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Adoptive Parent Hostility and Children's Peer Behavior Problems: Examining the Role of Genetically-Informed Child Attributes on Adoptive Parent Behavior

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Abstract

Socially disruptive behavior during peer interactions in early childhood is detrimental to children's social, emotional, and academic development. Few studies have investigated the developmental underpinnings of children's socially disruptive behavior using genetically-sensitive research designs that allow examination of parent-on-child and child-on-parent (evocative genotype-environment correlation) effects when examining family process and child outcome associations. Using an adoption-at-birth design, the present study controlled for passive genotype-environment correlation and directly examined evocative genotype-environment correlation (r_{GE}) while examining the associations between family processes and children's peer behavior. Specifically, the present study examined the evocative effect of genetic influences underlying toddler low social motivation on mother-child and father-child hostility, and the subsequent influence of parent

hostility on disruptive peer behavior during the preschool period. Participants were 316 linked triads of birth mothers, adoptive parents, and adopted children. Path analysis showed that birth mother low behavioral motivation predicted toddler low social motivation, which predicted both adoptive mother-child and father-child hostility, suggesting the presence of an evocative genotype-environment association. In addition, both mother-child and father-child hostility predicted children's later disruptive peer behavior. Results highlight the importance of considering genetically-influenced child attributes on parental hostility that in turn link to later child social behavior. Implications for intervention programs focusing on early family processes and the precursors of disrupted child social development are discussed.

Keywords

genotype-environment correlation; hostile parenting; toddler low social motivation; child peer behavior

Disruptive peer behavior is characterized by aggressive, defiant, or antisocial behavior that interferes with peer interactions (McWayne, Sekino, Hampton, & Fantuzzo, 2002). In early childhood (three-to-five year olds), this disruptive behavior occurs primarily in the classroom and during peer play and can negatively impact concurrent and future social, emotional, and academic outcomes (Coolahan, Fantuzzo, Mendez, & McDermott, 2000; Crick et al., 2006; Hampton & Fantuzzo, 2003). Disruptive peer behavior during early childhood can inhibit the development of social competencies necessary for establishing later relationships with peers (Crick et al., 2006), and has been linked to deficits in early learning and motivation (Coolahan et al., 2000; Fantuzzo & McWayne, 2002), as well as antisocial and criminal behavior in early adulthood (Vitaro, Barker, Brengden, & Tremblay, 2012).

Parenting practices have a significant and well-established impact on early childhood socialization processes, including children's peer behavior (Belsky, 1984; Ladd, 1999). Positive aspects of parenting such as warmth and supportiveness predict both concurrent and later social competence in children between 3 and 5 years of age (Eiden, Colder, Edwards, & Leonard, 2009; Lengua, Honorado, & Bush, 2007). Conversely, negative or hostile parenting can have a detrimental effect on children's social competence and social interaction skills (Brannigan, Gemmell, Pevalin, & Wade, 2002; Carson & Parke, 1996). Consistent with social learning theory (Putallaz & Heflin, 1990), when poor social skills are learned through negative parent-child interactions, they may shape children's social behavior, negatively affecting their reactions in social situations (Russell, Petit, & Mize, 1998). Additionally, mounting evidence suggests that mothers' vs. fathers' negative parenting may have differential influences on child social outcomes, with overt hostility in fathers contributing to disruptive peer behavior (Cabrera & Mitchell, 2009; Carson & Parke, 1996; Casas et al., 2006; Webster-Stratton & Hammond, 1999), and a lack of warmth and support in mothers contributing to less prosocial child behavior (Cabrera, Fagan, Wight, & Schadler, 2011; Dumas, LaFreniere, & Serketich, 1995; Lengua et al., 2007).

Aspects of toddler temperament, such as low social motivation, have also been associated with concurrent and later disruptive peer behavior (Fantuzzo, Bulotsky-Shearer, Fusco, &

McWayne, 2005; Zeller, Vannatta, Schafer, & Noll, 2003). Low social motivation is characterized by a preference for solitary play and inattention to social interactions (Asendorpf, 1990; Coplan, Prakesh, O'Neil, & Armer, 2004). Additionally, genetic influences have been found for low social motivation (Silberg et al., 2005), and inattention in social situations (e.g., Saudino, 2005; Sherman, Iacono, & McGue, 1997), indicating possible parent-to-child transmission. Thus, there is evidence that low social motivation is linked to the development of disruptive peer behavior and that this linkage may be due, in part, to genetic influences inherited from one's biological parents.

In biologically-related families, associations between parent and child characteristics may be the result of shared environmental influences and/or shared genetic influences. These shared genetic influences may also affect the child's rearing environment. When there is an association between a person's genotype and environment, this is referred to as genotype-environment correlation (*rGE*). Because the majority of studies examining the role of parenting on the development of peer behavior have typically focused on biologically-related families, it is impossible to unambiguously disentangle whether such parent-child associations are due to genetic or environmental influences.

The present study addresses this gap by examining disruptive peer behavior using a sample of children adopted at birth and their adoptive parents *and* birth mothers. A cascading set of influences will be examined, beginning with (1) the influence of birth mother low behavioral motivation on toddler low social motivation; (2) associations between toddler low social motivation and adoptive mother-child and father-child hostility; and (3) associations between adoptive parenting hostility and subsequent disruptive peer behavior.

Temperamental Factors Associated With Disruptive Peer Behavior

Many child characteristics have been observed as developmental correlates of disruptive peer behavior, including the temperamental traits of social inattention and low motivation to engage in social situations (Bulotsky-Shearer, Fantuzzo, & McDermott, 2010; Fantuzzo, Sekino, & Cohen, 2004; Mendez, Fantuzzo, & Cicchetti, 2002; Olson, Bates, Sandy, & Lanthier, 2000). A growing body of research has examined behavior that is characteristic of low social motivation such as solitary play and socially inattentive behavior in childhood (Asendorpf, 1990; Coplan et al., 2004; Coplan & Weeks, 2010; Rubin & Asendorpf, 1993). Low social motivation-based behavior has been identified as conceptually distinct from shyness (Coplan et al., 2004), and social avoidance (Coplan & Weeks, 2010). Theoretically, this behavioral profile is thought to be underpinned by low social approach motivation, where children lack intrinsic motivation to engage in social activities (Coplan et al., 2004). Additionally, research has shown that there is a significant genetic component to low social motivation in early childhood (Silberg et al., 2005).

A related construct in adults is the biologically-based behavioral approach system (BAS) which is proposed to account for individual differences in behavioral motivation in adults (Carver & White, 1994; Corr, 2004; Gray & McNaughton, 2000). The BAS is related to incentive and approach behavior such as reward-seeking, impulsivity, and extraversion (Gray & McNaughton, 2000), and has shown to have a significant genetic influence

(Takahashi et al., 2007). Individuals with high levels of BAS exhibit greater extraversion and sensitivity to reward, whereas those with low levels of BAS experience low motivation to engage in rewarding situations. BAS scores have been found to be associated with behavioral motivation (Jackson & Smillie, 2004). Low BAS scores have been related to low motivation, and clinically low levels of BAS have been associated with a severe lack of motivation and depression (Takahashi, Ozaki, Roberts, & Ando, 2012). Additionally, low BAS scores are associated with low motivation to engage in social interactions (Kimbrel, Mitchell, & Nelson-Gray, 2010) and inattentive social behavior (Hundt, Kimbrel, Mitchell, & Nelson-Gray, 2008; Kimbrel et al., 2010).

