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Vulnerability to depression: A moderated mediation model of the roles of child maltreatment, peer victimization, and 5-HTTLPR genetic variation among children from low-SES backgrounds

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Abstract

Child maltreatment, peer victimization, and a polymorphism of the serotonin transporter gene (5-HTTLPR) were examined as predictors of depressive symptomatology. Children (M age = 11.26, SD = 1.65), including 156 maltreated and 145 nonmaltreated children from comparable low socioeconomic backgrounds, provided DNA samples and self-reports of relational peer victimization, overt peer victimization, and depressive symptoms. Path analysis showed that relational and overt victimization mediated the association between child maltreatment and depressive symptoms. Bootstrapping procedures were used to test moderated mediation and demonstrated that genotype moderated the indirect effects of relational and overt victimization on child depressive symptoms, such that victimized children with the l/l variation were at an increased risk for depressive symptoms compared to victimized children carrying an s allele. Results highlight the utility of examining process models that incorporate biological and psychological factors contributing to the development of depressive symptomatology, and provide direction toward understanding and promoting resilience among high risk youth from a multiple levels of analysis approach.

Keywords

maltreatment; peer victimization; depression; 5-HTTLPR

Child maltreatment confers considerable risk for maladaptation across a wide range of developmental domains (Cicchetti & Toth, 2005). Exposed to a pathogenic relational environment, maltreated children are deprived of many of the experiences that are postulated to promote adaptive functioning across the lifespan. Instead, the experiences of maltreated children place them on a probabilistic pathway for future maladaptation and psychopathology (Cicchetti & Toth, 1995; Koenen, Moffitt, Poulton, Martin, & Caspi, 2007; Macmillan, Fleming, Streiner, Lin, Boyle, et al., 2001; Manly, Kim, Rogosch, & Cicchetti, 2001), characterized by an increased likelihood for compromised resolution of age-salient developmental tasks (Cicchetti & Lynch, 1995; Cicchetti & Valentino, 2006; Trickett & McBride-Chang, 1995). Failure to achieve developmentally relevant goals, in turn, may increase maltreated children's vulnerability to depression (Toth, Manly, & Cicchetti, 1992; Widom, DuMont, & Czaja, 2007).

Numerous studies have established a link between childhood maltreatment and the development of depressive symptomatology and disorder (Cicchetti & Rogosch, 2001; Kaufman, 1991; Kim & Cicchetti, 2006; Manly et al., 2001; Scott, Smith, & Ellis, 2010; Toth et al., 1992; Widom et al., 2007). Although this effect has been well-established, it is important to investigate psychological, as well as biological, mediators and moderators, in order to better understand the mechanisms by which maltreated children either traverse or avert trajectories to psychopathology (Cicchetti & Toth, 2005).

The current study examines the complex pathways by which maltreatment affects psychological adjustment in middle childhood by investigating multiple levels of risk. Because establishing peer relationships is an important developmental task during middle childhood (Waters & Sroufe, 1983), poor peer group functioning may heighten risk for depression and depressive symptomatology. Therefore, we evaluate a mediation model in which peer victimization is a mediator of the relationship between maltreatment and depressive symptoms. Additionally, we examine the moderating role of genotype in this model. Although maltreatment and peer victimization have been studied independently as stressors that contribute to depressive outcomes, dependent on genetic variation, no study to date has jointly examined these two salient environmental risk factors in a process oriented fashion.

Maltreatment and Peer Relations

According to an organizational perspective, development may be conceptualized as a series of reorganizations, during which previously developed structures become incorporated into subsequently emerging ones via a process of hierarchical integration (Cicchetti, 1993; Cicchetti & Schneider-Rosen, 1986; Sroufe & Rutter, 1984). In this way, competence at one stage prepares a child for adaptive functioning at the next stage (Sroufe & Rutter, 1984). Conversely, maladaptation may be carried forward, disrupting the development of later competencies (Cicchetti & Schneider-Rosen, 1986). Consistent with this approach, it has been theorized that the negative relational patterns acquired in a maltreating environment become incorporated into the structures that are pertinent for successful peer relations (Cicchetti, Lynch, Shonk, & Manly, 1992).

Continuity and coherence in relational patterns are thought to be derived from early relationship experiences. Within the context of the parent-child relationship, children develop attitudes and expectations regarding the self and others, which are subsequently applied to later social interactions (Sroufe & Fleeson, 1986, 1988). Exposed to insensitive and pathological care, maltreated children may develop negative expectations regarding the availability and trustworthiness of others, as well as mental representations of the self as incompetent and unworthy (Cicchetti et al., 1992; Cicchetti & Toth, 1998). In addition, they may expect that violence, coercion, and exploitation are fundamental to all relationships (Cicchetti & Lynch, 1995). These internalizations lead to the selection and structuring of later social interactions, such that familiar relationship patterns are recreated and validated (Sroufe & Fleeson, 1986, 1988). Individuals with a history of abuse, rejection, and parental insensitivity may continue to seek out relationships that confirm their relational expectations, revisiting patterns of victimization. Consistent with this conceptualization, research shows that adults with a history of child maltreatment are more likely to abuse their own children, as well as become victims and perpetrators of domestic violence (Browne & Finkelhor, 1986; Dutton, Van Ginkel, & Starzomski, 1995; Egeland, Jacobvitz, & Papatola, 1987).

Continuity in relational functioning is evident even earlier in development, as children navigate the peer domain. Maltreated children experience a variety of peer difficulties,

including peer rejection, aggressiveness, and withdrawal from peer interactions (Cullerton-Sen et al., 2008; Dodge, Pettit, & Bates, 1994; Mueller & Silverman, 1989; Murray-Close, Han, Cicchetti, Crick, & Rogosch, 2008; Rogosch & Cicchetti, 1994; Shields & Cicchetti, 2001). However, research on the peer relations of maltreated children has predominately focused on maltreated children's heightened tendency to engage in aggressive behavior (Cullerton-Sen et al., 2008; Haskett & Kistner, 1991; Murray-Close et al., 2008; Salzinger, Feldman, Hammer, & Rosario, 1993; Shields & Cicchetti, 1998), with little attention to their victimization status. This reflects a large oversight, given the deleterious implications of peer victimization on psychosocial adjustment (see Crick & Bigbee, 1998; Crick & Grotpeter, 1996; Cullerton-Sen & Crick, 2005; Prinstein, Boergers, & Vernberg, 2001; Putallaz, Grimes, Foster, Kupersmidt, Coie, & Dearing, 2007).

Two studies have identified child maltreatment as a risk factor for peer victimization. In the first study, Schwartz and colleagues (1997) demonstrated that abusive family treatment predicted boys' status as aggressive victims. Shields and Cicchetti (2001) expanded upon these findings by including girls in their investigation of bullying and peer victimization in a maltreated sample. Results indicated that maltreatment placed children at considerable risk for being victimized by their peers. Moreover, gender did not act as a moderator, suggesting that maltreated boys and girls experienced similar levels of victimization (Shields & Cicchetti, 2001).

