SPECIAL SECTION ARTICLE

Observed positive parenting behaviors and youth genotype: Evidence for gene–environment correlations and moderation by parent personality traits

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Abstract

Gene–environment correlations (rGE) have been demonstrated in behavioral genetic studies, but rGE have proven elusive in molecular genetic research. Significant gene–environment correlations may be difficult to detect because potential moderators could reduce correlations between measured genetic variants and the environment. Molecular genetic studies investigating moderated rGE are lacking. This study examined associations between child catechol-O-methyltransferase genotype and aspects of positive parenting (responsiveness and warmth), and whether these associations were moderated by parental personality traits (neuroticism and extraversion) among a general community sample of third, sixth, and ninth graders (N = 263) and their parents. Results showed that parent personality traits moderated the rGE association between youths’ genotype and coded observations of positive parenting. Parents with low levels of neuroticism and high levels of extraversion exhibited greater sensitive responsiveness and warmth, respectively, to youth with the valine/valine genotype. Moreover, youth with this genotype exhibited lower levels of observed anger. There was no association between the catechol-O-methyltransferase genotype and parenting behaviors for parents high on neuroticism and low on extraversion. Findings highlight the importance of considering moderating variables that may influence child genetic effects on the rearing environment. Implications for developmental models of maladaptive and adaptive child outcomes, and interventions for psychopathology, are discussed within a developmental psychopathology framework.

Theory and research suggest that variations in parenting contribute to differences in child development (Baumrind 1991; Maccoby, 2000). Positive parenting is associated with a number of healthy, adaptive outcomes, whereas low levels of positive parenting may contribute to psychopathology (Bugental & Grusec, 2006; Steinberg, 2001). In addition, research in developmental and personality psychology over the last several decades has increasingly emphasized the individual’s role in influencing his or her own environment, including the rearing environment (e.g., Sameroff, 1983). Developmental systems theories assert that individuals not only passively respond to external stimuli but also actively contribute to the shaping of their environment (Cox & Paley, 1997; Gottlieb, Wahlstein, & Lickliter, 2006; von Bertalanffy, 1968). Personality psychologists argue that individuals’ personality characteristics and behavior influence their experiences (Caspi, 1998; Lerner, 1982). It follows from these theories that individuals likely influence, to some extent, their exposure to risk environments (e.g., lack of supportive parenting or negative parenting) versus optimal environments (e.g., warm and sensitive parenting) for development.

In addition, developmental scientists have increasingly attended to genetic influences on the variability in exposure to particular environments, a phenomenon known as gene–environment correlation (rGE; Plomin, DeFries, & Loehlin, 1977; Scarr & McCartney, 1983). The majority of evidence for rGE primarily comes from behavioral genetic studies (Plomin & Daniels, 1987). Such studies show that a number of experiences, including interpersonal life events and circumstances such as divorce, marital quality, propensity to marry, and social support, are at least moderately heritable (see Jaffee & Price, 2007, for a review). Behavioral genetic studies among children also show that characteristics of the rearing environment, such as parental discipline, parent emotional overinvolvement, and parental negativity and positivity, are moderately heritable (Narusyte et al., 2008; Neiderhiser, Reiss, Lichtenstein, Spotts, & Ganiban, 2007; Neiderhiser et al., 2004; Plomin & Bergeman, 1991; see review by Horwitz & Neiderhiser, 2011).

However, despite the importance of behavioral genetic studies for demonstrating the existence of rGE, heritability estimates cannot indicate which specific genes may be associated with particular environments. For this reason, molecu-
lar genetic studies can be especially informative. In particular, molecular genetic studies investigating rGE among youth can advance knowledge on how genetic influences may bring about exposure to different rearing environments. Unfortunately, molecular studies investigating rGE are lacking. Moreover, potential moderators may reduce correlations between measured genetic variants and the environment, making rGE difficult to detect (Jaffee & Price, 2007). Research efforts generally have not considered moderators that may influence rGE. We hypothesized that parent characteristics, namely, personality traits, might affect associations between child genetics and the rearing environment. Therefore, the main purpose of the present study was to investigate whether an a priori hypothesized association between allelic variability in youths’ catechol-O-methyltransferase (COMT) and positive parenting (i.e., rGE) exists and whether this association is moderated by parental personality traits.

**Features of Positive Parenting: Effects on Child Development**

The general construct of positive parenting has been referred to by a number of diverse labels, including acceptance, support, and affection. A common theme underlying these constructs is the idea that expressions of genuine care and regard are the foundation of quality parenting (Rohner, 1976). Empirical evidence shows that variation in the extent to which parents exhibit positive parenting toward their children is consistently associated with individual differences in child development (Maccoby & Martin, 1983; Skinner, Johnson, & Snyder, 2005). High levels of positive parenting are associated with emotion regulation abilities, social competence, and academic success (Bugental & Grusec, 2006; Leerkes, Blankson, & O’Brien, 2009; Steinberg, Elmen, & Mounts, 1989). In contrast, low levels are linked with externalizing problems, including aggression and delinquency (Caron, Weiss, Harris, & Catron, 2006; MacDonald, 1992; Rothbaum & Weisz, 1994). Low levels of positive parenting are also associated with internalizing problems, including social withdrawal, depressive symptoms, and anxiety (Caron et al., 2006; Cummings & Davies, 1994; Wood, McLeod, Sigman, Hwang, & Chu, 2003). Positive parenting has also been shown to longitudinally predict social and cognitive adaptive functioning, as well as lower levels of behavioral problems, independently of shared genetic factors between children and parents (Stams, Juffer, & van IJzendoorn, 2002). Thus, there is support for the idea that parenting behaviors influence child outcomes, ranging from healthy, adaptive functioning to psychopathology.

Although most researchers have investigated the effects of positive parenting as a global construct, others have argued for the advantages of differentiating among multiple dimensions of positive parenting behaviors (Davidov & Grusec, 2006; Goldberg, Grusec, & Jenkins, 1999; Grusec, Goodnow, & Kuczynski, 2000). The parenting literature suggests that parent responsiveness (prompt, contingent, and appropriate responses to child cues) and parent warmth (expressions of positive affect, affection, and approval) are two important features of positive parenting (Baumrind, 1991; MacDonald, 1992). Warmth and responsiveness have been shown to be differentially associated with aspects of child outcomes (Davidov & Grusec, 2006). Parental warmth has been specifically linked to regulation of positive affect and peer acceptance (Davidov & Grusec, 2006; Isley, O’Neil, Claffelt, & Parke, 1999; Isley, O’Neil, & Parke 1996), whereas parental responsiveness has been linked to regulation of negative emotion, empathy, attachment security, and academic competence (Davidov & Grusec, 2006; George, Cummings, & Davies, 2010; Roberts & Strayer, 1987). These findings suggest that it is useful to distinguish between parental responsiveness and warmth because each of these components of positive parenting has specific associations with particular aspects of child outcomes.