Collectively this research indicates that low behavioral approach in adults and children is indicative of low behavioral and social motivation. Given evidence of genetic influences and common theoretical underpinnings for both low behavioral motivation in adults and low social motivation in children, a common genetic influence may be indicated in biologically-related parents and children. Whereas parents may affect child behavior through shared genetic influences, children's social behavior may also be a product of the family environment via parenting and parental responses to child behavior (Patterson, 1982).

The Influence of Hostile Parenting on Social Behavior

Parenting during early childhood has been shown to have a significant impact on social development such as social competence (Lengua et al., 2007) and cooperation and social engagement (Landry, Smith, Swank, & Guttentag, 2008). Parenting that is harsh, negative, or hostile is particularly detrimental for children's social outcomes; hostility and unsupportiveness in the parent-child relationship are associated with less social competence and more social aggression in early to middle childhood (Brannigan et al., 2002; Carson & Parke, 1996; Chang, Schwartz, Dodge, & McBride-Chang, 2003). This is consistent with social learning theory, where children exposed to hostile parent-child exchanges learn maladaptive social responses (Russell et al., 1998). Consequently, children may interpret and respond disruptively in peer contexts based on prior negative experiences with parents.

Previous research on hostile parenting has primarily focused on the mother-child relationship in studying parent-to-child influences. Recent evidence indicates that the father-child relationship also has specific influences on children's emotional and behavioral development, specifically in relation to hostility in the parent-child relationship (Harold, Elam, Lewis, Rice, & Thapar, 2012; Lamb, 2004; Stover et al., 2012). For example, harsh and controlling paternal behavior was found to negatively predict child social competence (Cabrera & Mitchell, 2009) and social restraint in the classroom (Feldman & Wentzel, 1990). Fathers' harsh, negative, and controlling authoritarian parenting has also been associated with poor social development (Kelley et al., 1998) and child relational aggression (Carson & Parke, 1996; Casas et al., 2006), leading to subsequent future peer rejection (Crick et al., 2006). Whereas some research has evidenced a link between mother's controlling behavior and social aggression (Casas et al., 2006), less warmth, sensitivity, and supportive behavior have typically been found to negatively affect child social competence and prosocial behavior (Cabrera et al., 2011; Dumas et al., 1995; Lengua et al., 2007). Thus, although both mother-child and father-child hostility adversely affect social development in

early childhood, fathers' hostile parenting, in particular, may make stronger contributions to children's disruptive social behavior.

The Confound of Genotype-Environment Correlation

Low behavioral motivation, low social motivation, and inattention have been shown to be moderately heritable in both adults and children (Goldsmith, Buss, & Lemery, 1997; Saviouk et al., 2011; Sherman et al., 1997; Silberg et al., 2005; Takahashi et al., 2007), indicating possible parent-to-child transmission of these characteristics in biologically-related parents and children. Such parent characteristics (i.e., low behavioral motivation) may therefore influence child characteristics (i.e., low social motivation) through shared genetic influences. Additionally, associations between hostile parenting and children's social behavior may be due to shared genetic influences. It is not possible to unambiguously disentangle whether parent-to-child influences are a result of shared genetic effects (i.e., genotype), postnatal environmental influences (i.e., parenting), or both, in studies of biologically-related families because these effects are confounded (see Harold et al., 2010). As biologically-related parents and children share genes, associations between parent and child traits may also result from this overlap. It is also possible that a child's genotype may be related to their rearing environment, as studies have found evidence of genetic influences on parenting behaviors (see Horwitz & Neiderhiser, 2011 for a review). When a child's genotype is systematically related to their environment, this is known as genotype-environment correlation (rGE ; Plomin, DeFries, Knopik, & Neiderhiser, 2013; Plomin, DeFries, & Loehlin 1977). Two primary types of rGE are described in the literature. First, passive rGE is present when the child's genes are correlated with their environment. For example, passive rGE occurs when parenting behavior is correlated with the parents' genes that the child inherits (e.g., temperamentally dysregulated parents may parent more harshly than parents with other temperament profiles). Second, evocative rGE occurs when a child's genetically-influenced characteristics evoke a systematic response from the environment (e.g., child behavior may evoke more hostile parenting).

Passive and evocative rGE have been highlighted in past research using the twin design (Horwitz & Neiderhiser, 2011), and a variation thereof known as the children-of-twins (CoT) design (D'Onofrio, 2005). Some studies suggest that passive rGE is not an evident component underlying associations between features of the rearing environment (e.g., parenting behavior) and children's developmental outcomes (Caspi et al., 2004). However, evidence of passive rGE cannot be ruled out in most genetically informed studies, specifically in relation to links between parenting behavior and child adjustment. Examination of evocative rGE has been facilitated by longitudinal designs where genetically-influenced twin behaviors predict later parenting. Using this design, evocative effects have been found between toddlers' difficult temperament and behavior on mothers' hostile parenting (Forget-Dubois et al., 2007).

A handful of genetically-informed studies have examined measures of peer relationships. Peer difficulties at ages 5 to 7 were found to be influenced by genetic and nonshared environmental influences (Boivin et al., 2012). This pattern of influences has also been found for peer delinquency (Beaver et al., 2009; Bullock, Deater-Deckard, & Leve, 2006;

Iervolino et al., 2002), and peer interaction (Pike & Atzaba-Poria, 2003) during late childhood and adolescence. The few studies examining peer behavior in early childhood have evidenced genetic influences on prosocial behavior (Knafo & Plomin, 2006) and social competence (Roisman & Fraley, 2012). In general, there is less evidence of shared environmental influences on peer relationships than for parent-child relationships, although both show genetic and nonshared environmental influences.

Given the presence of both genetic and environmental contributions to parenting and peer interactions, as well as to child behavior, the associations among child behavior and parenting, and parenting and peer behavior, may be due to genetic factors, environmental factors, or a combination of the two (including *rGE*). Utilizing research designs that permit separation of passive *rGE* from family relationship and child outcome associations and that permit examination of evocative *rGE* has significant implications for understanding associations between patterns of family interaction and child development. We offer a study design that accommodates this unique opportunity.

The Present Study

The present study examined the influence of birth mother low behavioral motivation on toddler low social motivation and the potential evocative influence this child behavior may have on adoptive mother-child hostility and father-child hostility toward their toddler. Additionally, the present study examined the influence of adoptive mother-child and father-child hostility as predictors of disruptive peer behavior during early childhood, as reported by adoptive mothers and fathers (see Figure 1). In order to address the potential confounding role of shared method variance as a result of reliance on mother- and-father reported parenting practices and children's disruptive peer behavior, additional analyses were conducted. Specifically, separate mother-child and father-child models were estimated to remediate the potential confounding role of shared method variance and to affirm the pattern of results reported. To our knowledge, this is the first study to examine the interplay between specific parent-based family interaction patterns and child disruptive peer behavior, allowing the confound of passive *rGE* to be controlled, while also permitting simultaneous examination of child-on-parent effects stemming from child genetically-influenced risk behaviors (evocative *rGE*) on both mother-child *and* father-child relationships.