Although these studies have broadened our understanding of maltreated children's experiences in the peer group, no study of peer victimization among maltreated children has included both boys and girls, in addition to forms of victimization that are most salient for girls (i.e., relational victimization). Whereas overt victimization inflicts harm via verbal threats and physically aggressive behavior (e.g., name calling, hitting, pushing), relational victimization damages relationships and threatens feelings of inclusion (e.g., exclusion, rumor spreading, threats to withdraw friendship; Crick & Grotpeter, 1996; Crick et al., 2001). A number of studies have demonstrated that girls are more likely to experience relational victimization, whereas boys are more likely to experience overt victimization (Crick & Bigbee, 1998; Cullerton-Sen & Crick, 2005; Putallaz et al., 2007; Schäfer, Werner, & Crick, 2002). However, other studies have not detected gender differences (Crick & Grotpeter, 1996; Paquette & Underwood, 1999; Prinstein et al., 2001). Despite discrepant findings on gender differences in exposure to relational victimization, research is consistent in showing that assessment of relational victimization results in the identification of significantly more victimized girls than does focusing on overt victimization alone (Crick & Bigbee, 1998; Crick, Casas, & Nelson, 2002). Therefore, the current study aims to more fully capture the implications of peer victimization in a maltreated sample by including boys and girls, as well as assessments of both relational and overt forms of victimization.

Peer Victimization and Adjustment

Once the effects of maltreatment are carried forward into the peer realm, disruption in peer relationships may place a child at risk for the development of depression. Research has demonstrated that both overt and relational forms of peer victimization are concurrently and longitudinally associated with depressive symptoms (Boivin, Hymel, & Bukowski, 1995; Crick & Bigbee, 1998; Crick & Grotpeter, 1996; Cullerton-Sen & Crick, 2005; Hodges, Boivin, Vitaro, & Bukowski, 1999; LaGreca & Harrison, 2005; Olweus, 1993; Prinstein et al., 2001; Putallaz et al., 2007; Rosen et al., 2009; Storch, Phil, Nock, Masia-Warner, & Barlas, 2003; Vernberg, 1990). Given maltreated children's increased likelihood to be victimized by their peers (Schwartz et al., 1997; Shields & Cicchetti, 2001), peer victimization may be an important factor in understanding the link between maltreatment and psychological maladjustment. Therefore, the current study examines relational and overt

victimization as potential mediators of the association between maltreatment and depressive symptoms.

Genetic Moderation of Environmental Stress

Despite robust findings that have linked parental maltreatment and peer victimization with depression, not all of the children who experience these stressors develop depression or depressive symptomatology. The concept of multifinality stresses the possibility that diverse outcomes may emerge from a single risk factor, including healthy adaptation (Cicchetti & Rogosch, 1996). Such variability in children's response to the environment suggests that genes may play a role in this observed heterogeneity (Rutter, 2006; Rutter, Moffitt, & Caspi, 2006).

Molecular genetics studies have identified a functional polymorphism (5-HTTLPR) in the promoter region of the serotonin transporter gene (5-HTT) that is involved in the development of depression. The genotype has two allelic forms: long (*l*) and short (*s*) variants. The presence of the *s* allele is associated with reduced transcriptional activity of serotonin, whereas the *l* allelic variant has two to three times the basal level of transcriptional activity than the *s* variant (Lesch, et al., 1996; Lesch & Heils, 2000). Moreover, the *s* variant appears to have a dominant influence, such that 5-HTT expression and uptake are similar for homozygous short and heterozygous genotypes (Greenberg et al., 1999; Lesch et al., 1996). However, evidence for a genotype to phenotype association has been inconsistent, suggesting that there may not be a direct effect of 5-HTT on depression (Lasky-Su, Faraone, Glatt, & Tsuang, 2005; Lesch, 2003; Rutter, Thapar, & Pickles, 2009).

Rather than conceptualize environmental stress or genetic makeup as deterministic predictors of psychopathology, several studies have demonstrated gene-by-environment interactions (G X E) in the development of depression. In a landmark epidemiological study, Caspi and colleagues (2003) found that 5-HTTLPR genotype moderated the effects of stressful life events in the development of depression in adulthood. In particular, adults carrying the *s* allele exhibited more depressive symptoms, diagnosable depression, and suicidality in response to stressful life events than individuals homozygous for the *l* allele (Caspi et al., 2003). Moreover, an examination of early life stress showed that a history of child maltreatment longitudinally predicted depression in adulthood, but only among *s* carriers. These results were instrumental in providing evidence that an individual's response to the environment may be moderated by genes.

Efforts to replicate Caspi's initial findings have yielded both positive and negative findings. Among these studies, the majority of supporting findings show that the *s* allele heightens risk for depression in the context of stress (e.g., Jacobs, Kenis, Peeters, Derom, Vlietinck, & van Os, 2006; Kendler, Kuhn, Vittum, Prescott, & Riley, 2005); however, some show that the *l/l* genotype confers vulnerability for depression (e.g., Chipman et al., 2007; Cicchetti, Rogosch, & Oshri, 2011; Laucht et al., 2009). Conversely, other investigative attempts have not resulted in an interaction effect (e.g., Coventry et al., 2010; Wichers et al., 2008).

In recent years, a series of meta-analyses have been conducted examining G X E effects involving 5-HTTLPR, generating controversy and discussion. Of these, Munafo et al. (2009) and Risch et al. (2009) concluded that there is no evidence supporting an interaction between 5-HTTLPR and stressful life events predicting depression; however, they have been met with serious criticism. Rebuttals have largely focused on study selection, as these meta-analyses included only 5 and 14 of the 34 relevant studies. In particular, only investigations examining interactions between 5-HTTLPR and stressful life events in the development of depression were included, even though the original Caspi et al. (2003) study demonstrated

an interaction between 5-HTTLPR and maltreatment, in addition to the interaction with stressful life events. By focusing on only a subset of available studies, these meta-analyses have been criticized for ignoring the methodological heterogeneity inherent within this body of research.

Subsequent meta-analyses have demonstrated that there is a systematic relationship between the methods used to assess stressful life events and the outcomes of research examining interactions with 5-HTTLPR (Karg, Burmeister, Shedden, & Sen, 2011; Uher & McGuffin, 2010). In particular, studies of broadly-defined "stressful life events," typically produce mixed results (Caspi, Hariri, Holmes, Uher, & Moffitt, 2010). Such variability in findings may be attributed to the fact that the measurement of stressful life events varies from study to study, such that stress measures are not comparable. Additionally, a count of stressful life events produces a heterogeneous high-stress group consisting of individuals who may be experiencing qualitatively different forms of stress. Moreover, these studies generally use self-reports of stress, which are prone to reporter biases and inaccuracies in retrospective recall. On the other hand, studies of objectively measured, specific stressors, such as maltreatment, often generate positive findings. In their meta-analysis, Karg and colleagues (2011) showed that when studies are stratified by stressor type (i.e., stressful life events, maltreatment, and specific medical conditions), the most robust findings occur when a specific stressor is identified, as opposed to broadly-defined stress. Such a pattern of replication emphasizes the importance of a well-defined environmental stressor in the examination of G X E effects.