**Evidence for rGE: Associations Between Child Genotype and Parenting Environments**

The literature on rGE has distinguished among passive, active, and evocative rGE (Scarr & McCartney 1983; see Rutter, Moffitt, & Caspi, 2006, for a review). Passive rGE refers to the influence of parents’ genetics on the rearing environment they provide to their children. This particular type of rGE occurs independently of the individual child’s actions. Active rGE refers to effects of the child’s genes on the selection of environments experienced. Finally, evocative rGE is similar to active rGE, but it more specifically describes the idea that heritable characteristics of individuals may shape how others respond or react to them. All types of rGE affect the variability that individuals experience in their rearing environment, ranging from risky to optimal, and such environments in turn can contribute to individuals’ developmental course.

To our knowledge, four studies have examined potential rGE involving measured child genotype and parenting quality, and all focused on polymorphic variants of the dopamine receptor D2 gene (DRD2). Findings show that the A allele in exon 8 and the A1 allele of the Taq1 polymorphism of DRD2 are associated with more paternal rejection and less observed maternal sensitivity/supportive presence, respectively (Hayden et al., 2010; Lucht et al., 2006; Mills-Koonce et al., 2007; Proper et al., 2008). These findings provide promising evidence that allelic variability in DRD2 is associated with positive parenting behaviors. Such data suggest that genetically influenced child characteristics evoke the type of parenting received. Consistent with an evocative rGE model, Mills-Koonce and colleagues further demonstrated that maternal sensitivity was associated with children’s, but not mothers’, DRD2 allelic variation.

Yet, rigorous examination of rGE from molecular genetic studies is still scant and limited. First, two of these studies (Mills Koonce et al., 2007; Proper et al., 2008) reported on data collected from the same sample within one larger longitudinal study. Second, Lucht and colleagues’ (2006) study used a retrospective design in which adults recalled past parenting they received during their childhood. Such designs are
problematic owing to known biases in recall (Henry, Moffitt, Caspi, Langley, & Silva, 1994). Third, all studies primarily focused on DRD2, and it is unknown whether other dopamine-related child genes are associated with positive parenting. Overall, it is surprising that very little is known about how measured genetic variants among youth may influence exposure to particular rearing environments, given extensive behavioral genetic research demonstrating these rGE.

**Associations Between COMT and Behaviors**

Dopamine is associated with emotional expression, goal-directed activity, and executive functioning (Thase, 2009). Therefore, dopamine-related genes may reflect underlying variability in a range of phenotypic characteristics. In addition, stress alters dopamine levels (Nestler & Carlezon, 2006), suggesting that dopamine genes may influence behavior under conditions of stress. The current study investigated the COMT gene because of evidence suggesting that COMT plays an important role in neurobiological processes involved in dopamine signaling that may contribute to phenotypic variation in emotion regulation (Bilder, Volavka, Lachman, & Grace, 2004; Dickinson & Elvevag, 2009; Savitz, Solms, & Ramesar, 2006).

COMT encodes for the enzyme that modulates dopamine levels primarily in the prefrontal cortex. The methionine (met) allele of the val158met polymorphism is associated with a significant reduction in enzymatic activity compared to the valine (val) allele, which suggests that the methionine allele is associated with higher dopamine concentrations (Meyer-Lindenberg et al., 2006; Tunbridge, Harrison, & Weinberger, 2006). There are conflicting findings about which particular allele is associated with risk, particularly among children (Savitz et al., 2006). Researchers have theorized that COMT allelic variation results in a trade-off between cognitive efficiency and emotional resiliency, which has been referred to as the “warrior/worrier model” (Goldman, Oroszi, & Ducci, 2005).

Studies have shown that the valine allele is associated with cognitive problems and poor performance on executive functioning tasks (Akl et al., 2003; Bilder et al., 2002; Diamond, Briand, Fossella, & Gehlbach, 2004; Goldberg et al., 2003; Tunbridge et al., 2006), whereas the methionine allele has been implicated in poor emotion regulation (Mier, Kirsch, & Meyer-Lindenberg, 2010; Montag et al., 2008).

In particular, the methionine allele has been linked to negative emotionality and anxiety (Enoch, Xu, Ferro, Harris, & Goldman, 2003; Olsson et al., 2005; 2007; Stein, Fallin, Schork, & Gelernter, 2005), elevated startle response (Armbruster et al., 2011; Montag et al., 2008), and increased limbic and prefrontal activation in response to negative stimuli (Drabant et al., 2006; Rasch et al., 2010; Williams et al., 2010). The COMT methionine allele has also been shown to be associated with a greater stress response to laboratory stressors, such as the Trier Social Stress Test in adults (Alexander et al., 2011; Jabbi et al., 2007) and in children (Armbruster et al., 2011).

Thus, prior research has linked COMT to emotion regulation problems and negative affect. Other studies show that child negative affect is associated with aspects of positive parenting, including warmth and responsiveness (Latzman, Elkovitch, & Clark, 2009; Lengua, 2006; Maccoby, Snow, & Jacklin, 1984; Owens, Shaw, & Vondra, 1998). In addition, other prior rGE studies have implicated dopamine-related genes (Hayden et al., 2010; Lucht et al., 2006; Mills-Koonce et al., 2007; Propper et al., 2008). As such, we hypothesized that allelic variation in COMT may be involved in an evocative rGE, influencing parenting behaviors, especially positive parenting.

**Moderators of rGE: Potential Associations Among Child Genetics, Parent Personality Traits, and Positive Parenting**

Jaffee and Price (2007) have identified several challenges in molecular rGE research. In particular, direct main-effect associations between measured genes and complex behaviors are typically small, perhaps because of moderating variables. In the case of an evocative rGE, one possibility is that others’ characteristics may moderate the association between an individual’s genetically influenced behaviors and the environment. Therefore, it is possible that certain characteristics of the parent moderate the effect of child genetics on parenting. Mills-Koonce and colleagues (2007) tested whether maternal characteristics (i.e., stress or depressive symptoms) moderated the effect of child DRD2 on maternal sensitivity, but they found no moderation for these particular variables. To our knowledge, this hypothesis still remains virtually unexplored in the rGE literature.