Method

Participants and Procedures

Early Growth and Development Study (EGDS)—Participants were a subsample ($n = 316$) of 361 linked sets of adopted children, adoptive mothers and fathers, and birth mothers. Participants were recruited between 2003 and 2006 through 33 adoption agencies located in 10 states spanning the Northwest, Mid-Atlantic and Southwest regions of the United States. Each adoption agency appointed a liaison from their organization to assist with recruitment who identified participants who completed an adoption plan that met the study's eligibility criteria. Eligibility criteria included: (1) domestic adoption placement; (2) placement occurring within 3 months postpartum; (3) non-relative placement; (4) no known major medical conditions such as extreme prematurity or extensive medical surgeries; and (5) birth

and adoptive parents able to understand English at the eighth-grade level. Study participants were representative of the adoptive and birth parent populations that completed adoption plans at the participating agencies during the same time period (Leve et al., 2013). Data were collected by home visit assessments and online questionnaires. For the present study, adoptive parent data from the 27-month ($M = 2.30$ years, $SD = 0.13$) and age 4.5 year ($M = 4.62$, $SD = 0.16$) assessments were used, and from the birth parent assessment at 4.5 years. Fifty-six percent of the children were male. The median child age at adoption placement was 2 days. Birth parents typically had high school or trade school education levels and household incomes under \$25,000. Adoptive parents were typically college educated, middle to upper class families. Given the nature of our hypotheses, single parents ($n = 13$) and same sex couples ($n = 21$) were excluded from the present report. Adoptive mother, adoptive father, and birth mother mean age in years was 37 ($SD = 5.5$), 38 ($SD = 5.8$), and 24 ($SD = 5.9$), respectively, at the child's birth. The ethnicity of adoptive mothers, fathers, and adopted child respectively was: 91%, 90%, and 71% Caucasian, 4%, 5%, and 11% African American, 3%, 2%, and 7% Hispanic or Latino, 1%, 1%, and 5% multiracial, 1%, 1%, 2% Asian, <1%, 0%, and 3% American Indian or Alaskan Native, and 1%, 1%, and 1% unknown or unreported. There were no significant differences between the full EGDS sample and the analytical sample used in this report. For full demographic information refer to Leve et al., (2013).

Measures

Birth mother low behavioral motivation—Birth mothers completed the Behavioral Inhibition/Behavioral Activation Scales (Carver & White, 1994) at the age 4.5 year assessment. Birth mothers responded to statements assessing their behavioral inhibition and behavioral activation on a 4-point scale ranging from 'very true' to 'very false', with high scores indicating less inhibition and activation. The 5-item reward responsiveness scale assessed birth mother's reaction to positive outcomes, the 4-item drive scale assessed birth mother's motivation relevant to goals, and the 4-item fun seeking scale assessed birth mother's likelihood to engage in new activities and spontaneous behavior. The reward responsiveness scale included items such as, "When good thing happen to me it affects me strongly", "When I'm doing well at something I love to keep at it", and "It would excite me to win a contest"; the drive scale included items such as, "When I want something I usually go all-out to get it", "When I see a chance to get something I want I move on it right away", and "I go out of my way to get things I want"; and the fun seeking scale "I crave excitement and new sensations", "I often act on the spur of the moment", and "I am willing to try something new if I think it will be fun." Internal consistency estimates were good (reward $\alpha = .77$, drive $\alpha = .80$, fun seeking $\alpha = .68$). The scales were all moderately correlated ($r = .49$ to $.50$, $p < .001$), and were combined into a single measure of low behavioral motivation (Corr, 2004; Gray & McNaughton, 2000), with higher scores indicating lower behavioral motivation ($\alpha = .88$).

Toddler low social motivation—When the children were 27-months of age, adoptive mothers and fathers each completed 5 items from the Maternal Perception Questionnaire (Olsen, Bates, & Bayles, 1982), comprising the unresponsiveness to parent subscale. Adoptive parents responded to statements assessing how unresponsive they perceived their

child to be on a 7-point scale ranging from ‘*strongly disagree*’ to ‘*strongly agree*’, with higher scores indicating greater disengagement and low social motivation towards parents. Items from the scale included “My child prefers playing by him/herself rather than with me”, “My child doesn’t come to me as often as I would like”, “I often find it hard to get my child’s attention”.

Also at 27-months of age, adoptive mothers and fathers individually participated in a 3-minute free play task with their child in the families’ home. The free play session was later rated by independent coders for a number of qualities of parent and child interaction. Three of the items were selected to reflect toddler low social motivation. They included “How often did the child become involved in his/her own play without reference to the parent’s play?”, “How often did the child and parent engage in parallel play?”, and “How often did the child engage in solitary pretend play?”, which were rated by coders on a 5-point scale ranging from ‘*never*’ to ‘*almost all the time*’ (Pears & Ayers, 2000). Items were scored for low levels of child engagement and low levels of responsiveness to the parent. Reliabilities were calculated on 15% of the sample using weighted percent agreement by assigning weights to the reliability coder and calibrator answers. Each differing set of answers was assigned a percentage of how far they varied from absolute agreement, with the weights assigned determined by the range of the scale. An average was then taken of the weights to arrive at a weighted percent agreement with values for the three items ranging from .80 to .94. The 5 parent-rated questionnaire items and the 3 coder-rated items from the free play task were standardized and combined to form composite measures of child low social motivation relative to both mother and father. The resulting mother and father measures were found to have adequate internal consistency, respectively ($\alpha = .63$, $\alpha = .66$), and to be moderately correlated ($r = .36$), and were combined into a single measure of child low social motivation.

Adoptive parent-child hostility—Adoptive mothers and fathers completed the Iowa Family Interaction Rating Scales (Melby et al., 1993) about their parenting behaviors at child age 27-months. Parents reported on their own hostile behaviors toward their child on a 7-point scale ranging from ‘*never*’ to ‘*always*’ with high scores indicating greater hostility. The 5-item hostility subscale included items such as “how often did you get angry at him/her”, “how often did you criticize him/her”, and “how often did you argue with him/her when you disagreed about something.” Internal consistency estimates were good for mothers and fathers, respectively ($\alpha = .72$, $\alpha = .66$).

Child disruptive peer behavior—Adoptive mothers and fathers completed the Penn Interactive Peer Play Scale (McWayne et al., 2002) at child age 4.5 years. Parents reported on children’s peer play behaviors on a 4-point scale ranging from ‘*never*’ to ‘*always*’ with high scores indicating greater occurrence of social or antisocial behavior. The 11-item disruption subscale included items such as “starts fights and arguments”, “disrupts the play of others”, and “rejects the play ideas of others.” Internal consistency estimates were good for mothers and fathers, respectively ($\alpha = .80$, $\alpha = .77$).

Control variables—A composite measure of prenatal influences was used which assessed birth mothers pregnancy complications, neonatal complications, exposure to environmental

toxins, and use of drugs, alcohol, and tobacco. This measure of prenatal influences was not found to be associated with any variable in the current study. To further control for any possible prenatal influences, this measure was residualized out of the birth mother low behavioral motivation variable, ensuring any association between birth mother low behavioral motivation and toddler low social motivation was not due to variance associated with prenatal influences. In addition, adoptive parent reports of child peer disruption partialled out the effect of adoption openness (contact between adoptive and birth parents). Adoption openness was not found to be associated with any variable in the current study.