Child maltreatment is a clearly-operationalized, depression-inducing stressor that has been shown to be moderated by 5-HTTLPR genotype (Aguilera et al., 2009; Åslund et al., 2009; Caspi et al., 2003; Cicchetti et al., 2011; Cicchetti, Rogosch, & Sturge-Apple, 2007; Kaufman et al., 2006; Kaufman et al., 2004). Moreover, researchers examining child maltreatment have been successful in demonstrating that the interaction effect may be generalized to child and adolescent populations (Åslund et al., 2009; Cicchetti et al., 2011; Cicchetti et al., 2007; Kaufman et al., 2004; Kaufman et al., 2006). In the first of such investigations, Kaufman et al. (2004) found that maltreated children (*M* Age = 9 years) with the *s/s* genotype experienced depression scores that were almost twice as high as the depression scores of maltreated children with the *s/l* and *l/l* genotypes. Kaufman et al. (2006) replicated these findings in a subsequent study (*M* Age = 9 years), the results of which revealed a significant three-way interaction between BDNF genotype, 5-HTTLPR, and maltreatment in predicting heightened levels of depression. In another instance of G X G X E, Cicchetti et al. (2011) demonstrated that maltreated children (*M* Age = 10 years) with two copies of the TAT haplotype of CRHR1 and the *l/l* genotype of 5-HTTLPR had higher levels of internalizing symptoms than nonmaltreated children with the same combination of gene variants. Among adolescents, Cicchetti and colleagues (2007) showed a G X G X E effect indicating that individuals with a history of sexual abuse (*M* Age = 16.7 years) who carried both the *s/s* genotype and the low MAOA activity genotype evinced higher levels of depression symptomatology compared to sexually abused adolescents with alternative combinations of the variants of the 5-HTT and MAOA genes. Åslund et al. (2009) also demonstrated a positive maltreatment X 5-HTTLPR effect for depression among adolescents (*M* Age = 17 years); however, results were only significant for females.

Although the reviewed literature has been instrumental in demonstrating the utility in specifying a well-defined environmental stressor, most studies focus on family-level stress, to the exclusion of other developmentally relevant stressors. As children progress into middle childhood, stress that originates from the peer group may become especially salient. This period is characterized by an increase in the quantity of peer interaction, as well as a marked change in the developmental significance of peers for psychological health (Hartup,

1996). Therefore, the inclusion of peer-related stressors in G X E designs may be particularly helpful in elucidating the developmental pathways to childhood depression.

Two molecular genetic studies have shown that peer victimization is a salient source of stress for children. In the first study, Benjet and colleagues (2009) examined 5-HTTLPR as a moderator of the effect of relational peer victimization on depression in adolescent girls (*M* Age = 12 years). Relational victimization significantly predicted increased depressive symptoms for girls in the *s/s* group, but not for girls in the *s/l* or *l/l* group.

In another study, Sugden et al. (2010) utilized an assessment of bully victimization that measured both relational and overt forms of victimization. Relational and overt victimization experiences were aggregated and children were classified as not bullied, occasionally bullied, or frequently bullied. They found that 5-HTTLPR moderated the association between bully victimization and emotional problems (i.e., withdrawn, anxious/depressed), such that frequently bullied children were at an increased risk for emotional problems at age 12 if they possessed the *s/s*, but not the *s/l* or *l/l* genotype. Moreover, genetic moderation persisted even after controlling for the effects of family risk factors, as measured by within-family comparisons in a twin study design.

Sugden et al. (2010) expanded upon the Benjet et al. (2009) study by including males and females and by utilizing a measure of bully victimization that incorporated both relational and overt forms of victimization. Due to the composite nature of their assessment, however, it was not possible to independently determine the effects of relational and overt victimization. Given that relational and overt victimization are distinct behaviors with unique effects on adjustment (Crick & Grotpeter, 1996; Cullerton Sen & Crick, 2005; Prinstein et al., 2001; Storch et al., 2003), it is important to distinguish between the two when assessing developmental outcomes.

Hypotheses and Research Questions

The current study investigates the development of depressive symptoms in a preadolescent sample of maltreated and nonmaltreated comparison children. We propose a moderated mediation model, whereby peer victimization mediates the association between maltreatment and depressive symptoms among children who are genetically predisposed to developing depression. Research indicates that maltreated children experience disruptions in the peer domain, including an increased likelihood of being victimized by their peers compared to nonmaltreated children. We hypothesize that compromised resolution of this stage salient developmental task subsequently increases risk for depression. Additionally, we believe that maltreated children carrying an *s* allele are more likely to traverse this pathway from maltreatment to peer victimization to depressive symptoms, compared to maltreated children homozygous for the *l* allele.

To our knowledge, this is the first G X E study to independently examine the effects of both relational and overt forms of victimization on depressive symptomatology. Moreover, the current study is unique in its approach of examining potential genetic moderation, by allelic variation of 5-HTTLPR, of a process model whereby maltreatment contributes to child depression via maltreatment's contribution to peer victimization.

We posit the following hypotheses and research questions:

1. We do not expect to observe significant between group differences in the distribution of the 5-HTTLPR genotype for maltreated and nonmaltreated children, suggesting a lack of an evocative gene-environment correlation as an explanation for maltreatment.

2. We do not expect to observe significant differences between genotype groups on scores of overt and relational victimization, suggesting a lack of an evocative gene-environment correlation as an explanation for peer victimization.
3. We hypothesize that there will be a significant G X E interaction between maltreatment status and 5-HTTLPR genotypes, such that maltreated children with an *s* allele (*s/s* or *s/l*) will have higher levels of depressive symptoms than those with the *l/l* genotype, whereas depressive symptoms will not vary by genotype among nonmaltreated children.
4. Maltreatment will be positively related to depressive symptoms, as well as relational and overt victimization. In turn, relational and overt peer victimization will mediate the association between child maltreatment and depressive symptomatology.
5. Within the mediational process model, the paths (b_1) from relational victimization and from overt victimization to depressive symptoms will be moderated by 5-HTTLPR genotypes, such that extremely victimized children carrying an *s* allele will have higher levels of depressive symptoms compared to extremely victimized children homozygous for the *l* allele.

Method

Participants

Participants included 301 children aged 8–13 ($M = 11.26$, $SD = 1.65$, $Mdn = 11.48$) who attended a summer day camp research program designed for school-aged, low income children. The sample was composed of both maltreated children ($n = 156$) and nonmaltreated children ($n = 145$). Among the participants, 62.1% were boys. In terms of racial/ethnic characteristics, 59.3% of the sample was African American, 23.7% was Caucasian, 15.3% was Hispanic, and 1.7% was from other racial/ethnic groups. The Add Health system for coding race/ethnicity was used (<http://www.cpc.unc.edu/projects/addhealth/data/code/race>; accessed March 6, 2012). The families of the children were low income, with 95.35% of the families having a history of receiving public assistance.

Recruitment and Classification Procedures

Parents of all children provided informed consent for their child's participation, as well as for examination of Department of Human Services (DHS) records pertaining to the family. Children in the maltreated group had been identified by the county DHS as having experienced child abuse or neglect, and the sample was representative of the children in families receiving services from the DHS. A recruitment liaison from DHS contacted eligible maltreating families and explained the study. If parents were interested, then they signed a name release form allowing the project team to contact them for recruitment. Families were free to choose whether or not to participate. Comprehensive searches of DHS records were completed and maltreatment information was coded utilizing operational criteria from the maltreatment nosology specified in the Maltreatment Classification System (MCS; Barnett, Manly, & Cicchetti, 1993).