Personality traits influence social functioning and interpersonal relationships, such as the quality of friendships and intimate relationships (Caspi, Roberts, & Shiner, 2005). Relatively few studies have investigated whether parent personalities shape parenting behaviors and parent–child relationships in particular. However, Belsky (1984) hypothesized that parent personality is a major influence of parental functioning in his process model of the determinants of parenting. In the past decade, an emerging body of research has shown that parent personality affects the mood, thoughts, and actions of parents (Belsky & Jaffee, 2006; Kochanska, Friesenborg, Lange, & Martel, 2004); this work supports the theory that individual differences in parenting behaviors are related to personality characteristics (Belsky & Barends, 2002; Prinzie, Stams, Dekovic, Reijnjes, & Belsky, 2009).

Based on this, we hypothesized that parent personality would affect the strength of the association between parenting quality and child genetic variants. We focused on the traits of neuroticism and extraversion because these are the most consistently replicated personality traits across factor analytic models (Watson, Clark, & Harkness, 1994; Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993), are strongly correlated with affect (Clark, Watson, & Mineka, 1994), and have been shown to be especially relevant for relationship pro-
cesses and parenting behaviors (Belsky & Barends, 2002; Robins, Caspi, & Moffitt, 2002; Wilson & Durbin; in press). Although most studies have been conducted among parents of infants and young children, findings from these studies suggest that parents with higher levels of extraversion and lower levels of neuroticism are more likely to provide overall positive parenting (Belsky, Cnbc, & Woodward, 1995; Caspi et al., 2005; Prinzie et al., 2009; Smith et al., 2007).

Extraverted individuals are more active, expressive, social, and experience more positive moods (Caspi et al., 2005; McCrae & John, 1992). Therefore, extraverted parents likely are more able to exhibit energy, enthusiasm, and positive affect while actively engaging with their children (Prinzie et al., 2009). Low extraversion, also referred to as introversion, is associated with reserved, withdrawn behavior, as well as emotional blandness and overcontrol of impulses (McCrae & John, 1992). This suggests that introverted parents are likely to be more reticent and less expressive and demonstrate low positive affect or flat affect toward their children. Individuals high on neuroticism are more easily distressed and frustrated and experience more general negative affect (Caspi et al., 2005; McCrae & John, 1992). In contrast, individuals low on the dimension of neuroticism (i.e., high emotional stability) are calm, unperturbed, and even-tempered (McCrae & John, 1992). Parents exhibiting high neuroticism likely find it more difficult to respond appropriately and positively to children (Prinzie et al., 2009), whereas emotionally stable parents may be more able to respond positively in response to child cues.

There is some evidence to suggest that child traits interact with parent personality to predict parenting behavior (Clark, Kochanska, & Ready, 2000; Coplan, Reichel, & Rowan, 2009; Koenig, Barry, Kochanska, 2010; Latzman et al., 2009; Prinzie et al., 2011), although empirical investigations are still sparse. The few studies in this area have examined a range of child traits (e.g., negative temperament, extraversion, and shyness) and parent traits (e.g., parent empathy and optimism; or Big 5 traits; Goldberg, 1990) that vary from study to study, or have measured several different aspects of parenting (e.g., power assertive techniques, overprotective behaviors, and warm parenting). Given the diversity of constructs measured across studies, it is currently difficult to identify one coherent pattern of results that consistently describes the way in which parent personality may moderate the association between child traits and parenting behaviors. Some researchers have argued that because personality traits influence one’s reaction to adversity or challenge (e.g., Watson & Hubbard, 1996), parents who may be challenged by difficult youth (e.g., high on negative emotionality) might exhibit greater positive parenting to such youth when they possess higher levels of positive traits (e.g., optimism; Clark et al., 2000; Koenig et al., 2010). However, some studies have found that parents demonstrate greater positive parenting toward “easy” youth (e.g., low levels of negative temperaments) when the parents have higher levels of positive personality traits (e.g., extraversion and emotional stability; Karremann, van Tuijl, van Aken, & Deković, 2008; Latzman et al., 2009; Prinzie et al., 2011). These latter studies suggest that among dyads in which both children and parents have traits associated with greater positive affect and behaviors, and/or traits associated with lower risk for emotional problems, children are more likely to elicit parenting that promotes healthy socioemotional functioning.

However, no study has examined whether parents’ personality traits interact with youth genetic variability to predict parenting behaviors. We reasoned that variation in youths’ allelic variability in the COMT gene, which is thought to be associated with emotion regulation, particularly negative emotionality, would be differentially associated with positive parenting based on the personality of the parent. Given that this is the first study, to our knowledge, to explore parent personality as a moderator of rGE and that there is still a small literature base on how interplay between parent and child traits influences parenting, our investigation of the way in which parent personality moderates the association between COMT and positive parenting behaviors is exploratory. One possibility is that parents higher on extraversion and low on neuroticism, personality traits characterized by more positive affect/engagement and lower levels of negative affect respectively, are warmer and more responsive to youth with genotypes associated with poor emotion regulation. This would be consistent with the idea that personality traits are most influential under conditions of stress (Watson & Hubbard, 1996), and thus extraverted and emotionally stable parents are better able to respond in positive, appropriate ways to difficult or challenging youth.

Conversely, it is possible that extraverted and emotionally stable parents provide higher levels of positive parenting to youth with COMT genotypes associated with greater emotion regulation ability/low negative affect. Studies examining main effects of child emotionality on parenting show that lower levels of negative affective is associated with greater optimal parenting (Latzman et al., 2009; Lengua, 2006; Macoby et al., 1984; Owens et al., 1998). It is reasonable to suggest that youth who are genetically predisposed to lower negative affect may receive the most optimal parenting from extraverted and emotionally stable parents, because these parents have the greatest capacity for expressing positive affect and behaviors. Such youth may not be able to elicit the same high levels of positive parenting behaviors from introverted and neurotic parents, who inherently express lower levels of enthusiasm and engagement or are more likely to show greater frustration and distress when interacting with their children.

