H. Development of externalising and internalising problems from infancy to five years of age. *Australian and New Zealand Journal of Psychiatry*. 2012; 46:659–668.10.1177/0004867412450076 [PubMed: 22651982]
- Belsky J. The determinants of parenting: A process model. *Child Development*. 1984; 55:83–96. [PubMed: 6705636]

- Belsky J, Gilstrap B, Rovine M. The Pennsylvania Infant and Family Development Project: I. Stability and change in mother-infant and father-infant interaction in a family setting at one, three, and nine months. *Child Development*. 1984; 55:692–705.10.2307/1130122 [PubMed: 6734311]
- Belsky J, Youngblade L, Rovine M, Volling B. Patterns of marital change and parent-child interaction. *Journal of Marriage & the Family*. 1991; 53:487–498.10.2307/352914
- Bell RQ. Parent, child, and reciprocal influences. *American Psychologist*. 1979; 34:821–826.10.1037/0003-066X.34.10.821
- Bell RQ, Chapman M. Child effects in studies using experimental or brief longitudinal approaches to socialization. *Child Development*. 1986; 22:595–603.10.1037/0012-1649.22.5.595
- Blair SL, Wenk D, Hardesty C. Marital quality and paternal involvement: Interconnections of men's spousal and parental roles. *Journal of Men's Studies*. 1994; 2:221–237.10.3149/jms.0203.221
- Boivin M, Pérusse D, Dionne G, Sayssset V, Zoccolillo M, Tarabulsy GM, Tremblay RE. The genetic-environmental etiology of parents' perceptions and self-assessed behaviours toward their 5-month-old infants in a large twin and singleton sample. *Journal of Child Psychology and Psychiatry*. 2005; 46:612–630.10.1111/j.1469-7610.2004.00375.x [PubMed: 15877767]
- Bornstein MH, Hahn CS, Haynes OM. Maternal personality, parenting cognitions, and parenting practices. *Developmental Psychology*. 2011; 47:658–675.10.1037/a0023181 [PubMed: 21443335]
- Bradley RH, Corwyn RF. Infant temperament, parenting, and externalizing behavior in first grade: a test of the differential susceptibility hypothesis. *Journal of Child Psychology and Psychiatry*. 2008; 49:124–131.10.1111/j.1469-7610.2007.01829 [PubMed: 18211274]
- Bridgett DJ, Gartstein MA, Putnam SP, McKay T, Iddins E, Robertson C, Rittmueller A. Maternal and contextual influences and the effect of temperament development during infancy on parenting in toddlerhood. *Infant Behavior and Development*. 2009; 32:103–116.10.1016/j.infbeh.2008.10.007 [PubMed: 19111913]
- Burt AS, McGue M, Krueger RF, Iacono WG. How are parent-child conflict and childhood externalizing symptoms related over time? Results from a genetically informative cross-lagged study. *Development and Psychopathology*. 2005; 17:145–165.10.1017/S0954579405008X [PubMed: 15971764]
- Caspi A, Moffitt TE, Thornton A, Freedman D, Amell JW, Harrington H, Silva PA. The life history calendar: A research and clinical assessment method for collecting retrospective evident-history data. *International Journal of Methods in Psychiatric Research*. 1996; 6:101–114. doi: 10.1002.
- Clark LA, Kochanska G, Ready R. Mothers' personality and its interaction with child temperament as predictors of parenting behavior. *Journal of Personality and Social Psychology*. 2000; 79:274–285.10.1037/0022-3514.79.2.274 [PubMed: 10948980]
- Cloninger CR. A systematic method for clinical description and classification of personality traits. *Archives of General Psychiatry*. 1987; 44:573–588.10.1001/archpsyc.1987.01800180093014 [PubMed: 3579504]
- Cloninger CR, Svrakic DM, Przybeck TR. A psychobiological model of temperament and character. *Archives of General Psychiatry*. 1993; 50:975–990.10.1001/archpsyc.1993.01820240059008 [PubMed: 8250684]
- Constantino JN, Cloninger CR, Clarke AR, Hashemi B, Przybeck T. Application of the seven-factor model of personality to early childhood. *Psychiatry Research*. 2002; 109:229–244.10.1016/S0165-1781(02)00008-2 [PubMed: 11959360]
- Cowan, PA.; Cowan, CP. *Becoming a family: Research and intervention*. In: Sigel, IE.; Brody, GH., editors. *Methods of family research: Biographies of research projects, Vol. 1: Normal families*. Hillsdale, NJ: Lawrence Erlbaum; 1990. p. 1-51.
- Deater-Deckard K, O'Connor TG. Parent-Child Mutuality in Early Childhood: Two Behavioral Genetic Studies. *Developmental Psychology*. 2000; 36:561–570.10.1037//OO12-1649.36.5.561 [PubMed: 10976597]
- DiLalla LF, Bishop EG. Differential maternal treatment of infant twins: Effects on infant behaviors. *Behavior Genetics*. 1996; 26:535–542.10.1007/BF02361226 [PubMed: 8990532]
- Dix T. The affective organization of parenting: Adaptive and maladaptive processes. *Psychological Bulletin*. 1991; 110:3–25.10.1037/0033-2909.110.1.3 [PubMed: 1891517]