Consistent with national demographics characteristic of maltreating families (Fourth National Incidence Study of Child Abuse and Neglect [NIS-4]; Sedlack et al., 2010), the maltreated children were predominantly from low-socioeconomic status families. Consequently, demographically comparable nonmaltreated children were recruited from families receiving Temporary Assistance for Needy Families (TANF). Prior to contacting potential participants, a liaison screened DHS records to verify any record of child maltreatment. The DHS recruitment liaison then contacted eligible nonmaltreating families

and described the project, and if interested, parents signed a release for their names to be given to the project for recruitment. Trained research assistants subsequently interviewed mothers of children recruited for the nonmaltreatment group to confirm a lack of DHS involvement and prior maltreatment experiences utilizing the Maternal Maltreatment Classification Interview (Cicchetti, Toth, & Manly, 2003). Record searches were conducted in the year following camp attendance to verify that all available information had been accessed. Only children from families without any history of documented abuse or neglect were retained in the nonmaltreatment group. In addition, families who had received preventive services through DHS due to concerns over risk for maltreatment were excluded from the sample to reduce the potential for unidentified maltreatment existing within this group.

Classification of maltreatment experiences children had been subjected to was accomplished through use of the MCS (Barnett et al., 1993). The MCS is a reliable and valid method for classifying maltreatment (Bolger, Patterson, & Kupersmidt, 1998; English et al., 2005; Manly, Cicchetti, & Barnett, 1994) that utilizes DHS records detailing investigations and findings involving maltreatment in identified families over time. Rather than relying on official designations and case dispositions, the MCS codes all available information from DHS records, making independent determinations of maltreatment experiences.

Coding of the DHS records was conducted by trained research assistants, doctoral students, and clinical psychologists. Coders were required to meet acceptable reliability with criterion standards before coding actual records for the study. Adequate reliability has been obtained (weighted κ s = .86 to .98; Manly et al., 2005). Other investigators also have demonstrated that the MCS is reliable and valid in classifying maltreatment (e.g., Bolger & Patterson 2001; English et al., 2005; Stouthamer-Loeber, Loeber, Homish, & Wei, 2001). In the current study, reliability was established for each subtype of maltreatment: emotional maltreatment, κ = .91; neglect, κ = .93; physical abuse, κ = .89; and sexual abuse, κ = 1.00.

In terms of the subtypes of maltreatment, *neglect* involves failure to provide for the child's basic physical needs for adequate food, clothing, shelter, and medical treatment. *Emotional maltreatment* involves extreme thwarting of children's basic emotional needs for psychological safety and security, acceptance and self-esteem, and age-appropriate autonomy. *Physical abuse* involves the nonaccidental infliction of physical injury on the child (e.g., bruises, welts, burns, choking, broken bones). Finally, *sexual abuse* involves attempted or actual sexual contact between the child and a family member or person caring for the child for purposes of that person's sexual satisfaction or financial benefit.

Children in the maltreatment group all had histories of abuse, neglect, or both (i.e., emotional: 21.79%; physical: 31.41%; sexual: 16.03%; and neglect: 30.77%). The majority of children had experienced multiple subtypes of maltreatment. Specifically, 29.7% experienced one subtype; 33.3% experienced two; 28.3% experienced three; and 8.7% experienced four.

Procedures

Children attended a week-long day camp program and participated in research assessments (see Cicchetti & Manly, 1990, for detailed descriptions of camp procedures). Children were transported by bus to the camp each day, with travel time averaging 45 min. At the camp, children were assigned to groups of eight (four maltreatment, four comparison) same-age and same-sex peers. Each group was led by three trained camp counselors, who were unaware of the maltreatment status of children and the hypotheses of the study. Camp lasted 7 hours a day for 5 days, providing 35 hours of interaction between children and counselors. In addition to the recreational activities, after providing assent, children participated in

various research assessments. Trained research assistants, who also were unaware of research hypotheses and maltreatment status, conducted individual research sessions with children, in which questionnaires and other research measures were administered. In an effort to reduce potential negative cognitive biases, questionnaires that assessed depressive symptoms and peer victimization were administered three days apart in the camp week. Clinical consultation and intervention occurred if any concerns over danger to self or others emerged during research sessions. DNA samples also were obtained from children, as described below.

Measures

Children's Depression Inventory (CDI).—The CDI is a widely used self-report questionnaire that assesses depressive symptomatology in school-age children (Kovacs, 1992, 2004). For each item, children chose from among three option statements, depicting increasing levels of depressive symptoms, in order to characterize their experiences in the past 2 weeks. Kovacs (2004) reports that internal consistency for the total scale has ranged from 0.71 to 0.89, and that validity has been well established. In the current investigation, internal consistency was $\alpha = 0.81$.

Children's Social Experiences Questionnaire—Self-Report (CSEQ-S)—The CSEQ-S assesses peer victimization experiences (Crick & Grotpeter, 1996). The CSEQ-S includes two five-item victimization subscales: overt (e.g., “How often do you get hit by another kid?”) and relational (e.g., “How often do other kids leave you out on purpose when it is time to play or do an activity?”). Children were introduced to the measure with the following prompt: “Here is a list of things that sometimes happen to kids your age. How often do they happen to you?” Therefore, assessment of peer victimization was not limited to experiences at camp. Children indicated the frequency of being victimized by their peers by answering these questions on a 5-point Likert scale, with a score of 1 corresponding to “never” and a score of 5 corresponding to “all the time.” Crick & Grotpeter report (1996) adequate internal consistency, reliability, and construct validity for the CSEQ-S. In the current sample, internal consistency was $\alpha = .86$ for the overt victimization subscale and $\alpha = .80$ for the relational victimization subscale. Consistent with previous research using the SEQ (e.g., Benjet et al., 2010; Crick & Bigbee, 1998; Crick & Grotpeter, 1996; Prinstein et al., 2001), a child was categorized as extremely victimized based on a cut-off score of one standard deviation above the mean on each of the victimization scales. Because a certain degree of peer victimization is considered to be normative, children who are targeted at extreme levels are expected to be at the greatest risk for negative developmental outcomes (Crick et al., 2002).

DNA Collection, Extraction, and Genotyping

Using an established protocol, trained research assistants obtained DNA samples from participants by collecting buccal cells with the Epicentre Catch-All Collection Swabs. Subsequently, using the conventional method, DNA was extracted with the Epicentre BuccalAmp DNA Extraction Kit (Epicentre, Cat. No. BQ090155C) and Whole Genome amplified using the Repli-G Kit (Qiagen, Cat. No. 150043) per the kit instructions. Amplified samples were then diluted to a working concentration.

Genotyping was conducted following previously published protocols. For 5-HTT, we used the methods of Gelernter, Kranzler, and Cubells (1997). Representative genotypes were identified and sequenced with a Beckman–Coulter CEQ8000 semiautomated fluorescent sequencing system, utilizing the Fragment Analysis Application and associated software.

The 5-HTT gene has a polymorphism in the linked promoter region (5-HTTLPR) in the 5'-regulatory region due to a 44 base pair deletion which eventuates in either the *s* (short) or *l* (long) allele (Lesch et al., 1996). The presence of the *s* allele is associated with reduced transcriptional activity of serotonin and lower level of the gene expression (Lesch et al., 1996; Lesch & Heils, 2000).