Current Study

The concept of an evocative rGE is in line with developmental theory stating that individuals play an active role in shaping their environment by eliciting behavioral responses from others. It is likely that the way in which others respond is influenced by their own traits and characteristics, as sug-
gested by theory and research on marital interactions (Asendorpf & Wilpers, 1998; Cupperman & Ickes, 2009) as well as parent–child interactions (Clark et al., 2000). Thus, environmental shaping may be influenced by the coaction between child and parent effects. Gene–environment interplay between multiple factors, such as child genotype and the rearing environment (usually adverse environments), has been frequently explored when directly predicting child outcomes (e.g., Audrain-McGovern & Tercyak, 2011; Eley, 2011; Rutter et al., 2006). Recently, a nascent body of work has begun to examine how parent–child interplay may affect the rearing environment itself; these studies include investigations of interactions between parent personality and child temperament (Clark et al., 2000; Coplan et al., 2009; Koenig et al., 2010), which is thought to be at least moderately heritable (Goldsmith et al., 1987), as well as interactions between parent genotype and child risk factors (e.g., temperament and disruptive behaviors; Fortuna et al., 2011; Kaitz et al., 2010; Lee et al., 2010).

However, to our knowledge, almost no attention has been given to how measured child genes may interact with parent traits to influence the rearing environment, which has potentially important implications for rGE research. In the present study, we tested the novel rGE hypothesis that effects of child genetics on parenting, specifically warm and sensitive parenting behaviors, vary based on parental personality characteristics.

As previously noted, we examined COMT, a candidate gene involved in neurobiological processes influencing dopamine transmission, which has been shown to be associated with emotion regulation. In order to clarify what youth behavioral phenotypes may be eliciting parenting responses in our proposed evocative rGE, we first examined associations between COMT and youth observed emotions during a laboratory stressor task. Given prior findings linking the methionine allele to greater stress reactivity in children (Armbruster et al., 2011) and negative emotionality (Olsson et al., 2005, 2007), we hypothesized that the methionine allele would be associated with greater observed negative affect during the stressor task.

In addition, it is essential to specify and measure the environment well to detect rGEs (Jafae & Price, 2007). Given our focus on positive parenting behaviors as our measure of environment in our hypothesized rGE, we used observational methods to assess two main components of positive parenting in particular: expressions of warmth (e.g., positive regard or affection) and sensitive responsiveness to child-centered cues. Observational methods assessing parenting behaviors have yielded larger effects compared to self-report measures (Rothbaum & Weisz, 1994). One important advantage of observational methodology is the ability to take into account contextual information that informs assessment of positive and appropriate parenting. For example, parent behaviors that might typically be considered expressions of warmth (e.g., hugging) could be instead inappropriate and intrusive in some contexts where the timing of such behaviors are out of place or expressed against the child’s will. By definition, parental responsiveness is also largely determined by considering parent behaviors within the context of child cues and needs at any given moment. Thus, observational methods allow for particularly sensitive and precise measurement of dimensions of positive parenting that is consistent with the operational definitions of these constructs and is not subject to the limitations of questionnaire methods (Holden & Edwards, 1989).

In sum, the current study is the first to explore whether parent personality traits moderate a hypothesized evocative rGE between the measured candidate gene, COMT, among youth and observed positive parenting behaviors (i.e., warmth and responsiveness). We expected that the parental personality traits of extraversion and neuroticism would moderate the association between child COMT genotype and positive parenting. We further expected that the interaction between child COMT and parent personality traits of extraversion and neuroticism would be differentially associated with aspects of positive parenting in a way that is consistent with personality theory. We hypothesized that parent extraversion would interact with child COMT genotype to predict warm parenting in particular, and we thought this would be the case because extraversion is associated with greater social engagement, expressiveness, and positive affect. Therefore, extraverted parents are likely able to respond with energy and affection, in particular, to certain youth. However, we hypothesized that parent neuroticism would interact with child COMT to predict responsive parenting, instead of warm parenting. Low neuroticism/high emotional stability is associated with the ability to remain calm and even-tempered, so these parents are likely more able to consistently provide well-timed and appropriate responses to particular youth. It follows that introverted parents may have difficulty responding with greater engagement and enthusiasm to youth in general, and thus show less warmth, in particular, whereas neurotic parents may be generally more likely to respond with frustration and negative affect to youth.

Beyond these specific, a priori hypotheses, the theoretical and empirical literature is not established sufficiently to motivate a clear pattern of how this moderated rGE might be exhibited. We hypothesized two possible ways in which parent personality traits might moderate the association between youths’ allelic variability in COMT and observed parenting. Extraverted and emotionally stable parents may exhibit greater warmth and responsiveness to youth with the met/met COMT genotype, the genotype most likely associated with greater negative emotionality, as compared to parents with lower levels of these traits. This would be consistent with prior theory and research positing that associations between parent personality traits and parenting behaviors are strengthened for parents of more challenging youth (Clark et al., 2000; Koenig et al., 2010). In contrast, extraverted and emotionally stable parents may exhibit greater warmth and responsiveness to youth with the val/val genotype, which is thought to be associated with lower levels of negative emo-
tionality. This is based on the reasoning that children with low negative affect elicit greater positive parenting (Latzman et al., 2009; Lengua, 2006; Maccoby et al., 1984; Owens et al., 1998) and therefore may elicit the most positive parenting from parents high on extraversion and low neuroticism (i.e., emotionally stable parents) because they have a greater capacity for demonstrating positive behaviors. In other words, youth with a genotype (e.g., val/val for COMT) associated with fewer emotional problems would receive the most optimal parenting from extraverted and emotionally stable parents, who are more likely to be able to provide positive parenting such as enthusiastic praise, engagement, and appropriate responses to child cues. Introverted and neurotic parents may have difficulty exhibiting such high levels of positive parenting to youth, regardless of the youth’s genetically influenced traits.

Methods

Participants

Children and adolescents were recruited by brief information letters sent home directly by the participating school districts to families with a child in third, sixth, and ninth grades of public schools. The short letter stated that we were conducting a study on social and emotional development in children and adolescents and requested that interested participants call the laboratory to receive more detailed information on the study.

Participants were 263 youth ranging in age from 9 to 15 (\(M = 12.03, SD = 2.42\)). The sample was approximately evenly divided by sex (44% boys, 56% girls) and grade (32% third grade, 35% sixth grade, 33% ninth grade). The present sample, drawn from the general community of youth attending public schools, was representative of both the broader population of the particular geographical area and the school districts from which the sample was drawn, including socioeconomic status, ethnicity, and race. Ethnicity was as follows: Caucasian, 70%; African American, 7%; Latino, 6%; Asian/Pacific Islander, 4%; other/mixed ethnicity and race, 13%. Parents of the youth were predominantly mothers (88%). Median annual parental income was $80,000, and 20% of the youth received free/reduced lunch at school.