- Dogan S, Lei A, Milne-Kahn J, Pong H, Wu E, Conger R. Family interaction behavioral codes for the Early Growth and Development Study. 2004 Unpublished coding manual.
- Erel O, Burman B. Interrelatedness of marital relations and parent-child relations: A meta-analytic review. *Psychological Bulletin*. 1995; 118:108–132.10.1037/0033-2909.118.1.108 [PubMed: 7644602]
- Feldman R. Infant-mother and infant-father synchrony: The coregulation of positive arousal. *Infant Mental Health Journal*. 2003; 24:1–23.10.1002/imhj.10041
- Forget-Dubois N, Boivin M, Dionne G, Pierce T, Tremblay RE, Perusse D. A longitudinal twin study of the genetic and environmental etiology of maternal hostile-reactive behavior during infancy and toddlerhood. *Infant Behavior & Development*. 2007; 30:453–465.10.1016/j.infbeh.2006.12.005 [PubMed: 17683754]
- Gable S, Belsky J, Crnic K. Marriage, parenting, and child development: Progress and prospects. *Journal of Family Psychology, Special Issue: Diversity in contemporary family psychology*. 1992; 5:276–294.10.1037/0893-3200.5.3-4.276
- Ganiban JM, Spotts EL, Lichtenstein P, Khera GS, Reiss D, Neiderhiser JM. Can genetic factors explain the spillover of warmth and negativity across family relationships? *Twin Research and Human Genetics*. 2007; 10:299–313.10.1375/twin.10.2.299 [PubMed: 17564519]
- Gartstein MA, Rothbart MK. Studying infant temperament via the Revised Infant Behavior Questionnaire. *Infant Behavior and Development*. 2003; 26:64–86.10.1177/0165025411422181
- Ge X, Conger RD, Cadoret RJ, Neiderhiser JM, Yates W, Troughton E, Stewart MA. The developmental interface between nature and nurture: A mutual influence model of child antisocial behavior and parent behaviors. *Developmental Psychology*. 1996; 32:574–589.10.1037/0012-1649.32.4.574
- Hajal, NJ.; Neiderhiser, JM.; Shaw, D.; Moore, GA.; Leve, LD.; Reiss, D. Evocative Effects on Parenting over Time: Similarities and Differences Between Adoptive Mothers and Fathers. Paper presented at the 2011 Biennial Meeting of the Society for Research in Child Development; Montréal, Québec, Canada. 2011.
- Harold GT, Leve LD, Elam K, Thapar A, Neiderhiser JM, Natsuaki MN, Shaw DS, Reiss D. The nature of nurture: Disentangling passive genotype-environment correlation from family relationship influences on children's externalizing problems. *Journal of Family Psychology*. 2013; 27:12–21.10.1037/a0031190 [PubMed: 23421830]
- Harold GT, Leve LD, Barrett D, Elam K, Neiderhiser JM, Natsuaki MN, Shaw DS, Reiss D, Thapar A. Biological and rearing mother influences on child ADHD symptoms: revisiting the developmental interface between nature and nurture. *Journal of Child Psychology and Psychiatry*. in press. 10.1111/jcpp.12100
- Hayden EP, Klein DN, Dougherty LR, Olinio TM, Durbin CE, Sheikh HI, Singh SM. The dopamine D2 receptor gene and depressive and anxious symptoms in childhood: Associations and evidence for gene-environment correlation and gene-environment interaction. *Psychiatric Genetics*. 2010; 20:304–310.10.1097/YPG.0b013e32833adccb [PubMed: 20526230]
- Jaffee SR, Caspi A, Moffitt TE, Polo-Tomas M, Price TS, Taylor A. The limits of child effects: evidence for genetically mediated child effects on corporal punishment but not on physical maltreatment. *Developmental Psychology*. 2004; 40:1047–1058.10.1037/0012-1649.40.6.1047 [PubMed: 15535755]
- Klahr AM, Thomas KM, Hopwood CJ, Klump KL, Burt SA. Evocative Gene-Environment Correlation in the Mother-child Relationship: A Twin Study of Interpersonal Processes. *Development and Psychopathology*. 2013; 25:105–118.10.1017/S0954579412000934 [PubMed: 23398756]
- Knafo A, Jaffee SR. Gene-environment Correlation in Developmental Psychopathology. *Development and Psychopathology*. 2013; 25:1–6.10.1017/S0954579412000855 [PubMed: 23398748]
- Leve LD, Neiderhiser JM, Shaw DS, Ganiban J, Natsuaki MN, Reiss D. The Early Growth and Development Study: A prospective adoption study from birth through middle childhood. *Twin Research and Human Genetics*. 2013; 16:412–23.10.1017/thg.2012.126 [PubMed: 23218244]
- Lipscomb ST, Leve LD, Harold GT, Neiderhiser JM, Shaw DS, Ge XJ, Reiss D. Trajectories of parenting and child negative emotionality during infancy and toddlerhood: A longitudinal analysis.

