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Neighborhood Deprivation during Early Childhood and Conduct Problems in Middle Childhood: Mediation by Aggressive Response Generation

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Abstract

The tremendous negative impact of conduct problems to the individual and society has provided the impetus for identifying risk factors, particularly in early childhood. Exposure to neighborhood deprivation in early childhood is a robust predictor of conduct problems in middle childhood. Efforts to identify and test mediating mechanisms by which neighborhood deprivation confers increased risk for behavioral problems have predominantly focused on peer relationships and community-level social processes. Less attention has been dedicated to potential cognitive mediators of this relationship, such as aggressive response generation, which refers to the tendency to generate aggressive solutions to ambiguous social stimuli with negative outcomes. In this study, we examined aggressive response generation, a salient component of social information processing, as a mediating process linking neighborhood deprivation to later conduct problems at age 10.5. Participants ($N = 731$; 50.5 % male) were drawn from a multisite randomized prevention trial that includes an ethnically diverse and low-income sample of male and female children and their primary caregivers followed prospectively from toddlerhood to middle childhood. Results indicated that aggressive response generation partially mediated the relationship between neighborhood deprivation and parent- and teacher-report of conduct problems, but not youth-report. Results suggest that the detrimental effects of neighborhood deprivation on youth adjustment may occur by altering the manner in which children process social information.

Keywords

Conduct problems; Social information processing; Neighborhood deprivation; Middle childhood

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Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare that they have no conflict of interest.

Conduct problems (CPs) are moderately to highly stable from early childhood into adolescence and adulthood (Campbell et al. 2000; Shaw et al. 2003) and are reliably associated with negative outcomes, including comorbidity (e.g., substance abuse, anxiety disorders, ADHD), poor academic achievement, and compromised occupational and psychosocial functioning (Angold et al. 1999). Several researchers have documented that compared to late starters who begin delinquent activity in mid- to late-adolescence, early starters who display CPs prior to adolescence show a more persistent and chronic trajectory of antisocial behavior extending from middle childhood to adulthood (Moffitt 1993; Moffitt and Caspi 2001). Although early starters only represent 6–7 % of the population, they are responsible for almost half of adolescent crimes and three-fourths of violent crimes and are estimated to cost society at least \$1.3 million per individual (Cohen 1998; Odgers et al. 2008). The level of individual impairment and the significant costs to society associated with early-onset CPs have motivated efforts to identify risk factors prior to the onset of early-starting trajectories. In addition to numerous dispositional risk factors for CPs, such as neurochemical irregularities, genetic predispositions, temperamental vulnerabilities, and social information processing deficits, there are multiple contextual risk factors that make independent and important contributions to the emerging development of early starting CPs (Campbell et al. 2000; Shaw 2013). Spanning family, peer, school, and neighborhood domains, the contextual risk factors for CPs are numerous.

Within the domain of neighborhood risk, an extensive body of literature has demonstrated links between CPs and various neighborhood characteristics, such as residential instability, environmental toxins, and substandard institutional resources (Evans 2004; Gaylord-Harden et al. 2007; Leventhal and Brooks-Gunn 2000). Disadvantaged neighborhoods, defined based on a multidimensional index of community socioeconomic position (Messer et al. 2006), are another etiological factor underlying the development of CPs. Although neighborhood deprivation appears to account for unique variance in child outcomes beginning around age 5 in most neighborhoods, effects have been found as early as toddlerhood for children living in high-risk, urban neighborhoods (Kohen et al. 2008; Supplee et al. 2007). CPs and more serious forms of antisocial behavior tend to be clustered in deprived neighborhoods characterized by high rates of unemployment, welfare use, government subsidized housing, and other markers of material deprivation (Chung and Steinberg 2006; Dodge and Pettit 2003; Sampson 1997). Additionally, relative to youth from more affluent neighborhoods, children residing in deprived neighborhoods exhibit more CPs in early childhood (Duncan et al. 1994) and greater engagement in delinquent and criminal behavior in adolescence, even after controlling for individual- and family-level risk factors (Peebles and Loeber 1994).

Researchers have typically theorized and found that neighborhood influences on youth adjustment are mediated by compromised parenting and factors that compromise caregiving quality in early childhood (e.g., parenting stress). These neighborhood influences are thought to become more direct during middle childhood and early adolescence as children become less physically and psychologically dependent on their parents (Ingoldsby and Shaw 2002; Leventhal and Brooks-Gunn 2000). However, more recent research suggests that exposure to poverty, including living in disadvantaged neighborhoods, in early childhood may be more detrimental for children's adjustment than exposure during the school-age

period (Duncan and Magnuson 2001; Votruba-Drzal 2006). Nonetheless, relatively few studies have investigated associations between neighborhood-based factors and CPs beginning during early childhood (Leventhal and Brooks-Gunn 2003; Winslow and Shaw 2007).