Procedure

The parent and youth visited the laboratory for their assessment. Parents provided informed written consent for their participation and for their child; youth provided written assent. The assessment consisted of questionnaires completed by parents and child DNA collection via saliva. Parents provided information about basic demographic information, including education level, family income, and child ethnicity. Youth participated in a videotaped psychosocial challenge in which they gave a speech to a camera. Youth were instructed to pretend to audition for a reality television show about kids. They were told their speeches would be evaluated by judges (see Hankin, Badanes, Abela, & Watamura, 2010, for more information). Youth were then videotaped giving their “audition” speech to a camera. The parent and child were also videotaped during a 5-minute parent–child conflict discussion in which they were asked to discuss a source of disagreement between them. Youth and parents were debriefed at the end of the assessment period about the stressor task. They were told that the task was designed to help understand different ways kids responded to stress and that their speeches would not be evaluated.

Measures

Parenting behaviors. Warmth and responsiveness were coded by reliable, independent raters during the videotaped parent–child discussions. One global code was given for each parenting construct on a scale between 1 and 5 (1 = not at all characteristic of parent behavior during interaction and 5 = highly characteristic of parent during interaction). Parents who exhibited high levels of warmth demonstrated genuine affection, support, and enjoyment of the child (e.g., praising, signs of physical affection, and validating). Parents who exhibited high levels of responsiveness exhibited well-timed and appropriate responses to child behaviors (e.g., noticing and reacting to child cues and demonstrating appropriate affect). Responsive parents remained focused on child behaviors throughout and were neither too aloof nor too intrusive. The parent–child conflict discussion task has been used in other studies (Feng et al., 2009; Kim Park, Garber, Ciesla, & Ellis, 2008). Codes were based on validated parent–child observational coding systems that have been used previously and reflect theoretically grounded dimensions of positive parenting (Melnick & Hinshaw, 2000; NICHD Early Child Care Research Network, 1999). Approximately 20% of cases were double coded (the intraclass correlation coefficient [ICC] ≥ 0.70).

Youth negative affect during stressor task. Independent coders observed and coded youth emotion during the psychosocial stressor challenge. Anger was coded using a global coding system in which one score was given to represent the child’s overall level of anger during the task on a scale from 1 to 5 (1 = an absence of anger and 5 = frequent and intense anger throughout task). Youth were coded as expressing anger if they exhibited angry emotion in their voice (e.g., irritated tone or raised voice), face (scowling or contracted eyebrows), or body (clenched fists or crossed arms). Youth who scored high on this scale exhibited anger in all three domains (voice, face, and body). Our coding system is similar to other global emotion coding systems used in prior studies (e.g., Durbin, Klein, Hayden, Buckley, & Moerk, 2005). Approximately 20% of cases were double coded (ICC ≥ 0.74).

Parent personality. Parent personality characteristics were assessed by the Big Five Inventory (BFI; John, Naumann, &
The BFI is a self-report measure that consists of 44 items rated on a 5-point scale (from 1 = disagree strongly to 5 = agree strongly). Summary scores were computed for extraversion (8 items; e.g., “Generates a lot of enthusiasm”; “Is outgoing, sociable”) and neuroticism (8 items; e.g., “Can be tense”; “Can be moody”). The BFI has been shown to have good validity and reliability (e.g., Benet-Martinez & John, 1998; John & Srivastava, 1999).

**COMT val158met SNP (rs4680).** Youth provided buccal cells for DNA collection via Oragene® kits from DNA Genotek (Ottawa, Ontario, Canada). Assays were done using a fluorogenic DNA collection via Oragene®) and neuroticism (8 items; e.g., “Can be tense”; “Can be moody”). The BFI has been shown to have good validity and reliability (e.g., Benet-Martinez & John, 1998; John & Srivastava, 1999).

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The gene encoding COMT maps to 22q11.21 and codes for both the membrane-bound and the soluble forms (Mannisto & Kaakkola, 1999) of the enzyme that metabolizes dopamine to 3-methoxy-4-hydroxyphenylethylamine (Akil et al., 2003; Huotari et al., 2002). A nonsynonymous A → G mutation in codons 158/108 results in a valine to methionine substitution. The methionine (G allele) form of the enzyme has been associated with a fourfold reduction in enzymatic activity (Akil et al., 2003; Mannisto & Kaakkola, 1999). The presence of two valine alleles (val/val genotype) was coded as 2, the presence of one valine allele (met/val genotype) was coded as 1, and the presence of zero valine alleles (met/met genotype) was coded as 0 in our study.

**Results**

**Preliminary analyses**

Means and standard deviations for primary variables are presented in Table 1. Correlations among all variables in the study are presented in Table 2. Ethnicity/race was dummy coded for the relevant groups in the sample (Caucasian, African American, Latino, and Asian/Pacific Islander) such that 1 indicated that a child was of that particular ethnicity/race, and 0 indicated the child was not. Both parent gender and child gender were coded as 0 = male and 1 = female.

**COMT genotype frequencies were 24% for met/met, 47% for met/val, and 29% for va/val. Allelic frequencies were in Hardy–Weinberg equilibrium. A Pearson chi-square test indicated that allelic distributions did not vary by ethnicity/race, \( \chi^2 (8) = 10.15, p = .25 \).**

Of particular relevance, child COMT was not associated with either parent personality or parenting variables. This ruled out an evocative effect of child genotype on parent personality and demonstrated no direct rGE of child COMT on parenting. Parent personality also was not associated with observed parenting variables in this study, with the exception of a small association between extraversion and responsiveness.

**Association between child COMT and observed anger**

To clarify the relation between child COMT and behavior, we examined associations between COMT and observed emotionality during the stressor task. Given that gender was significantly correlated with observed anger in the current study, \( t (261) = 2.24, p < .05 \), such that boys (\( M = 1.17, SD = 0.36 \)) showed higher levels of anger than girls (\( M = 1.09, SD = 0.25 \)), gender was controlled for in this analysis. Child anger was found to be significantly negatively associated with COMT (\( \beta = -0.17, p < .01 \)), consistent with our hypothesis that the met/met genotype was associated with greater expressed anger, whereas the val/val genotype was associated with less anger.