- Child Development. 2011; 82:1661–1675.10.1111/j.1467-8624.2011.01639.x [PubMed: 21883160]
- Lorber MF, Egeland B. Infancy Parenting and Externalizing Psychopathology from Childhood through Adulthood: Developmental Trends. *Developmental Psychology*. 2009; 45:909–912.10.1037/a0015675 [PubMed: 19586169]
- Lovejoy MC, Graczyk PA, O'Hare E, Neuman G. Maternal depression and parenting behavior: A meta-analytic review. *Clinical Psychology Review*. 2000; 20:561–592.10.1016/S0272-7358(98)00100-7 [PubMed: 10860167]
- Matheny AP, Riese ML, Wilson RS. Rudiments of infant temperament: newborn to 9 months. *Developmental Psychology*. 1985; 21:486–494.10.1037/0012-1649.21.3.486
- McNeil TF, Cantor-Graae E, Sjöström K. Obstetric complications as antecedents of schizophrenia: Empirical effects of using different obstetric complications scales. *Journal of Psychiatric Research*. 1994; 28:519–530.10.1016/0022-3956(94)90042-6 [PubMed: 7699611]
- Melby JN, Conger RD, Ge X, Warner T. The use of structural equation modeling in assessing the quality of marital observations. *Journal of Family Psychology*. 1995; 9:280–293.10.1037/0893-3200.9.3.280
- Mills-Koonce WR, Propper CB, Gariepy J, Blair C, Garrett-Peters P, Cox MJ. Bidirectional genetic and environmental influences on mother and child behavior: The family system as the unit of analyses. *Development and Psychopathology*. 2008; 19:1073–1087.10.1017/S0954579407000545 [PubMed: 17931435]
- Narusyte J, Neiderhiser JM, D'Onofrio B, Reiss D, Spotts EL, Ganiban J, Lichtenstein P. Testing different types of genotype-environment correlation: An extended children-of-twins model. *Developmental Psychology*. 2008; 44:1591–1603.10.1037/a0013911 [PubMed: 18999324]
- Neiderhiser JM, Reiss D, Pedersen NL, Lichtenstein P, Spotts EL, Hansson K, Elthammer O. Genetic and Environmental Influences on Mothering of Adolescents: A Comparison of Two Samples. *Developmental Psychology*. 2004; 40:335–351.10.1037/0012-1649.40.3.335 [PubMed: 15122961]
- Neiderhiser JM, Reiss D, Lichtenstein P, Spotts EL, Ganiban J. Father-adolescent relationships and the role of genotype-environment correlation. *Journal of Family Psychology*. 2007; 21:560–571.10.1037/0893-3200.21.4.560 [PubMed: 18179328]
- O'Connor TG, Deater-Deckard K, Fulker D, Rutter M, Plomin R. Genotype-environment correlations in late childhood and early adolescence: Antisocial behavioral problems and coercive parenting. *Developmental Psychology*. 1998; 34:970–981.10.1037/0012-1649.34.5.970 [PubMed: 9779743]
- Oppenheimer CW, Hankin BL, Jenness JL, Young JF, Smolen A. Observed positive parenting behaviors and youth genotype: Evidence for gene-environment correlations and moderation by parent personality traits. *Development and Psychopathology*. 2013; 25:175–191.10.1017/S0954579412000983 [PubMed: 23398761]
- Plomin, R.; DeFries, JC. *Origins of individual differences in infancy: The Colorado Adoption Project*. Orlando, FL: Academic Press; 1985.
- Plomin, R.; DeFries, JC.; Fulker, DW. *Nature and nurture in infancy and early childhood*. New York: Cambridge University Press; 1988.
- Plomin R, Loehlin JC, DeFries JC. Genotype-environment interaction and correlation in the analysis of human behavior. *Psychological Bulletin*. 1977; 84:309–322.10.1037/0033-2909.84.2.309 [PubMed: 557211]
- Plomin R, Loehlin JC, DeFries JC. Genetic and environmental components of “environmental” influences. *Developmental Psychology*. 1985; 21:391–402.10.1037/0012-1649.21.3.391
- Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*. 2008; 40:879–891.10.3758/BRM.40.3.879 [PubMed: 18697684]
- Prinzle P, Stams GJ, Dekovic M, Reijntjes AH, Belsky J. The relations between parents' Big Five personality factors and parenting: a meta-analytic review. *Journal of Personality and Social Psychology*. 2009; 97:351–362.10.1037/a0015823 [PubMed: 19634980]
- Propper CB, Shanahan MJ, Russo R, Mills-Koonce WR. Evocative gene-parenting correlations and academic performance in first grade: An exploratory study. *Development and Psychopathology*. 2012; 24:1265–1282.10.1017/S0954579412000697 [PubMed: 23062296]