If a genotype was unable to be determined after the first run, then it was repeated up to four times. If the null result persisted, then the Whole Genome Amplification reaction was repeated along with subsequent genotyping until a genotype could be confidently assigned to a participant. The resultant genotyping data were subjected to quadratic discriminant analysis using JMP software from SAS. Samples with a predicted probability of 0.95 or less were repeated. The call rate for 5-HTTLPR was 100%. There were no missing results. The distribution of the three 5-HTTLPR genotypes did not differ significantly from Hardy-Weinberg equilibrium, $\chi^2 (1, N = 301) = 3.1, p = .08$.

Control samples were identified for the 5-HTTLPR polymorphisms using DTCS chemistry on an ABI 3130x1. Results were confirmed using the TaqMan SNP genotyping reagents used in this study and run with each sample set as positive and negative controls for each allele. All DNA samples were genotyped in duplicate for quality control. In addition, human DNA from cell lines was purchased from Coriell Cell Repositories for all representative genotypes in duplicate and genotypes confirmed by sequencing using DTC& chemistry on an ABI 3130x1.

The frequency distribution of the 5-HTTLPR genotype for the full sample was as follows: *s/s*: *n* = 40 (13.3%); *s/l*: *n* = 120 (39.9%); *l/l*: *n* = 141 (46.8%). Frequency distributions by racial/ethnic group were as follows: African American: *s/s*: *n* = 16 (9.0%); *s/l*: *n* = 64 (36.0%); *l/l*: *n* = 98 (55.0%); Caucasian: *s/s*: *n* = 14 (19.7%); *s/l*: *n* = 35 (49.3%); *l/l*: *n* = 22 (31.0%); Hispanic: *s/s*: *n* = 10 (21.7%); *s/l*: *n* = 19 (41.3%); *l/l*: *n* = 17 (37.0%). Chi-square analyses showed that the distributions of the *s/s*, *s/l* and *l/l* variants differed significantly across racial/ethnic groups, $\chi^2 (6, N = 301) = 17.62, p = .007$. Consistent with prior investigations (Gelernter et al., 1997), African American children were more likely to have the *l/l* genotype than Caucasian or Hispanic children. However, the genotype distribution did not differ by maltreatment status within the race/ethnicity groups, African American: $\chi^2 (2, N = 188) = 1.55, p = .46$; Caucasian: $\chi^2 (2, N = 71) = 2.38, p = .30$; Hispanic: $\chi^2 (2, N = 36) = 5.58, p = .06$.

Analytic Plan

All SEM analyses were performed using Mplus Version 6.00 (Muthén & Muthén, 1998-2010). To account for non-normality presented in the CDI and overt victimization variables (Kurtosis = 2.31 and 1.72, respectively), all structural relations were assessed using bootstrapping with 5,000 sample replicates. Traditional maximum likelihood methods assume the distributions of the continuous variables in the model are multivariate normal. In mediation models the normal distribution assumption is an important concern as the product coefficients used to evaluate mediation rarely meet this assumption (Preacher & Hayes, 2008; Shrout & Bolger, 2002). Thus, in the current study, the significance of mediation (i.e., indirect effects), as well as moderated mediation, was determined via bootstrapping techniques (Preacher & Hayes, 2008).

The full information maximum likelihood (FIML) procedure was used to estimate missing data in the model. The rates of missing data were minimal and ranged from 0% to 6.6% (CDI). There were no missing data on maltreatment status. Missing data were modeled under the assumption that missingness was related to variables that were observed but unrelated to the missing values themselves (i.e., Missing-At-Random; Schafer & Graham,

2002), and were analyzed under missing data theory using all available data (Schafer & Graham, 2002). To account for potential influence of gender, race/ethnicity, and age, we used these variables as covariates in all of the analyses across all of the examined endogenous variables.

Results

Preliminary Analyses

Table 1 summarizes Pearson bivariate correlations among variables included in the structural models, as well as means and standard deviations for the maltreated and nonmaltreated groups. T-tests showed that maltreated children reported significantly higher levels of overt victimization, $M = 10.24$, $SD = 5.39$, compared to nonmaltreated children, $M = 8.21$, $SD = 3.67$, $t(299) = -3.79$, $p < .001$, $d = .44$. Maltreated children also reported significantly higher levels of relational victimization, $M = 11.72$, $SD = 5.23$, compared to nonmaltreated children, $M = 9.97$, $SD = 4.13$, $t(299) = -3.21$, $p = .001$, $d = .37$. CDI scores were significantly higher among maltreated children, $M = 7.81$, $SD = 6.49$, compared to nonmaltreated children, $M = 6.08$, $SD = 5.59$, $t(279) = -2.38$, $p = .018$, $d = .28$.

In order to test the first research question, differences between maltreated and nonmaltreated children on frequency distributions of the 5-HTTLPR genotype were examined. Chi-square analyses revealed that for the 5-HTTLPR genotype, the distributions of the *s/s*, *s/l* and *l/l* variants did not differ between maltreated and nonmaltreated children, $\chi^2(2, N = 301) = 5.38$, $p = .068$. For the maltreated versus nonmaltreated groups, respectively, the percentages were as follows: *s/s*: 17.3% versus 9.0%; *s/l*: 40.4% versus 39.3%; and *l/l*: 42.3% versus 51.7%. These findings indicated that maltreatment status was not differentially associated with polymorphic variation in the 5-HTTLPR gene, thereby providing evidence against the existence of an evocative gene-environment correlation. Consistent with previous research strategies, as well as data indicating that the *s* allele has a dominant influence marked by lower transcriptional activity among *s/s* and *s/l* carriers compared to *l/l* carriers (Greenberg et al., 1999; Lesch et al., 1996; Lesch & Heils, 2000), participants with the *s/s* and *s/l* genotypes were combined and compared to children with the *l/l* genotype in all study analyses in order to address power concerns (e.g., Caspi et al., 2003; Cicchetti, et al., 2010; Hariri et al., 2005). Follow-up chi-square analyses of the distributions of the *s/s* or *s/l* and the *l/l* variants among the maltreated versus nonmaltreated children were not significant, $\chi^2(1, N = 301) = 2.68$, $p = .102$. Similarly, differences between 5-HTTLPR genotypes and scores on overt and relational victimization also were examined. Analyses revealed no significant differences between genotype group (i.e., *s/s* or *s/l* and *l/l*) and scores on either overt, $t(299) = 1.57$, $p = .117$, or relational victimization, $t(299) = 1.18$, $p = .24$, indicating that there was not a g-e correlation.

Next we evaluated the second hypothesis that 5-HTTLPR would moderate the association between maltreatment and depressive symptoms. After covarying for gender, race/ethnicity, and age, there was no main effect for the association between 5-HTTLPR genotype and depression symptoms, $F(1, 274) = 0.178$; $p = 0.178$, whereas the main effect of maltreatment was significant, $F(1, 274) = 4.565$; $p = .034$. Furthermore, analyses indicated there was no significant interaction effect between 5-HTTLPR genotype group and maltreatment status in the prediction of child depression symptoms, $F(1, 274) = 2.723$; $p = .100$.