Statistical Analyses

Path analysis using structural equation modeling (SEM; Muthén, & Muthén, 2007) was used to conduct all primary statistical analysis. All relevant statistical assumptions inherent to the application of SEM (e.g., multivariate normalcy) were examined and affirmed a priori. Correlations between primary theoretical constructs were initially examined. Following this, path analysis was used to examine the associations linking birth mother low behavioral motivation to mother-child and father-child hostility via toddler low social motivation, and the subsequent influence of hostility on disruptive peer behavior. Model tests were conducted using Mplus 5.2 (Muthén & Muthén, 2007). There was an available sample of 316 cases. Within this sample, the Little's test of missing data indicated that the data were missing completely at random (MCAR), $X^2(84) = 82.62, p = .52$ with the following proportion of missingness for each variable: birth mother low behavioral motivation: 12%, toddler low social motivation: 19%, mother-child hostility: 10%, father-child hostility: 12%, mother report of child disruptive peer behavior: 23%, father report of child disruptive peer behavior: 30%. Multiple imputation with data augmentation was used to generate values for missing data across relevant theoretical variables within the proposed model using NORM 2.03 (Schafer, 1997), regarded as the most robust method for multiple imputation (Allison, 2001).

Results

Correlational Analysis

Intercorrelations, means, and standard deviations for the sample are located in Table 1. Significant associations were found supporting the proposed theoretical model. Birth mother low behavioral motivation was significantly related to toddler low social motivation, as well as to mother-child hostility. Toddler low social motivation was significantly related to mother- and father-child hostility. Mother- and father-child hostility were significantly related to mother's and father's report of disruptive peer behavior.

Full Theoretical Model

As an initial step, the direct influence of birth mother low behavioral motivation on adoptive mother- and father-child hostility was tested. Birth mother low behavioral motivation was found to be significantly associated with greater mother-child hostility ($B = .07, SE B = .03, \beta = .16, p = .007$), with both mother- and father-child hostility predicting greater mother and father reports of disruptive peer behavior within rater ($B = .32, SE B = .12, \beta = .21, p = .007$ and $B = .41, SE B = .10, \beta = .29, p < .001$), and father-child hostility predicting greater

mother-reported disruptive peer behavior ($B = .22$, $SE B = .10$, $\beta = .14$, $p = .03$). Following these initial tests, the full proposed theoretical model was examined with results presented in Figure 1. Birth mother low behavioral motivation was found to significantly predict toddler low social motivation ($B = .21$, $SE B = .08$, $\beta = .17$, $p = .01$), which in turn significantly predicted mother- and father-child hostility ($B = .06$, $SE B = .02$, $\beta = .16$, $p = .005$ and $B = .08$, $SE B = .02$, $\beta = .22$, $p = .01$). A significant direct association from birth mother low behavioral motivation to mother-child hostility was also found ($B = .06$, $SE B = .03$, $\beta = .14$, $p = .03$). Mother- and father-child hostility were found to respectively predict mother and father reports of disruptive peer behavior within rater ($B = .31$, $SE B = .11$, $\beta = .20$, $p = .008$ and $B = .40$, $SE B = .11$, $\beta = .28$, $p < .001$), with father-child hostility also predicting mother reported disruptive peer behavior ($B = .21$, $SE B = .10$, $\beta = .13$, $p = .04$).

Because initial tests did not indicate a significant association between birth mother low behavioral motivation and father-child hostility, that portion of the model did not meet the criteria that Baron and Kenny (1986) describe as necessary to define a mediational pathway. However, an independent variable can have an *indirect effect* on a dependent variable even if the two variables are not correlated, if the independent variable influences a third, intervening variable, which in turn affects the dependent variable (MacKinnon, Krull, & Lockwood, 2000; MacKinnon et al., 2002). If the independent and dependent variables are each related to the proposed intervening variable, the significance of the indirect association between the independent and dependent variables can then be assessed statistically. We examined whether birth mother low behavioral motivation had an indirect effect on mother- and father-child hostility through the intervening variable of toddler low social motivation, using procedures outlined by Sobel (1982) to test the significance of all indirect effects. Significant indirect effects were found from birth mother low behavioral motivation and greater within rater mother- and father-child hostility via toddler low social motivation ($B = .01$, $SE B = .01$, $\beta = .03$, $p = .04$ and $B = .02$, $SE B = .01$, $\beta = .04$, $p = .03$) as well as between toddler low social motivation and mother and father reports of disruptive peer behavior via within rater reports of mother- and father-child hostility ($B = .02$, $SE B = .01$, $\beta = .03$, $p = .04$ and $B = .02$, $SE B = .01$, $\beta = .06$, $p = .02$). A marginally significant indirect effect was also found between toddler low social motivation and mother reports of disruptive peer behavior via father-child hostility ($B = .02$, $SE B = .01$, $\beta = .03$, $p = .06$). A good fit between the data and model was suggested by fit indices ($\chi^2(2) = 0.31$, RMSEA = .00, CFI = 1.00, TLI = 1.06, SRMR = .008).

Discussion

The present study utilized an adoption design to examine the evocative association between genetic influences on toddler low social motivation and mother-child and father-child hostility, and the subsequent relation with child disruptive peer behavior at age 4.5. Both the correlational and model results indicated a significant association between birth mother low behavioral motivation and toddler low social motivation, which in turn was related to both adoptive mother- and father-child hostility. This process suggests evocative *rGE* where a genetic liability for low behavioral motivation manifested as toddler low social motivation evokes greater hostility in both the mother-child and father-child relationships. Mother-child hostility predicted mother-report of later disruptive peer behavior in the child, whereas

father-child hostility predicted both father- and mother-report of disruptive peer behavior in the child. Given the absence of genetic relatedness between adoptive parents and their adopted child, passive rGE cannot explain the association between mother and father hostility and disruptive peer behavior. As mother and father hostility were examined separately, a distinct influence of father-child hostility appeared to confer greater risk for disruptive peer behavior. This study advances the investigation of evocative rGE and environmental mediation by examining both in the context of the same study where these processes can be detected and distinguished given the absence of genetic relatedness.

Whereas previous twin (Burt, McGue, Krueger, & Iacono, 2005; Narusyte et al., 2011; Pike, McGuire, Hetherington, Reiss, & Plomin, 1996) and adoption (O'Connor et al., 1998) studies have suggested evocative rGE between antisocial-type behaviors and negative parenting practices in adolescence, little research has focused on temperamental aspects of child behavior in early childhood, where evocative rGE has also been evidenced (Boivin et al., 2005; Forget-Dubois et al., 2007). The present study advances this area of research by first illustrating a significant association between birth mother low behavioral motivation and toddler low social motivation, suggesting that this temperamental behavior is genetically informed. Evidence of evocative rGE was suggested where toddler low social motivation predicted greater mother-child and father-child hostility. This pattern of effects was strengthened by the presence of indirect effects from birth mother low behavioral motivation to both mother- and father-child hostility operating via toddler low social motivation. These results suggest that a genetic liability for low social motivation early in life elicits hostile parenting from both mothers and fathers. This finding is noteworthy, as little research has previously examined these constructs (Boivin et al., 2005; Forget-Dubois et al., 2007), especially with regard to the relative effects of mother and father parenting practices considered in the same context. Additionally, this evocative relation appears to be relatively equivalent on both mother and father hostility, possibly indicating that both mothers and fathers are similarly responsive in a hostile manner to difficult aspects of their child's temperament. Also, the presence of a remaining direct path from birth mother low behavioral motivation to mother-child hostility in the final model indicates that some other unmeasured variable may still mediate this evocative relationship (e.g., toddler internalizing symptoms). Compared to father-child hostility, genetically-influenced aspects of low child social motivation may be more likely to evoke hostile parenting in mothers.