- Propper CB, Willoughby MM, Halpern CT, Carbone MA, Cox MM. Parenting quality, *DRD4*, and the prediction of externalizing and internalizing behaviors in early childhood. *Developmental Psychobiology*. 2007; 49:619–632.10.1002/dev.20249 [PubMed: 17680609]
- Putnam, SP.; Sanson, AV.; Rothbart, MK. Child temperament and parenting. In: Bornstein, M., editor. *Handbook of parenting: Vol. 1: Children and parenting*. 2. Mahwah, NJ: Lawrence Erlbaum Associates; 2002. p. 255-277.
- Rhoades KA, Leve LD, Harold GT, Neiderhiser JM, Shaw DS, Reiss D. Longitudinal pathways from marital hostility to child anger during toddlerhood: Genetic susceptibility and indirect effects via harsh parenting. *Journal of Family Psychology*. 2011; 23:282–291.10.1037/a0022886 [PubMed: 21480707]
- Rothbart MK. Measurement of temperament in infancy. *Child Development*. 1981; 52:569–578.10.1111/j.1467-8624.1981.tb03082.x
- Rueger SY, Katz RL, Risser HJ, Lovejoy MC. Relations between parental affect and parenting behaviors: A meta-analytic review. *Parenting: Science and Practice*. 2011; 11:1–33.10.1080/15295192.2011.539503
- Rutter M, Dunn J, Plomin R, Simonoff E, Pickles A, Maughan B, Ormel J, Meyer J, Eaves L. Integrating nature and nurture: Implications of person-environment correlations and interactions for developmental psychopathology. *Development and Psychopathology*. 1997; 9:335–364.10.1017/S0954579497002083 [PubMed: 9201448]
- Scarr S, McCartney K. How people make their own environments: A theory of genotype → environment effects. *Child Development*. 1983; 54:424–435. [PubMed: 6683622]
- Smith CL. Multiple determinants of parenting: Predicting individual differences in maternal parenting behavior with toddlers. *Parenting: Science and Practice*. 2010; 10:1–17.10.1080/15295190903014588
- Stover CS, Connell CM, Leve LD, Neiderhiser JM, Shaw DS, Scaramella LV, Conger R, Reiss D. Fathering and mothering in the family system: linking marital hostility and aggression in adopted toddlers. *Journal of Child Psychology and Psychiatry*. 2012; 53:401–409.10.1111/j.1469-7610.2011.02510 [PubMed: 22191546]
- Towers H, Spotts EL, Neiderhiser JM. Genetic and environmental influences on parenting and marital relationships: Current findings and future directions. *Marriage & Family Review*. 2002; 33:11–29.10.1300/J002v33n01_03
- Wilson S, Durbin CE. Dyadic parent-child interaction during early childhood: contributions of parental and child personality traits. *Journal of Personality*. 2012; 80:1313–1338.10.1111/j.1467-6494.2012.00789 [PubMed: 22433002]