Mediation Models

We evaluated two path analytic models to test relational victimization and overt victimization, respectively, as mediators for the relation between child maltreatment and

child depression symptoms. Race/ethnicity, gender, and age were included as covariates in the two path analytic models and for all of the endogenous variables (i.e., mediator and outcome variables). Standardized and unstandardized path coefficients of the direct and indirect effects tested at 95% bias corrected confidence intervals are presented in Table 2 and in Figures 1a and 1b. Maltreatment status significantly predicted increased depressive symptoms, as well as higher levels of relational and overt victimization. In addition, relational and overt victimization were significantly positively associated with child depression. The indirect paths of the two models from child maltreatment to child depression via relational victimization and overt victimization, respectively, were both statistically significant ($ps < .01$), as shown in Table 2. Following the recommendations of Preacher & Kelly (2011), multiple effect size estimates are reported below. In the overt victimization model, $R^2 = .100$, indicating that the model explains 10% of the variance. Another effect size estimate for the indirect effect of overt victimization is $R_M = 1.15$, the ratio of the indirect effect to the direct effect (Sobel, 1982), which indicates that the indirect effect of overt victimization on depression is approximately 1.15 times the size of the direct effect. Additionally, $\kappa^2 = .07$, which represents the proportion of the maximum possible indirect effect that could have occurred within the examined model, given the characteristics of the data (Preacher & Kelly, 2011). In the relational victimization model, $R^2 = .128$. For the indirect effect of relational victimization, the effect sizes were $R_M = .54$ and $\kappa^2 = .05$. These results supported the third hypothesis that the relations between child maltreatment status and increased depression symptoms in childhood are mediated by both relational and overt victimization.

Moderated Mediation

Subsequently, we tested for moderated mediation using a bootstrapping procedure following Preacher et al.'s (2007) model 3, in which moderation of the path between the mediator and the outcome (i.e., path b) is evaluated. Specifically, we wanted to test hypothesis 4, i.e., whether the association between victimization (i.e., relational and overt) and depression symptoms is moderated by genetic variation of 5-HTTLPR within the mediational path models. The findings showed that the associations between high relational victimization and high overt victimization and child depression symptoms are moderated by 5-HTTLPR genotype groups (Table 3). Specifically, the indirect effects from child maltreatment to depression symptoms via high relational victimization and high overt victimization were significant ($ps < .01$) for both the homozygous long and short allele groups. However, the indirect effect coefficient for children with the *l/l* variation ($B = .347$) was significantly larger ($p < .05$) for high relational victimization than the indirect coefficient for children with an *s* allele ($B = .319$). Similarly, for high overt victimization, the indirect effect coefficient for the *l/l* variation ($B = .586$) was significantly larger ($p < .05$) than the coefficient for the *s* allele group ($B = .538$). These findings indicate statistically significant moderated mediation effects, such that within the mediational models, the association of high victimization (i.e., relational or overt) and depression was stronger among children with the *l/l* genotype than among children with the *s/s* or *s/l* variations. These findings support the prediction of moderated mediation in hypothesis 4, albeit in the opposite direction.¹

¹At the suggestion of a reviewer, we ran the moderated mediation model separately for boys and girls. Although results were not statistically significant, the direction of effects support previous studies that demonstrate gender moderation of GXE effects. Exploratory analyses revealed that boys with the *l/l* genotype are at a heightened risk for depressive symptoms, which is consistent with other studies that suggest that the *l* allele confers risk for males, whereas the *s* allele confers risk for females (e.g., Brummet et al., 2008; Sjöberg et al., 2006).

Discussion

Previous research has established a robust association between child maltreatment and depression (Cicchetti & Rogosch, 2001; Kim & Cicchetti, 2006; Manly et al., 2001; Scott et al., 2010; Toth, et al., 1992; Widom et al., 2007). However, a developmental psychopathology approach emphasizes that maltreated children may traverse various pathways that lead to a diverse array of adaptive, as well as maladaptive, outcomes (Cicchetti & Rogosch, 1996). Rather than conceptualizing the relationship between child maltreatment and depression as direct and deterministic, the current study investigated underlying psychological and biological processes that may account for variation in the developmental sequelae of child maltreatment. Our goal was to examine whether peer victimization accounted for the association between maltreatment and depressive symptoms in middle childhood. We were also interested in whether genetic variation in 5-HTTLPR moderated mediational pathways.

Maltreated children and nonmaltreated comparisons were not found to differ in their distributions of the 5-HTTLPR genotype. Similarly, genotypic variation also did not account for the extent of overt or relational victimization experienced. These findings rule out the possibility of evocative gene-environment correlations (Rende & Waldman, 2006; Rutter, 2006; Scarr & McCartney, 1983), which would suggest that genetic variation accounts for maltreatment and victimization by peers. Moreover, these results support the current study's first two hypotheses positing that maltreatment and victimization are not elicited as a function of children's particular genetic characteristics. In addition, 5-HTTLPR did not directly predict differences in depressive symptoms. This finding corroborates results from previous research studies that have demonstrated the absence of a main effect of genes on depression (e.g., Benjet et al., 2010; Caspi et al., 2003; Cicchetti et al., 2007).

Next, we tested for a G X E interaction effect on depressive symptoms. Contrary to our second hypothesis, 5-HTTLPR did not moderate the association between maltreatment and depressive symptomatology. This finding corroborates research by Cicchetti et al. (2007) and Cicchetti et al. (2011), which similarly did not show G X E effects among maltreated adolescents (*M* Age = 16.7 years) and children (*M* Age = 10 years), respectively. It is possible that cross-study heterogeneity in the measurement of maltreatment contributes to discrepant results. Many G X E studies rely on retrospective self-reports of child maltreatment, whereas the current study used a well-defined and operationalized nosological system to code DHS records of maltreatment (MCS; Barnett et al., 1993). Stage of illness factors may also account for failure to replicate G X E effects among younger populations. Recent research suggests that the 5-HTTLPR X child maltreatment effect on depression may be specific to depression that runs a persistent course in adulthood, as opposed to single-episode depression (Uher et al., 2011). Longitudinal research is needed in order to distinguish G X E effects on chronic versus single-episode depression.

Consistent with previous research, maltreatment was positively associated with depressive symptoms; however, results from the current study revealed that this association was mediated by overt and relational peer victimization. Analyses indicated that the effect of maltreatment on depressive symptomatology became nonsignificant when peer victimization was taken into account, demonstrating full versus partial mediation (Baron & Kenny, 1986). In other words, maltreatment increased the risk for relational and overt victimization, which in turn predicted elevated levels of depressive symptoms. Although other mechanisms beyond the scope of the present study are likely involved in the development of depressive symptomatology, these results indicated that peer victimization experiences may be a significant factor in explaining the association between maltreatment and depressive symptoms.

The present investigation's mediational findings are congruent with organizational theories of development that suggest continuity in relationships (Main, Kaplan, & Cassidy, 1985; Sroufe & Fleeson, 1986, 1988). Exposed to a pathogenic rearing environment, maltreated children may develop negative expectations regarding the self and others, as well as a concept of relationships as involving victimization and coercion (Cicchetti et al., 1992; Cicchetti & Toth, 1998; Cicchetti & Lynch, 1995). Maltreated children may maintain a coherent sense of self by recreating familiar social environments that validate their relational expectations (Sroufe & Fleeson, 1986, 1988). Drawing from a repertoire of limited social skills, maltreated children may be more vulnerable to victimization from their peers as a result of engaging in behaviors such as hypervigilance to threatening cues, submissiveness, and withdrawal (Pollak, Cicchetti, Hornung, & Reed, 2000; Rieder & Cicchetti, 1989; Shields & Cicchetti, 2001; Shields, Ryan, & Cicchetti, 2001; Teisl & Cicchetti, 2008; Troy & Sroufe, 1987). Paradoxically, these behaviors may have been adaptive for them in abusive and chaotic homes (Sroufe, 1997). Once identified as vulnerable, maltreated children may be less likely to avoid their bullies if exploitation and violence do not violate their relational expectations (Dean, Malik, Richards, & Stringer, 1986; Troy & Sroufe, 1987).