Findings from the present study also examined the subsequent effect of parental hostility on later disruptive peer behavior. Past research has illustrated the unique influences of mother-child hostility and father-child hostility on child social outcomes, suggesting that where fathers' parenting toward the child is harsh, hostile, and overt, it may be more detrimental to children's social behavior (Cabrera & Mitchell, 2009; Kelley et al., 1998). The present pattern of results fits with prior research; both mother-child and father-child hostility predicted their own report of disruptive peer behavior. Father-child hostility also predicted mothers' report of disruptive peer behavior. This may indicate that father-child hostility in the family context is more salient in child socialization, and when present confers a greater risk for later aggressive-type behaviors, including those occurring in social settings. Further, similar to past genetically sensitive studies, the current use of an adoption sample controlled

for passive *rGE*, removing this as a potential mechanism underlying the association between hostility in the mother-child and father-child relationship and disruptive peer behavior. Thus, it can be concluded with greater confidence that transmission linking parent-child hostility to disruptive peer behavior is explained by the environmental salience of negative parenting.

The most notable advance of the present study over past research is the examination of evocative *rGE* between toddler low social motivation on parent-child hostility while also controlling for passive *rGE*, in the longitudinal interplay between hostile parenting and disruptive peer behavior. This is especially relevant given that the present age range, 2 to 4 years of age, appears to be a period across which both evocative and passive *rGE* may occur as during middle childhood children still spend the majority of their time out of school with their parents. In non-genetically sensitive studies, disruptive behavior in early childhood predicts negative parent-child responses (Combs-Ronto et al., 2009), and greater vulnerability to the effects of negative parenting (Kiff et al., 2011). This is supported by research indicating the presence of evocative *rGE* effects between infants' and toddlers' difficult behavior and parent's hostile-reactive behavior (Boivin et al., 2005; Forget-Dubois et al., 2007). When temperamental problems are present in early childhood, such as these, they appear to evoke negative parenting. When considered collectively, this suggests a 'cascading' effect (i.e., Scaramella & Leve, 2004) where risk for child behavioral dysfunction in childhood originates early in life and negative parenting practices arising in response to temperamental difficulty subsequently contribute to child disorder later in life (Kiff et al., 2011; Trentacosta & Shaw, 2008). The present study advances previous research by testing both processes within the same longitudinal design, illustrating that children's genetic propensities early in life that manifest as undesirable behaviors (low social motivation) can elicit hostile parenting and through (likely) environmental routes affect later child development (disruptive peer behavior).

Limitations and Recommendations for Future Research

Whereas the ability to examine evocative *rGE* between toddler low social motivation and hostile parenting served as a primary strength of the present study, toddler low social motivation only partially mediated the influences from birth mother low behavioral motivation to mother-child hostility. This indicates that an unmeasured aspect of the child may further mediate this relationship. Another limitation in the present examination of evocative *rGE* was that toddler low social motivation and parent-child hostility were measured at the same time of assessment. This limits the ability to draw inference between these constructs, which would be strengthened by longitudinal separation (Rutter, 2007). However, the direction of effects observed in the present study fits with the pattern of evocative effects observed in past research in both genetically sensitive longitudinal studies (Boivin et al., 2005; Forget-Dubois et al., 2007), and meta-analysis of normative samples (Kiff et al., 2011). An additional limitation was that the proportion of variance explained in disruptive peer behavior was small, indicating significant influence of other unmeasured variables on disruptive peer behavior. Despite this limitation, the measurement of parenting and child outcome in the present study were longitudinally separated, allowing for a more confident assumption that parent hostility predicted disruptive peer behavior. Future research is needed where each parent and child construct are separated longitudinally to

further assure this pattern of effects. Finally, the present study relied on adoptive parent report of both adoptive parent and child behavior. This limitation was partially addressed by using a cross-rater approach including mother and father report of both hostility and disruptive peer behavior, which allowed examination of the relative effects of mothers and fathers. However, shared method variance may be a factor in confounding the pattern of associations noted between parent-reported family interaction patterns and children's disruptive peer behavior, such that noted associations are amplified by the presence of shared method variance. In order to address this concern, we partitioned our proposed theoretical model and ran separate mother-child and father-child models (using opposite-parent report of child disruptive peer behavior). Results were replicated with no substantial differences to the pattern of results reported for the full theoretical model.¹

Despite these limitations, the present study illustrates the unique opportunity that an adoption design confers in the parallel examination of evocative *rGE* and environmental mediation. Further, this study facilitated investigation of these mechanisms within the context of family processes (parenting) in a longitudinal design. As a result, the study advances important objectives in the study of child development by identifying associations that are not confounded by shared genetic influences. This is especially relevant as social skills and positive social interactions are vital for the promotion of child resilience in the face of genetic and environmental risks (Rutter, 2012). This underscores the importance and relevance of the present study in identifying aspects of mother's and father's parenting that impinge on social development applicable to prevention and intervention programs.

References

- Allison, PD. Missing Data. Thousand Oaks, CA: Sage; 2001.
- Asendorpf J. Beyond social withdrawal: Shyness, unsociability and peer avoidance. *Human Development*. 1990; 33:250–259.10.1159/000276522
- Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology*. 1986; 51:1173–1182.10.1037//0022-3514.51.6.1173 [PubMed: 3806354]
- Beaver KM, Shutt JE, Boutwell BB, Ratchford M, Roberts K, Barnes JC. Genetic and environmental influences on levels of self-control and delinquent peer affiliation: Results from a longitudinal sample of adolescent twins. *Criminal Justice and Behavior*. 2009; 36:41–60.10.1177/0093854808326992
- Belsky J. The determinants of parenting: a process model. *Child Development*. 1984; 55:83–96.10.2307/1129836 [PubMed: 6705636]
- Boivin M, Brendgen M, Vitaro F, Dionne G, Girard A, Pérusse D, Tremblay RE. Strong genetic contribution to peer relationship difficulties at school entry: Findings from a longitudinal twin study. *Child Development*. 2012 Advance online publication. 10.1111/cdev.12019
- Boivin M, Perusse D, Dionne G, Sayset V, Zoccolillo M, Tarabulsy GM, Tremblay RE, et al. 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]
- Brannigan A, Gemmell W, Pevalin DJ, Wade TJ. Self-control and social control in childhood misconduct and aggression: The role of family structure, hyperactivity, and hostile parenting. *Canadian Journal of Criminology*. 2002; 44:119–142.