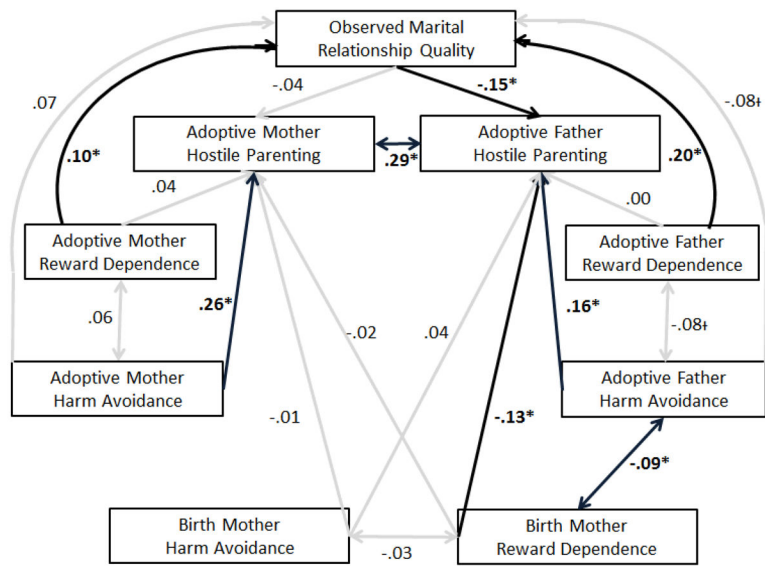


Figure 1.

Notes: Correlations among AM, AF, and BM temperament variables that are not pictured were nonsignificant.

Nonsignificant pathways are represented in grey.

* $p < .05$ and $^\dagger p < .10$

Table 1

Psychometric Properties of Study Variables.