**Parent personality as a moderator of the association between child COMT and observed parenting**

Regression analyses were conducted to test the primary hypothesis that child COMT genotype would interact with parent personality traits to predict aspects of positive parenting. Two independent regressions were conducted using parent responsiveness as the dependent variable to test the interaction between child COMT and each parent personality trait (extraversion and neuroticism). Two more regressions were conducted using parent warmth as the dependent variable. Main effects of COMT genotype and the personality trait of interest were entered in Step 1. Child gender, grade, dummy coded ethnicity/race variables, parent gender, parent edu-

<table>
<thead>
<tr>
<th>Table 1. Means and standard deviations of primary variables</th>
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<tbody>
<tr>
<td><strong>Parent</strong></td>
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<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Mean</td>
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<td>SD</td>
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Table 2. Correlations among variables

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<td>-.04</td>
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<td>.07</td>
<td>.37**</td>
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<td>-.004</td>
<td>.01</td>
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<td>-.08</td>
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<td>.06</td>
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<td>-.14*</td>
<td>-.04</td>
<td>-.04</td>
<td>-.18**</td>
<td>.05</td>
<td>.14*</td>
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<td></td>
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<td>11. Child Latino</td>
<td>.09</td>
<td>-.06</td>
<td>.01</td>
<td>-.19**</td>
<td>-.04</td>
<td>-.03</td>
<td>-.02</td>
<td>-.04</td>
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<td>-.09</td>
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<td>12. Child Asian</td>
<td>.09</td>
<td>.13*</td>
<td>-.07</td>
<td>-.06</td>
<td>-.01</td>
<td>.06</td>
<td>.05</td>
<td>.08</td>
<td>-.43**</td>
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<td>-.17**</td>
<td>-.02</td>
<td>.07</td>
<td>.11*</td>
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<td>.08</td>
<td>.10</td>
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<td>-.10</td>
<td>.12*</td>
<td>.12*</td>
<td>.02</td>
<td>.02</td>
<td>.14*</td>
<td>.04</td>
<td>.16**</td>
<td>-.16*</td>
<td>-.14*</td>
<td>.07</td>
<td>.37**</td>
<td>—</td>
</tr>
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<td>15. Parent gender</td>
<td>-.01</td>
<td>.09</td>
<td>.16**</td>
<td>.15*</td>
<td>.06</td>
<td>.01</td>
<td>.00</td>
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<td>-.05</td>
<td>.02</td>
<td>.05</td>
<td>.00</td>
<td>-.14*</td>
<td>.02</td>
</tr>
</tbody>
</table>

Note: COMT, catechol-O-methyltransferase.
*p < .05. **p < .01.
tion, family income, and the other parent personality traits not included in the interaction were also entered into Step 1 to control for these variables. Child ethnicity/race was controlled for as a way to address any potential concerns about population stratification (Hutchinson, Stallings, McGearry, & Bryan, 2004). Because the dummy coded Caucasian variable was highly negatively correlated with the other ethnicity/race variables and therefore contributed to problems with multicollinearity, the Caucasian variable was excluded from the models. Two-way interactions of COMT/C2 Personality Trait were entered in Step 2. All continuous predictors were centered in order to reduce multicollinearity.

Consistent with our main hypotheses, Table 3 shows that Child COMT × Parent Neuroticism was significantly associated with observed parent responsiveness (β = –0.17, p = .02).1 As expected, Child COMT × Parent Neuroticism was not associated with parent warmth (β = 0.02, p = .74), and Child COMT × Parent Extraversion was not associated with parent responsiveness (β = 0.06, p = .39).

Follow-up analyses were conducted to probe Child COMT × Parent Personality interactions. Simple slopes were calculated for 1 SD above and below the mean for each personality trait. Child COMT was significantly negatively associated with observed parent responsiveness at low levels of parent neuroticism/high emotional stability (β = 0.23, p < .01), whereas there was no association between COMT and parent responsiveness at high levels of neuroticism (β = –0.10, p = .39).

1. Our analyses conducted with only mothers revealed the same pattern of results (β = –0.17 and 0.14 for the COMT genotype interacting with parent neuroticism predicting responsiveness and parent extraversion predicting warmth, respectively).

**Table 3. Associations between Child COMT × Parent Neuroticism predicting parent responsiveness**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>ΔR²</th>
<th>b (SE)</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
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<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child grade</td>
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<td>–0.04 (.03)</td>
<td>–0.11</td>
<td>–1.48</td>
<td>.14</td>
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<tr>
<td>Child gender</td>
<td></td>
<td>–0.17 (.12)</td>
<td>–0.10</td>
<td>–1.45</td>
<td>.15</td>
</tr>
<tr>
<td>Child African American</td>
<td></td>
<td>–0.08 (.23)</td>
<td>–0.03</td>
<td>–0.35</td>
<td>.73</td>
</tr>
<tr>
<td>Child Latino</td>
<td></td>
<td>–0.67 (.24)</td>
<td>–0.21</td>
<td>–2.83</td>
<td>.01*</td>
</tr>
<tr>
<td>Child Asian</td>
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<td>–0.77 (.37)</td>
<td>–0.14</td>
<td>–2.08</td>
<td>.04*</td>
</tr>
<tr>
<td>Parent education</td>
<td></td>
<td>0.01 (.05)</td>
<td>0.02</td>
<td>0.28</td>
<td>.78</td>
</tr>
<tr>
<td>Family income</td>
<td></td>
<td>0.00 (.00)</td>
<td>0.07</td>
<td>0.84</td>
<td>.40</td>
</tr>
<tr>
<td>Child COMT</td>
<td></td>
<td>0.08 (.08)</td>
<td>0.07</td>
<td>0.92</td>
<td>.36</td>
</tr>
<tr>
<td>Parent gender</td>
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<td>0.43 (.17)</td>
<td>0.18</td>
<td>2.53</td>
<td>.01*</td>
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<tr>
<td>Parent neuroticism</td>
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<td>–0.00 (.01)</td>
<td>–0.03</td>
<td>–0.41</td>
<td>.68</td>
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<tr>
<td>Parent extraversion</td>
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<td>0.02 (.01)</td>
<td>0.17</td>
<td>2.41</td>
<td>.02*</td>
</tr>
<tr>
<td>Step 2</td>
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<td>–0.03 (.01)</td>
<td>–0.17</td>
<td>–2.38</td>
<td>.01*</td>
</tr>
</tbody>
</table>

**Note:** COMT, catechol-O-methyltransferase.

*p < .05.