¹Results from these analyses may be obtained by writing to the corresponding author.

- Bullock BM, Deater-Deckard K, Leve LD. Deviant peer affiliation and problem behavior: A test of genetic and environmental influences. *Journal of Abnormal Child Psychology*. 2006; 34:29–41.10.1007/s10802-005-9004-9 [PubMed: 16550453]
- Bulotsky-Shearer RJ, Fantuzzo JW, McDermott PA. Typology of classroom emotional and behavioral adjustment for urban Head Start children: A child-centered, contextually relevant approach. *Journal of Applied Developmental Psychology*. 2010; 31:180–191.
- Burt SA, 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/S095457940505008X [PubMed: 15971764]
- Cabrera NJ, Fagan J, Wight V, Schadler C. Influence of mother, father, and child risk on parenting and children’s cognitive and social behaviors. *Child Development*. 2011; 82:1985–2005.10.1111/j.1467-8624.2011.01667.x [PubMed: 22026516]
- Cabrera N, Mitchell S. An exploratory study of fathers parenting stress and toddlers social development in low-income African American families. *Fathering*. 2009; 7:201–225. [PubMed: 20190875]
- Carson J, Parke RD. Reciprocity of parent-child negative affect and children’s social competence. *Child Development*. 1996; 67:2217–2226. [PubMed: 9022239]
- Carver CS, White TI. Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS Scales. *Journal of Personality and Social Psychology*. 1994; 67:319–333. 10.1037//0022- 3514.67.2.319.
- Casas JF, Weigel SM, Crick NR, Ostrov JM, Woods KE, Jansen Yeh EA, Huddleston-Casas CA. Early parenting and children’s relational and physical aggression in the preschool and home contexts. *Journal of Applied Developmental Psychology*. 2006; 27:209–227.10.1016/j.appdev.2006.02.003
- Caspi A, Moffitt TE, Morgan J, Rutter M, Taylor A, Arseneault L, Polo-Tomas M. Maternal expressed emotion predicts children’s antisocial behavior problems: Using MZ-twin differences to identify environmental effects on behavioral development. *Developmental Psychology*. 2004; 40:149–161.10.1037/0012-1649.40.2.149 [PubMed: 14979757]
- Chang L, Schwartz D, Dodge KA, McBride-Chang C. Harsh parenting in relation to child emotion regulation and aggression. *Journal of Family Psychology*. 2003; 17:598–606.10.1037/0893-3200.17.4.598 [PubMed: 14640808]
- Combs-Ronto LA, Olson SL, Lunkenheimer ES, Sameroff AJ. Interactions between maternal parenting and children’s early disruptive behavior: Bidirectional associations across the transition from preschool to school entry. *Journal of abnormal child psychology*. 2009; 37:1151–1163.10.1007/s10802-009-9332-2 [PubMed: 19533326]
- Coolahan K, Fantuzzo J, Mendez J, McDermott P. Preschool peer interactions and readiness to learn: Relationships between classroom peer play and learning behaviors and conduct. *Journal of Educational Psychology*. 2000; 92:458–465.10.1037//0022-0663.92.3.458
- Coplan RJ, Prakash K, O’Neil K, Armer M. Do you ‘want’ to play? Distinguishing between conflicted shyness and social disinterest in early childhood. *Developmental Psychology*. 2004; 40:244–258.10.1037/0012-1649.40.2.244 [PubMed: 14979764]
- Coplan RJ, Weeks M. Unsociability in middle childhood: Conceptualization, assessment, and associations with socio-emotional functioning. *Merrill-Palmer Quarterly*. 2010; 56:105–130.
- Corr PJ. Reinforcement sensitivity theory and personality. *Neuroscience & Biobehavioral Reviews*. 2004; 28:317–332.10.1016/j.neubiorev.2004.01.005 [PubMed: 15225974]
- Crick NR, Ostrov JM, Burr JE, Cullerton-Sen C, Jansen-Yeh E, Ralston P. A longitudinal study of relational and physical aggression in preschool. *Journal of Applied Developmental Psychology*. 2006; 27:254–268.10.1016/j.appdev.2006.02.006
- D’Onofrio, BM. Children of twins design. In: Everitt, BS.; Howell, DC., editors. *Encyclopedia of Statistics in Behavioral Science*. Hoboken, NJ: John Wiley & Sons; 2005. p. 256-258.
- Dumas JE, LaFreniere PJ, Serketich WJ. "Balance of power": A transactional analysis of control in mother-child dyads involving socially competent, aggressive, and anxious children. *Journal of Abnormal Psychology*. 1995; 104:104–113.10.1037//0021-843X.104.1.104 [PubMed: 7897032]

- Eiden RD, Colder C, Edwards EP, Leonard KE. A longitudinal study of social competence among children of alcoholic and nonalcoholic parents: Role of parental psychopathology, parental warmth, and self-regulation. *Psychology of Addictive Behaviors*. 2009; 23:36–46.10.1037/a0014839 [PubMed: 19290688]
- Fantuzzo JW, Bulotsky-Shearer R, Fusco RA, McWayne C. An investigation of preschool classroom behavioral adjustment problems and socialemotional school readiness competencies. *Early Childhood Research Quarterly*. 2005; 20:259–275.10.1016/j.ecresq.2005.07.001
- Fantuzzo J, McWayne C. The relationship between peer-play interactions in the family context and dimensions of school readiness for low-income preschool children. *Journal of Educational Psychology*. 2002; 94:79–87.10.1037//0022-0663.94.1.79
- Fantuzzo J, Sekino Y, Cohen HL. An examination of the contributions of interactive peer play to salient classroom competencies for urban Head Start children. *Psychology in the Schools*. 2004; 41:323–336.10.1002/pits.10162
- Feldman SS, Wentzel KR. Relations among family interaction patterns, classroom self-restraint, and academic achievement in preadolescent boys. *Journal of Educational Psychology*. 1990; 82:813–819.10.1037//0022-0663.82.4.813
- Forget-Dubois N, Boivin M, Dionne G, Pierce T, Tremblay RE, Pérusse D. A longitudinal twin study of the genetic and environmental etiology of maternal hostile-reactive behavior during infancy and toddlerhood. *Infant Behavior and Development*. 2007; 30:453–465.10.1016/j.infbeh.2006.12.005 [PubMed: 17683754]
- Goldsmith HH, Buss KA, Lemery KS. Toddler and childhood temperament: Expanded content, stronger genetic evidence, new evidence for the importance of environment. *Developmental Psychology*. 1997; 33:891. [PubMed: 9383612]
- Gray, JA.; McNaughton, N. *The neuropsychology of anxiety*. Oxford: Oxford University Press; 2000.
- Hampton VR, Fantuzzo JW. The validity of the Penn Interactive Peer Play Scale with urban, low-income kindergarten children. *School Psychology Review*. 2003; 32:77–91.
- Harold GT, Elam KK, Lewis G, Rice F, Thapar A. Interparental conflict, parent psychopathology, hostile parenting and child antisocial behavior: Examining the role of maternal versus paternal influences using a novel genetically sensitive research design. *Development and Psychopathology*. 2012; 24:1283–1295.10.1017/S0954579412000703 [PubMed: 23062297]
- Harold GT, Rice F, Hay DF, Boivin J, Van DBM, Thapar A. Familial transmission of depression and antisocial behavior symptoms: disentangling the contribution of inherited and environmental factors and testing the mediating role of parenting. *Psychological Medicine*. 2010; 41:1–11.10.1017/S0033291710001753 [PubMed: 20624328]
- Horwitz BN, Neiderhiser JM. Gene–environment interplay, family relationships, and child adjustment. *Journal of Marriage and Family*. 2011; 73:804–816.10.1111/j.1741-3737.2011.00846.x [PubMed: 22162877]
- Hundt NE, Kimbrel NA, Mitchell JT, Nelson-Gray RO. High BAS, but not low BIS, predicts externalizing symptoms in adults. *Personality and Individual Differences*. 2008; 44:565–575.10.1016/j.paid.2007.09.018
- Iervolino AC, Pike A, Manke B, Reiss D, Hetherington E, Plomin R. Genetic and environmental influences in adolescent peer socialization: Evidence from two genetically sensitive designs. *Child Development*. 2002; 73:162–174.10.1111/1467-8624.00398 [PubMed: 14717250]
- Jackson CJ, Smillie LD. Appetitive motivation predicts the majority of personality and an ability measure: A comparison of BAS measures. *Personality and Individual Differences*. 2004; 36:1627–1636.10.1016/j.paid.2003.06.010
- Kelley ML, Smith TS, Green AP, Berndt AE, Rogers MC. Importance of fathers' parenting to African-American toddler's social and cognitive development. *Infant Behavior and Development*. 1998; 21:733–744.10.1016/S0163-63839890041-8
- Kiff CJ, Lengua LJ, Zalewski M. Nature and nurturing: Parenting in the context of child temperament. *Clinical Child and Family Psychology review*. 2011; 14:251–301.10.1007/s10567-011-0093-4 [PubMed: 21461681]