Within the context of the moderated mediation model, analyses showed that 5-HTTLPR moderated associations between overt and relational victimization and depressive symptoms; however, interaction effects were not in the anticipated direction. Specifically, we found that children with the *l/l* genotype displayed heightened levels of depressive symptoms when exposed to relational and overt peer victimization, compared to children with an *s* allele. Moreover, our study differs from prior G X E investigations of victimization (i.e., Benjet et al., 2010; Sugden et al., 2010) in that we evaluated the moderational effect of genetic variation within the context of a process model linking child maltreatment to depression via the experience of relational and overt victimization. The *l/l* genotype moderated the mediational pathway from victimization to depressive symptoms. Although the effect of consequent high victimization on depression was stronger among children with the *l/l* genotype, that is not to say that there was no effect among children with an *s* allele; rather, the effect was not as strong.

It is important to note that our results were not accounted for by population stratification. Upon inspecting individual cases, there was no evidence that the relatively higher *l/l* frequency among African American participants accounted for our finding that the *l/l* genotype increased the risk for depression symptomatology among overtly and relationally victimized children. Additionally, analyses indicated that maltreated children did not differ from nonmaltreated children in terms of their genotype distributions within race/ethnicity groups.

Although our pattern of results is at variance with previous studies demonstrating that the effects of stress on depression are more robust among individuals with an *s* allele, our findings are in agreement with other studies showing increased risk for depression among individuals homozygous for *l* (Brummet et al., 2008; Chipman et al., 2007; Chorbov et al., 2007; Cicchetti et al., 2011; Laucht et al., 2009; Ritchie et al., 2009; Sjorberg et al., 2006; Zhang et al., 2009). A number of reasons may account for this observed heterogeneity in G X E research. A meta-analysis by Uher and McGuffin (2010) suggests that age is a significant factor, as opposite findings often have occurred in studies with adolescent samples (e.g., Chipman et al., 2007; Chorbov et al., 2007; Laucht et al., 2009; Sjorberg et al., 2006). For example, Laucht and colleagues (2009) found that the *l/l* genotype moderated the association between family adversity and depressive symptoms among adolescents (*M* Age = 19 years). Similarly, in a study by Chipman et al. (2007), adolescents ages 17 to 18 who had experienced chronic family adversity were at a heightened risk for depression if they carried the *l/l* genotype. Research by Cicchetti and colleagues (2011) suggests that this

pattern of results may extend to even younger children. In a three-way interaction between CRHR1 genotype, 5-HTTLPR genotype, and maltreatment, it was revealed that the *l/l* genotype conferred risk for depression among maltreated children (*M* Age = 10 years) who also carried two copies of the TAT haplotype (Cicchetti et al., 2011). Laucht et al. (2009) suggest that developmental differences in the manifestation of depression may explain this variation in the impact of genetic factors. In fact, some researchers have raised the question of whether child-, adolescent-, and adult-onset depression represent one homogeneous disorder. Depressed children, adolescents, and adults have been found to differ with respect to various neurobiological correlates, treatment response, and psychosocial risk profile (Duggal, Carlson, Sroufe, & Egeland, 2001; Harrington et al., 1997; Jaffee et al., 2002; Kaufman, Martin, King, & Charney, 2001). Given that that etiology and correlates of depression appear to vary by developmental period, researchers should continue to explore whether the pattern of G X E results observed among adults generalizes to other age groups.

Another developmental consideration concerns potential changes in G X E interactions across the lifespan (Casey et al., 2009; Lenroot & Giedd, 2011). For example, research examining the influence of the brain-derived neurotrophic factor (BDNF) gene suggests that the BDNF_{MET} allele predicts functional deficits in learning early in development when BDNF levels are low, but acts as a protective factor in adolescence when BDNF levels peak (Casey et al., 2009). Future research should examine potential developmental period X gene X environment interactions to explore whether 5-HTTLPR operates in a similar fashion, such that a particular genotype confers risk during one period of development and serves as a protective factor during another.

Gender moderation may be an additional contributing factor. For example, Brummet et al. (2008) and Sjöberg et al. (2006) found that the *s* allele, combined with stress, was associated with depression among women, whereas the *l/l* genotype conferred heightened risk among men. Similarly, Surtees et al., (2006) found that adverse childhood experiences predicted depression in men with the *l/l* genotype, but not among women. Among adolescents (*M* Age = 16 years), Eley et al. (2004) showed that the *s* allele moderated the association between stress and depression, but only among the girls in their sample. In the present investigation, exploratory analyses supported this pattern of results, suggesting that maltreated boys with the *l/l* genotype who have been exposed to peer victimization may experience a heightened risk for depression.

The results of the present study build upon the growing body of research indicating that 5-HTTLPR moderates the effect of stressful life events on the development of depression. Importantly, this investigation illustrates how genetic differences may contribute to variation in unfolding developmental processes through demonstrating genetic moderation of the linkage of child maltreatment to depression via peer victimization experiences. Results also underscore the importance of investigating biological, in addition to psychological, resilient processes (Charney, 2004; Cicchetti & Curtis, 2007; Cicchetti et al., 2011; Curtis & Cicchetti, 2003; Kim-Cohen & Gold, 2009). Although maltreatment is a potent environmental hazard, maltreated children are not destined to follow pathways to maladaptation, and genetic differences may influence the pathways that unfold.

The present investigation also contributes to our understanding of the peer relations of maltreated children. No other study to date has assessed the occurrence of both overt and relational victimization in a maltreated sample. Consistent with previous research, maltreated children were more likely to be overtly victimized compared to nonmaltreated children (Schwartz et al., 1997; Shields & Cicchetti, 2001). However, the current study is unique in demonstrating that maltreated children are also at an increased risk for relational victimization. Although research has identified maltreated children as relational aggressors

(Cullerton Sen et al., 2008; Murray-Close et al., 2008), no studies to date have investigated the occurrence of relational victimization among maltreated children. Unfortunately, assessment of solely overt forms of victimization likely overlooks a substantial group of children who are relationally victimized, and therefore, at risk for depression and other adjustment problems.

Limitations and Future Directions

Although this study offers new information about biological and social processes involved in the pathways from child maltreatment to depressive symptomatology, limitations exist that should be addressed in future research. First, self reports were used to assess both peer victimization and depressive symptoms; therefore, the association between victimization and maladjustment may be partially due to shared method variance. For example, negative cognitive biases may lead children who are reporting high levels of depressive symptoms to perceive that they are more victimized than their peers. However, by administering these questionnaires on different days, potential negative biases may have been minimized. Although external validation of peer victimization would have been preferable, research has shown high levels of agreement between self reports and peer reports (Crick & Bigbee, 1998), as well as between self reports and teacher reports, of victimization (Cullerton-Sen & Crick, 2005; Putallaz et al., 2007). Additionally, research supports the value of assessing children's own perceptions of their internal states, which may be difficult for external reporters to observe (Loeber, Green, & Lahey, 1990; Youngstrom, Loeber, & Stouthamer-Loeber, 2000).