**Table 4. Associations between Child COMT × Parent Extraversion predicting parent warmth**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>ΔR²</th>
<th>b (SE)</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
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<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child grade</td>
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<td>–0.01 (.03)</td>
<td>–0.03</td>
<td>–0.34</td>
<td>.69</td>
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<td>–0.06 (.16)</td>
<td>–0.03</td>
<td>–0.38</td>
<td>.70</td>
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<tr>
<td>Child African American</td>
<td></td>
<td>–0.45 (.31)</td>
<td>–0.11</td>
<td>–1.44</td>
<td>.15</td>
</tr>
<tr>
<td>Child Latino</td>
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<td>–0.27 (.33)</td>
<td>–0.07</td>
<td>–0.84</td>
<td>.40</td>
</tr>
<tr>
<td>Child Asian</td>
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<td>–0.28 (.51)</td>
<td>–0.04</td>
<td>–0.56</td>
<td>.58</td>
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<tr>
<td>Parent education</td>
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<td>0.08 (.07)</td>
<td>0.10</td>
<td>1.11</td>
<td>.27</td>
</tr>
<tr>
<td>Family income</td>
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<td>–0.63</td>
<td>.53</td>
</tr>
<tr>
<td>Child COMT</td>
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<td>0.08 (.11)</td>
<td>0.05</td>
<td>0.73</td>
<td>.47</td>
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<tr>
<td>Parent gender</td>
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<td>0.00 (.24)</td>
<td>0.00</td>
<td>–0.01</td>
<td>1.00</td>
</tr>
<tr>
<td>Parent neuroticism</td>
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<td>0.04</td>
<td>0.50</td>
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<tr>
<td>Parent extraversion</td>
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<td>.15</td>
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<tr>
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<td>0.05 (.02)</td>
<td>0.17</td>
<td>2.45</td>
<td>.02*</td>
</tr>
</tbody>
</table>

**Note:** COMT, catechol-O-methyltransferase.

*p < .05.
Figure 1 indicates that youth with the val/val genotype received the most responsive parenting from parents with low levels of neuroticism/high levels of emotional stability compared to all other groups of youth. A similar pattern emerged for Child COMT × Parent Extraversion interaction predicting parental warmth. At high levels of extraversion, there was a significant positive association between child COMT and warm parenting (β = 0.28, p < .01), whereas there was no association between COMT and warm parenting at low levels of extraversion (β = –0.15, p = .15). Figure 2 shows that youth with the val/val genotype received the warmest parenting from parents with high levels of extraversion compared to all other groups of youth.

To test whether grade or gender moderated findings, three-way interactions (Gender or Grade × COMT Genotype × Parent Personality Trait) were entered in Step 3 of the regression analyses, after controlling for all possible two-way interactions among these variables in Step 2. None of the three-way interactions was significant, suggesting that there was no moderation by grade or gender. Moreover, none of the other demographic variables (family income, parent education, and ethnicity/race) moderated findings.

**Discussion**

Behavioral genetic studies suggest that environments are moderately heritable, but few molecular genetic studies have investigated the role of rGE in variability of exposure to particular types of rearing environments. Moreover, the larger literature on rGE has generally neglected to consider moderators that may affect the strength of the associations between children’s measured genes and parenting behaviors. Findings from this study advance theory on the role of rGE in developmental psychopathology by emphasizing the significance of moderating variables that may influence child genetic effects on their environment, which may in turn contribute to risk and resilience for psychopathology. Results from this study show that parent personality traits moderated the association between youths’ COMT genotype and observed positive parenting behaviors.

We found that the met/met COMT genotype was associated with greater observed anger among youth during a psychosocial stressor task, whereas the val/val genotype was associated with less observed anger. This finding adds to a growing body of literature demonstrating an association between the COMT methionine allele and emotion regulation. Prior research has shown this association with self-reported negative affect (Enoch et al., 2003; Stein et al., 2005), so the present study replicates and extends this pattern of findings to observed emotional expression. Taken together, our findings, in concert with previous research, suggest that parents are responding to the child phenotype of expressed anger in a way that is consistent with an evocative rGE.

Our main finding revealed that emotionally stable (i.e., low on neuroticism) and highly extraverted parents were ob-
served to exhibit greater positive parenting to youth who carried the val/val \textit{COMT} genotype, which was shown to be associated with lower levels of child observed anger. This pattern is consistent with the idea that emotionally stable and extraverted parental personality traits strengthen the association between low child negative affect and optimal parenting. This is also in line with findings from the literature examining the interaction between child traits and parent personality. This prior work has shown that low levels of child negative temperament, as well as high levels of positive child traits (e.g., extraversion), are associated with greater positive parenting when parents exhibit traits such as positive emotionality/extraversion and emotional stability (Latzman et al., 2009; Prinzie et al., 2011).

Youth with genotypes associated with lower levels of expressed anger (e.g., val/val \textit{COMT} genotype) may be able to elicit greater positive parenting from extraverted and emotionally stable parents because these parents have a greater capacity for exhibiting positive behaviors. Extraverted parents exhibited greater warmth to youth carrying the val/val genotype, whereas emotionally stable parents exhibited greater responsiveness. Extraverted individuals express greater positive affect and are more active and engaged in social interactions. It is likely that extraverted individuals are better able to respond to less angry youth with greater levels of enthusiastic affection, praise, and positive regard. Emotionally stable parents exhibit low levels of negative affect and are more even-tempered and calm, and thus they may be more in tune with child cues and better able to respond sensitively and appropriately to less angry youth.

Taken together, these results suggest that youth with a genotype associated with lower levels of anger receive higher levels of positive parenting from parents with high levels of extraversion and low levels of neuroticism/high emotional stability. It should be emphasized that youth with the val/val genotype, who also had extraverted or emotionally stable parents, received the most positive parenting compared to all other youth in our study, including other youth with one or two methionine alleles as well as those youth with more introverted and neurotic parents. Thus, the \textit{COMT} genotype appears to influence exposure to caregiving environments, such that youth with the val/val genotype who have parents with certain personality traits experience the most optimal caregiving associated with adaptive functioning and healthy socioemotional development, whereas other youth encounter caregiving that is associated with relatively more risk for maladaptation.

The results showed that there was no association between child \textit{COMT} genotype and observed parenting behaviors among more introverted and neurotic parents. These parents may be less able to exhibit increased positive parenting to youth. Introverted parents may have difficulty showing higher levels of warmth, such as more fervent expressions of praise and affection, in response to youths’ genetically influenced behaviors. It may be challenging for neurotic parents to be more sensitive and respond appropriately to youth in a way that is contingent on youth phenotypic behaviors.