	<i>n</i>	<i>M</i>	<i>SD</i>	Range		Skew
				Potential	Actual	
Adoptive Mother Harsh Parenting	463	1.72	0.58	1.00 – 7.00	1.00 – 4.57	1.12
Adoptive Father Harsh Parenting	452	1.81	0.64	1.00 – 7.00	1.00 – 4.57	1.13
Birth Mother Harm Avoidance	486	9.15	5.11	0 – 20.00	0.00 – 20.00	0.17
Birth Mother Reward Dependence	486	10.06	2.78	0 – 15.00	2.00 – 15.00	-0.40
Adoptive Mother Harm Avoidance	494	8.07	4.35	0 – 20.00	0.00 – 20.00	0.31
Adoptive Mother Reward Dependence	495	11.73	2.53	0 – 15.00	2.00 – 15.00	-0.90
Adoptive Father Harm Avoidance	478	5.48	4.10	0 – 20.00	0.00 – 20.00	0.81
Adoptive Father Reward Dependence	478	9.57	2.93	0 – 15.00	1.00 – 15.00	-0.40
Adoptive Parents' Observed Marital Relationship Quality	453	7.25	1.09	1.00 – 9.00	2.50 – 9.00	-1.29
Infant Smiling & Laughter	489	5.10	0.68	1.00 – 6.00	2.21 – 6.67	-0.32
Infant Distress to Novel Stimuli	475	2.48	0.55	1.00 – 6.00	1.00 – 4.32	0.48
Infant Distress to Limitations	490	3.17	0.62	1.00 – 6.00	1.13 – 5.24	0.16
Obstetric Complications	503	2.18	1.29	0 – N/A	0.00 – 6.00	0.48
Openness of Adoption	503	0.03	0.91	-	-2.23 – 1.86	-0.16
Adoptive Mother Age	498	37.80	5.43	-	24.48 – 52.53	-0.05
Adoptive Father Age	482	38.93	5.83	-	25.14 – 60.55	0.35

Notes: There was no upper limit on the measure of Obstetric Complications.

The Openness of Adoption variable was a composite (averaged) score of adoptive mothers', adoptive fathers', and birth mothers' standardized ratings on 1 – 7 rating scales regarding openness. Potential range is not relevant for adoptive mother and father ages.

Table 2

Bivariate correlations among key variables of interest.

	1	2	3	4	5	6	7	8	9	10	11	12
1). AM Harsh Parenting	1	.31**	.00	-.02	.28**	.05	.08	.02	-.01	-.21**	.13**	.17**
2). AF Harsh Parenting		1	.04	-.15**	.05	-.04	.21**	-.03	-.16**	-.12*	.10*	.21**
3). BM Harm Avoidance			1	-.04	.02	-.01	-.02	-.00	-.02	.03	.00	-.01
4). BM Reward Dependence				1	-.01	.08	-.08 [†]	.00	.03	.13**	.03	-.03
5). AM Harm Avoidance					1	.07	.03	.01	.09+	-.17**	.10*	.18**
6). AM Reward Dependence						1	.03	-.07	.11*	.08 [†]	-.08 [†]	-.06
7). AF Harm Avoidance							1	-.08 [†]	-.09 [†]	-.10*	.04	.14**
8). AF Reward Dependence								1	.19**	-.03	.05	.00
9). Marital Relationship Quality									1	-.03	-.11*	-.06
10). Infant Smiling & Laughter										1	-.11*	-.18**
11). Infant Distress to Novel Stimuli											1	.36**
12). Infant Distress to Limitations												1

Note:

* $p < .05$;** $p < .01$;† $p < .10$

Table 3

Comparison of standardized beta weights across the full sample and two random halves.

β	Full Sample, $N = 503$	1 st Half, $N = 251$	2 nd Half, $N = 252$
AM RDP → Marital Quality	.10*	.11	.10
AF RDP → Marital Quality	.20*	.21*	.18*
AM HAV → Marital Quality	.07	.11	.02
AF HAV → Marital Quality	.08	-.10	-.05
Marital Quality → AM Harsh Par.	-.04	-.04	-.04
AM RDP → AM Harsh Par.	.04	.02	.07
AM HAV → AM Harsh Par.	.26*	.29*	.21*
BM RDP → AM Harsh Par.	-.02	-.04	.00
BM HAV → AM Harsh Par.	-.01	-.03	.02
Marital Quality → AF Harsh Par.	-.15*	-.20*	-.11
AF RDP → AF Harsh Par.	.00	.05	-.05
AF HAV → AF Harsh Par.	.16*	.13*	.19*
BM RDP → AF Harsh Par.	-.13*	-.19*	-.10
BM HAV → AF Harsh Par.	-.02	.02	.04

Notes. RDP = Reward Dependence, HAV = Harm Avoidance.

* $p < .05$ and

† $p < .10$