Future research should examine the role of gender in predicting maltreated children's peer experiences and psychological adjustment. Some studies have suggested that girls are more often the targets of relational victimization, whereas boys more often experience overt victimization. Additionally, girls report significantly higher levels of distress compared to boys in response to relational victimization (Paquette & Underwood, 1999). Cullerton-Sen and colleagues (2008) have already demonstrated the utility of examining gender-specific pathways to overtly and relationally aggressive behavior among maltreated children. Similarly, we could expect that it is possible that girls may be more likely to traverse a pathway from maltreatment to relational victimization to depression. Alternatively, perhaps maltreated boys are more likely to experience overt forms of victimization, which subsequently increases their risk for depressive symptoms. In addition, previous research indicates that sex may be an important factor influencing G X E results (Brummet et al., 2008; Eley et al., 2004; Sjorberg et al., 2006; Surtees et al., 2006). Despite having a sample of 301 children in the current study, exploration of gender moderation would have yielded cells with limited size, thereby raising power concerns. Future research that explores the effects of gender may help to determine whether boys and girls follow distinct, yet converging, pathways from maltreatment to depression (Kim & Cicchetti, 2006).

Finally, we were interested in testing a complex model with multiple levels of analysis that included both psychological and biological factors; therefore, it is possible that our power was limited in detecting all hypothesized effects. Although the power of our design was strengthened by objective measurement of maltreatment experiences, in future research, these findings should be replicated with larger sample sizes (Duncan & Keller, 2011).

In conclusion, the findings from the present investigation indicate that maltreated children are at an increased risk for being relationally and overtly victimized by their peers, which in turn contributes to the development of depressive symptoms. Results also demonstrated that not all maltreated children are destined to follow this pathway to peer victimization and depression. Rather, 5-HTTLPR moderates the mediational pathway from peer victimization to depressive symptoms, such that victimized children homozygous for *l* are at a heightened

risk for depressive symptomatology compared to their victimized peers carrying an *s* allele. These findings underscore the multifactorial nature of childhood depression and resilient processes. Knowledge that particular genotypes may confer protection to vulnerable children provides further support that biological and psychological factors may promote competent functioning in the face of adversity.

Longitudinal studies that incorporate multiple levels of analysis are needed in order to elucidate the developmental sequelae of child maltreatment (Cicchetti, 2010). Such investigations will contribute to the creation of prevention and intervention programs aimed to mitigate the impact of early life stress and to promote adaptive functioning at multiple levels of influence. Moreover, genetically informed research may help to identify which programs lead to maximal outcomes for different children (Howe, Beach, & Brody, 2010). Results of the present study suggest that, in middle childhood, enhancing maltreated children's peer group functioning may be a promising target for intervention and prevention of depressive symptomatology. Additionally, intervention strategies aimed at modifying internal representations of the self and others may help to develop competence in age-salient domains (Cicchetti, Rogosch, & Toth, 2006; Toth, Maughan, Manly, Spagnola, & Cicchetti, 2002). Early interventions that target representational systems may prevent developmental cascades leading to costlier interventions, such as special education services, residential treatment, and incarceration (Cicchetti & Toth, 2010). Basic research that elucidates the various pathways by which maltreated children develop or avert maladaptation can inform translational efforts that have the potential to reduce the burden of mental illness on society.

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Figure 1a.

Mediation of the association between maltreatment and depression symptoms by relational victimization. The values shown in the figure are unstandardized and standardized (in parentheses) path coefficients. * $p < .05$. ** $p < .01$.

Figure 1b.

Mediation of the association between maltreatment and depression symptoms by overt victimization. The values shown in the figure are unstandardized and standardized (in parentheses) path coefficients. ** $p < .01$.

Table 1

Intercorrelations, Means, Standard Deviations, & Genotype Frequencies

Variable	1	2	<i>M (SD) Mal.</i>	<i>M (SD) Comp.</i>	<i>t</i>
1. Overt Victimization			10.24 (5.39)	8.21 (3.67)	-3.79***
2. Relational Victimization	.76***		11.72 (5.23)	9.97 (4.13)	-3.21***
3. CDI scores	.36***	.29***	7.81 (6.49)	6.08 (5.59)	-2.38*
<i>ss/sl</i> genotype			57.69%	48.28%	
<i>ll</i> genotype			42.31%	52.72%	

Note. Mal. = Maltreated; Comp. = Comparison; CDI = Child Depression Inventory.

*
 $p < .05$.

 $p < .001$.

Table 2

Unstandardized & Standardized Path Coefficients of Direct & Indirect Effects

Direct Effects	B (β)	S.E.	95% CI
Maltreatment→ (C) Depression Symptoms	1.650(0.135)	0.725(0.059)	[0.215, 3.085] **
Maltreatment → R.V.	1.594(0.167)	0.535(0.054)	[0.546, 2.642] **
R.V. → Depression Symptoms	0.302(0.236)	0.096(0.075)	[0.115, 0.489] **
Maltreatment → (C') → Depression	1.125(0.092)	0.745 (0.060)	[-0.336, 2.585]
Maltreatment→ (C) Depression Symptoms	1.650(0.135)	0.725(0.059)	[0.215, 3.085] **
Maltreatment → O.V.	1.672(0.178)	0.499(0.051)	[0.694, 2.650] **
O.V. → Depression Symptoms	0.427 (0.330)	0.095(0.073)	[0.242, 0.613] **
Maltreatment→ (C')→Depression	0.885(0.072)	0.729(0.059)	[-0.545, 2.314]
Indirect Effects(Mediation Tests)	B (β)	S.E.	95% CI†
Maltreatment to Depression			
via R.V.	0.482(0.039)	0.220(0.018)	[0.128, 1.047] **
via O.V.	0.715(0.059)	0.263 (0.021)	[0.016, 0.101] **

Note. R.V. = Relational victimization; O.V. = Overt victimization; C = Direct effect of maltreatment on depression; **C' = Indirect effect of maltreatment on depression adjusted for the mediator.**

**
p < .01.

Table 3

Test of Moderated Mediation

Indirect Effects	B	S.E.	95% CI [†]
<u>Short Allele (5-HTTLPR s/s; s/l)</u>			
Maltreatment to Depression			
via R.V.	0.319	0.185	[0.040, 0.787] **
via O.V.	0.538	0.243	[0.135, 1.087] **
<u>Long Allele (5-HTTLPR l/l)</u>			
Maltreatment to Depression			
via R.V.	0.347	0.188	[0.060, 0.817] **
via O.V.	0.586	0.243	[0.196, 1.135] **
Indirect effect difference			
Short vs. Long allele (Relational)	0.028	0.017	[0.004, 0.081] *
Short vs. Long allele (Overt)	0.047	0.025	[0.006, 0.116] *

Note. R.V. = High relational victimization; O.V. = High overt victimization.

* $p < .05$.

** $p < .01$.

[†] Bootstrapping based Confidence Intervals.