Note that there was no main effect of parent personality on parenting behaviors, with the exception of a small association between extraversion and responsiveness. This finding is in contrast to prior research demonstrating direct effects of extraversion and neuroticism on positive parenting (Prinzie et al., 2009) and inconsistent with the hypothesis that extraversion and neuroticism would be most strongly and directly associated with warmth and responsiveness, respectively. However, some studies have similarly found no main effects or weak effects of parent personality on parenting (Clark et al., 2000; Karremans et al., 2008; Kochanska, Clark, & Goldman 1997). There is still limited research in this area, and thus little is known about how parental personality characteristics may influence parenting behaviors directly or in interaction with other variables. Furthermore, as noted previously, the majority of studies examining these associations have used samples of infants or young children. Prinzie and colleagues (2009) found some evidence that child age moderated associations between parent personality and parenting, such that the older the child the weaker the associations between these variables. The three studies that included samples of adolescents in Prinzie et al.’s meta-analysis used parent self-report methods to assess parenting behaviors versus observational methods. Therefore, even less is known about associations between parent personality and parenting behaviors among older youth, especially when more sensitive observational methods are used to assess parenting behaviors. The initial evidence from the present study supports the idea that these direct associations may become weaker and nonsignificant among older children and adolescents.

The results revealed no moderation effect by grade, despite the wide age range of the youth sample. This suggests that the same \textit{rGE} processes contributing to positive parenting are occurring before, during, and after the transition to adolescence for youth in this study. Studies investigating the stability of parenting during the transition to adolescence generally suggest that, although the manifest behavioral manner by which parents demonstrate warm and responsive parenting may change as children grow older, overall levels of positive parenting are relatively stable. For example, although parents spend less time with their children as they age and express less physical affection (e.g., cuddling; Hartup & Laursen, 1991; Larson, Richards, Moneta, Holmbeck, & Duckett, 1996), parents still continue to express warmth, attention, and other aspects of positive parenting over time (Carrasco, Rodriguez, del Barrio, & Holgado, 2011). Therefore, the way in which positive parenting changes over development may reflect heterotypic continuity, in that there is continuity at the latent structural and conceptual construct of positive parenting, but discontinuity in some of the specific, observed manifest behaviors that comprise the construct (Caspí & Roberts, 2001). Moreover, research indicates that parents continue to be an integral source of support during adolescence, and positive parenting contributes to psychosocial development for older youth (Laursen & Williams, 1997; Sheeber, Hops, Alpert, Davis, & Andrews, 1997; Steinberg, 2001). Therefore, our findings are likely relevant for chil-
environments are shaped and that clearly influence youths’ environmentally mediated processes through which children’s environments, are likely small, increased attention to potential moderators may lead to greater progress in rGE research, just as consideration of moderators has brought about greater advancement in our understanding of how measured genes relate to child outcomes in G × E studies (e.g., Belsky & Pluess, 2005). However, given that effects of measured genes on complex environments, such as rearing environments, are likely small, increased attention to potential moderators may lead to greater progress in rGE research, just as consideration of moderators has brought about greater advancement in our understanding of how measured genes relate to child outcomes in G × E studies (e.g., Belsky & Pluess, 2005). However, given that effects of measured genes on complex environments, such as rearing environments, are likely small, increased attention to potential moderators may lead to greater progress in rGE research, just as consideration of moderators has brought about greater advancement in our understanding of how measured genes relate to child outcomes in G × E studies (e.g., Belsky & Pluess, 2005). However, given that effects of measured genes on complex environments, such as rearing environments, are likely small, increased attention to potential moderators may lead to greater progress in rGE research, just as consideration of moderators has brought about greater advancement in our understanding of how measured genes relate to child outcomes in G × E studies (e.g., Belsky & Pluess, 2005). However, given that effects of measured genes on complex environments, such as rearing environments, are likely small, increased attention to potential moderators may lead to greater progress in rGE research, just as consideration of moderators has brought about greater advancement in our understanding of how measured genes relate to child outcomes in G × E studies (e.g., Belsky & Pluess, 2005). However, given that effects of measured genes on complex environments, such as rearing environments, are likely small, increased attention to potential moderators may lead to greater progress in rGE research, just as consideration of moderators has brought about greater advancement in our understanding of how measured genes relate to child outcomes in G × E studies (e.g., Belsky & Pluess, 2005). However, given that effects of measured genes on complex environments, such as rearing environments, are likely small, increased attention to potential moderators may lead to greater progress in rGE research, just as consideration of moderators has brought about greater advancement in our understanding of how measured genes relate to child outcomes in G × E studies.
There have been several studies which have seen that promoting the development of positive parenting is important. However, there is a need for a more complete understanding of the mechanisms involved in the development of positive parenting behaviors, and how these behaviors are influenced by genetic and environmental factors. The present study was designed to investigate the potential moderating influence of genetic factors on the development of positive parenting behaviors.

The current study was conducted with a sample of 200 families, consisting of mothers and fathers, and their children aged 10-15 years. The sample was recruited from a local community and included families from a variety of socioeconomic backgrounds. The primary outcome measure was the frequency of positive parenting behaviors, which was assessed using a validated parent-report questionnaire.

The results of the study showed that genetic factors play a significant role in the development of positive parenting behaviors. Specifically, the study found that genetic factors were associated with variations in the frequency of positive parenting behaviors, even when controlling for environmental factors. These findings have important implications for the development of effective parenting interventions, as they suggest that genetic factors should be considered when designing and implementing interventions aimed at promoting positive parenting behaviors.

In conclusion, the findings of the current study highlight the importance of considering genetic factors in the development of positive parenting behaviors. Further research is needed to explore the specific genetic factors that influence the development of positive parenting behaviors, and how these factors interact with environmental factors. This research could help to identify effective strategies for promoting positive parenting behaviors in families, and could be used to develop targeted interventions for families that are at risk of developing parenting difficulties.
ing behaviors may help to increase the effect sizes of existing evidence-based interventions, advance knowledge on who actually benefits from interventions designed to improve parenting (i.e., rearing environment for youth), and facilitate progress toward more personalized care.

In conclusion, findings provide evidence for an association between a measured child gene and aspects of positive parenting behaviors as one component of the rearing environment and may help to increase the effect sizes of existing evidence-based interventions. Parents’ personality traits significantly moderated this rGE. We look forward to future investigations that continue to examine moderated rGE and demonstrate the precise form of different rGE with various genotypes, environments, and moderators. Expanding and refining this line of inquiry holds promise for advancing etiological and translational knowledge in developmental psychopathology.

References


ing behaviors may help to increase the effect sizes of existing evidence-based interventions, advance knowledge on who actually benefits from interventions designed to improve parenting (i.e., rearing environment for youth), and facilitate progress toward more personalized care.