- Kimbrel NA, Mitchell JT, Nelson-Gray RO. An examination of the relationship between behavioral approach system (BAS) sensitivity and social interaction anxiety. *Journal of Anxiety Disorders*. 2010; 24:372–378.10.1016/j.janxdis.2010.02.002 [PubMed: 20197227]
- Knafo A, Plomin R. Prosocial behavior from early to middle childhood: Genetic and environmental influences on stability and change. *Developmental Psychology*. 2006; 42:771–786.10.1037/0012-1649.42.5.771 [PubMed: 16953685]
- Ladd GW. Peer relationships and social competence during early and middle childhood. *Annual Review of Psychology*. 1999; 50:333–359.10.1146/annurev.psych.50.1.333
- Lamb, ME. *The role of the father in child development*. 4. Hoboken, NJ: Wiley; 2004.
- Landry SH, Smith KE, Swank PR, Guttentag C. A responsive parenting intervention: The optimal timing across early childhood for impacting maternal behaviors and child outcomes. *Developmental Psychology*. 2008; 44:1335–1353.10.1037/a0013030 [PubMed: 18793067]
- Lengua LJ, Honorado E, Bush N. Contextual risk and parenting as predictors of effortful control and social competence in preschool children. *Journal of Applied Developmental Psychology*. 2007; 28:40–55.10.1016/j.appdev.2006.10.001 [PubMed: 21687825]
- 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; 16:412–423.10.1017/thg.2012.126 [PubMed: 23218244]
- MacKinnon DP, Krull JL, Lockwood CM. Equivalence of the mediation, confounding, and suppression effect. *Prevention Science*. 2000; 1:173–181.10.1023/A:1026595011371 [PubMed: 11523746]
- MacKinnon DP, Lockwood CM, Hoffman JM, West SG, Sheets V. A comparison of methods to test the significance of the mediated effect. *Psychological Methods*. 2002; 7:83–104. [PubMed: 11928892]
- McWayne, C.; Sekino, Y.; Hampton, V.; Fantuzzo, J. *Manual: Penn Interactive Peer Play Scale: Teacher and parent rating scales for preschool and kindergarten children*. Philadelphia: University of Pennsylvania; 2002.
- Melby, JN.; Conger, RD.; Book, R.; Rueter, M.; Lucy, L.; Repinski, D.; Stavros, T., et al. *The Iowa Family Interaction Rating Scales*. 2. Unpublished manuscript, Iowa State University Center for Family Research in Rural Mental Health; 1993.
- Mendez JL, Fantuzzo J, Cicchetti D. Profiles of social competence among low-income African American preschool children. *Child Development*. 2002; 73:1085–1100.10.1111/1467-8624.00459 [PubMed: 12146735]
- Muthén, L.; Muthén, B. *Mplus User's Guide*. 5. Los Angeles, CA: Muthén and Muthén; 2007.
- Narusyte J, Neiderhiser JM, D'Onofrio BM, Reiss D, Spotts EL, Ganiban J, Lichtenstein P. Parental criticism and externalizing behavior problems in adolescents– the role of environment and genotype-environment correlation. *Journal of Abnormal Psychology*. 2011; 120:365–376. [PubMed: 21280930]
- 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]
- Olson SL, Bates JE, Bayles K. Predicting long-term developmental outcomes from maternal perceptions of infant and toddler behavior. *Infant Behavior & Development*. 1989; 12:77–92.10.1016/0163-63838990054-4
- Olson SL, Bates JE, Sandy JM, Lanthier R. Early developmental precursors of externalizing behavior in middle childhood and adolescence. *Journal of Abnormal Child Psychology*. 2000; 28:119–133. [PubMed: 10834765]
- Patterson, GR. *Coercive family process*. Castalia; Eugene, OR: 1982.
- Pears K, Ayers M. *Coding Manual for the Clean-up Task*. Unpublished Manuscript. 2000
- Pike A, Atzaba-Poria N. Do sibling and friend relationships share the same temperamental origins? A twin study. *Journal of Child Psychology and Psychiatry*. 2003; 44:598–611.10.1111/1469-7610.00148 [PubMed: 12751851]

- Pike A, McGuire S, Hetherington E, Reiss D, Plomin R. Family environment and adolescent depressive symptoms and antisocial behavior: A multivariate genetic analysis. *Developmental Psychology*. 1996; 32:590–604.10.1037/0012-1649.32.4.590
- Plomin, R.; DeFries, J.C.; Knopik, V.S.; Neiderhiser, J.M. *Behavioral Genetics*. 6. New York: Worth; 2013.
- Plomin R, DeFries JC, Loehlin 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]
- Putallaz, M.; Heflin, A. Parent-child interaction. In: Asher, S.R.; Coie, J.D., editors. *Peer rejection in childhood*. New York: Cambridge University Press; 1990. p. 189-216.
- Roisman GI, Fraley RC. A behavior-genetic study of the legacy of early caregiving experiences: academic skills, social competence, and externalizing behavior in kindergarten. *Child Development*. 2012; 83:728–742.10.1111/j.1467-8624.2011.01709.x [PubMed: 22239458]
- Rubin, K.H.; Asendorpf, J.B. Social withdrawal, inhibition, and shyness in childhood: Conceptual and definitional issues. In: Rubin, K.H.; Asendorpf, J.B., editors. *Social withdrawal, inhibition, and shyness in childhood*. Hillsdale, NJ: Erlbaum; 1993. p. 3-17.
- Russell A, Pettit GS, Mize J. Horizontal qualities in parent-child relationships: Parallels with and possible consequences for children's peer relationships. *Developmental Review*. 1998; 18:313–352.10.1006/drev.1997.0466
- Rutter M. Proceeding from observed correlation to causal inference: The use of natural experiments. *Perspectives on Psychological Science*. 2007; 2:377–395.10.1111/j.1745-6916.2007.00050.x
- Rutter, M. Resilience: Causal pathways and social ecology. In: Ungar, M., editor. *The social ecology of resilience*. New York: Springer; 2012. p. 33-42.
- Saudino KJ. Behavioral genetics and child temperament. *Journal of Developmental and Behavioral Pediatrics*. 2005; 26:214–223.10.1097/00004703-200506000-00010 [PubMed: 15956873]
- Saviouk V, Hottenga JJ, Slagboom EP, Distel MA, de Geus EJ, Willemsen G, Boomsma DI. ADHD in Dutch adults: heritability and linkage study. *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics*. 2011; 156:352–362.10.1002/ajmg.b.31170
- Scaramella LV, Leve LD. Clarifying parent-child reciprocities during early childhood: The early childhood coercion model. *Clinical Child and Family Psychology Review*. 2004; 7:89–107.10.1023/B:CCFP.0000030287.13160.a3 [PubMed: 15255174]
- Schafer, J.L. *Analysis of Incomplete Multivariate Data*. London: Chapman and Hall; 1997.
- Sherman DK, Iacono WG, McGue MK. Attention-deficit hyperactivity disorder dimensions: a twin study of inattention and impulsivity-hyperactivity. *Journal of the American Academy of Child and Adolescent Psychiatry*. 1997; 36:745–753.10.1097/00004583-199706000-00010 [PubMed: 9183128]
- Silberg JL, Miguel VFS, Murrelle EL, Prom E, Bates JE, Canino G, Eaves LJ, et al. Genetic and environmental influences on temperament in the first year of life: The Puerto Rico Infant Twin Study (PRINTS). *Twin Research and Human Genetics*. 2005; 8:328–336.10.1375/1832427054936808 [PubMed: 16176717]
- Sobel, M.E. Asymptotic confidence intervals for indirect effects in structural equation models. In: Leinhardt, S., editor. *Sociological Methodology*. Washington DC: American Sociological Association; 1982. p. 290-312.
- Stover SS, Connell C, Leve LD, Neiderhiser JM, Shaw DS, Scaramella L, Reiss D, et al. 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.x [PubMed: 22191546]
- Takahashi Y, Ozaki K, Roberts BW, Ando J. Can low Behavioral Activation System predict depressive mood?: An application of non-normal structural equation modeling. *Japanese Psychological Research*. 2012; 54:170–181. 10.1111/j.1468-5884.2011.00492.x.
- Takahashi Y, Yamagata S, Kijima N, Shigemasu K, Ono Y, Ando J. Continuity and change in behavioral inhibition and activation systems: A longitudinal behavioral genetic study. *Personality and Individual Differences*. 2007; 43:1616–1625.10.1016/j.paid.2007.04.030

- Trentacosta CJ, Shaw DS. Maternal predictors of rejecting parenting and early adolescent behavior. *Journal of Abnormal Child Psychology*. 2008; 36:247–259.10.1007/s10802-007-9174-8 [PubMed: 17805957]
- Vitaro F, Barker ED, Brendgen M, Tremblay RE. Pathways explaining the reduction of adult criminal behaviour by a randomized preventive intervention for disruptive kindergarten children. *Journal of child psychology and psychiatry*. 2012; 53:748–756.10.1111/j.1469-7610.2011.02517.x [PubMed: 22211635]
- Webster-Stratton C, Hammond M. Marital conflict management skills, parenting style, and early-onset conduct problems: Processes and pathways. *Journal of Child Psychology and Psychiatry*. 1999; 40:917–927.10.1111/1469-7610.00509 [PubMed: 10509886]
- Zeller M, Vannatta K, Schafer JC, Noll RB. Behavioral reputation: A cross age perspective. *Developmental Psychology*. 2003; 39:129–139. 10.1037/0012-1649.39.1.129. [PubMed: 12518814]

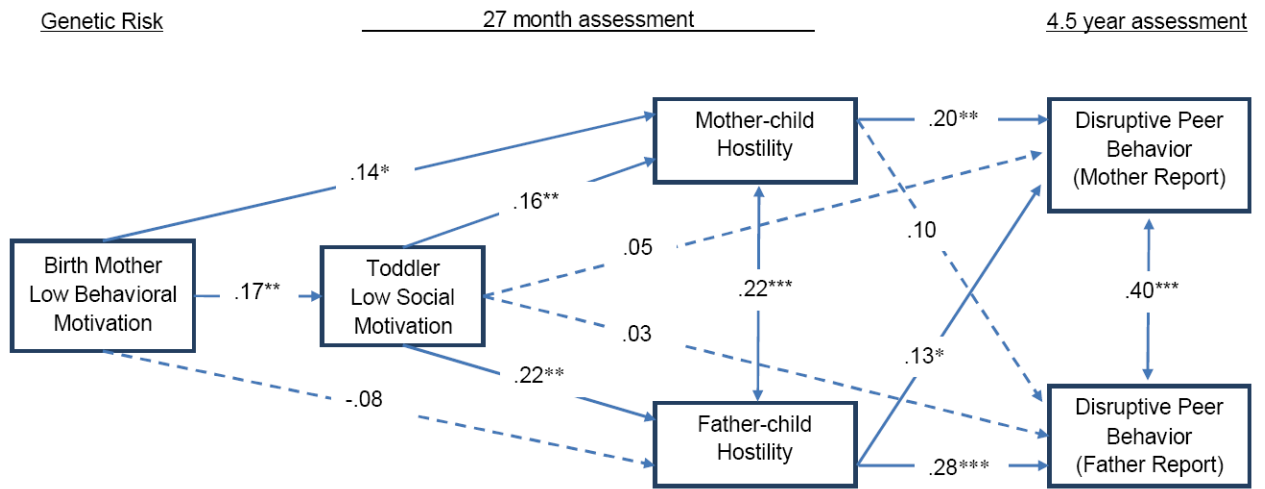


Figure 1.
 Full theoretical model results.
 * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 1
Intercorrelations, Means, and Standard Deviations Among Indicators of Theoretical Constructs

Variable	Mean (SD)	1	2	3	4	5	6
1. Birth Mother Low Behavioral Motivation	25.26 (5.64)	–					
2. Toddler Low Social Motivation	32.98 (7.98)	.17*	–				
3. Mother-child Hostility	9.01 (2.50)	.16***	.19***	–			
4. Father-child Hostility	8.94 (2.47)	-.04	.21**	.24***	–		
5. Peer Disruptive Behavior (Mother report)	20.90 (3.84)	.02	.11	.24**	.19**	–	
6. Peer Disruptive Behavior (Father report)	20.61 (3.42)	-.03	.11	.18†	.31***	.45***	–

Note. Means and standard deviations reflect raw values.

† $p < .06$,

* $p < .05$,

** $p < .01$,

*** $p < .001$.