In an exception to this trend, Choe et al. (2016) examined the independent effects of neighborhood deprivation trajectories from ages 2 to 5 on later CPs at age 9.5 in the current sample of ethnically diverse, low-income children. Even after accounting for numerous individual (e.g., child sex and race), neighborhood (e.g., neighborhood urbanicity), and family characteristics (e.g., household income), children in the persistently high neighborhood deprivation trajectory group received higher teacher-ratings of school-age CPs compared to children in the low-decreasing and moderately-low groups. Choe and his colleagues corroborate other findings suggesting that neighborhood deprivation contributes unique variance to the prediction of child CPs above and beyond child, family, and other community risk factors, with the most powerful neighborhood effects directed at youth in the most disadvantaged areas (Crane 1991; Hogan and Kitagawa 1985).

Mechanisms of Transmission for Neighborhood Effects: Aggressive Response Generation

Efforts in elucidating the mechanisms by which neighborhood deprivation increases risk for children's CPs have predominantly focused on structural characteristics (e.g., ethnic composition, socioeconomic factors), social relationships among neighborhood youth (e.g., deviant affiliation with neighborhood same-age and older peers), and community-level social processes (e.g., low levels of collective efficacy) (Jencks and Mayer 1990; Sampson 1997). However, limited attention has been dedicated to the importance of potential cognitive mediators, such as impaired social information processing (SIP; e.g., Perkins et al. 2012). Social information processing theory is broadly concerned with the cognitive processes that are deployed to generate a behavioral response during a social interaction, including selective attention to social cues, attributions and inferences about those cues, the generation of goals, and accessing behavioral scripts from memory (Crick and Dodge 1994; Dodge and Pettit 2003).

A salient aspect of maladaptive SIP, aggressive response generation (ARG), includes the tendency to generate aggressive responses when faced with ambiguous social situations with negative outcomes and to fail to generate more socially appropriate responses. Although aggressive behavior is a multi-determined phenomenon with many contributing factors, maladaptive SIP is thought to reflect a proximal control mechanism that accounts for a specific act of aggression in a particular moment (Salzer Burks et al. 1999). These online decision-making processes are thought to reflect negatively-oriented knowledge structures that have been derived from past experiences and organized in long-term memory to inform how an individual interprets and responds to ongoing social events (Higgins 1990; Murphy and Medin 1985). Specifically, several theories concerning the origins of knowledge structures have implicated early exposure to aggression, physical abuse, and more normative forms of punitive parenting as having a dramatic effect on children's SIP styles (Camras et

al. 1996; Dodge et al. 1995). Despite research documenting that maladaptive SIP mediates the relationship between family environment and youth outcomes, there has been limited work exploring its role as a potential mediator between neighborhood deprivation and child CPs in middle childhood.

As an exception, Schwartz and Proctor (2000) demonstrated that SIP mediated the relationship between exposure to community violence and aggressive behavior in a sample of inner-city children in Grades 4–6. In a cross-sectional study of highly aggressive, incarcerated adolescent boys, Shahinfar et al. (2001) demonstrated that exposure to violence predicted maladaptive SIP, but the authors did not examine whether SIP in turn predicted subsequent youth adjustment. To the best of our knowledge, no study has explicitly examined such questions using a broader, multidimensional index of neighborhood deprivation that not only captures exposure to violence and crime, but other indicators of neighborhood-level socioeconomic deprivation as well.

While high levels of community violence typically characterize deprived neighborhoods, recent findings on neighborhood deprivation recommend creating an index composed of multiple indicators to avoid problems with single variables and to more accurately reflect the multidimensional character of neighborhood quality (e.g., Messer et al. 2006). Additionally, while the two previously cited studies (i.e., Schwartz and Proctor 2000; Shahinfar et al. 2001) examined neighborhood risk in middle childhood and adolescence, the present study measured neighborhood risk beginning at age 2 among a sample of low-income children, for whom neighborhood effects might be identified at earlier periods.

Current Study

Based on the extant theory and empirical findings suggesting that exposure to neighborhood risk should place children at elevated risk for early-starting CPs through its influence on children's SIP, the present study probes whether individual differences in aggressive response generation (ARG) at age 9.5 mediate associations between neighborhood deprivation at age 2 and youth CPs at age 10.5. Identifying potential mediators between correlates of poverty and child CPs could have enormous implications for targeting underlying mechanisms in family- and neighborhood-based prevention and intervention programs. Research questions were examined in a longitudinal sample of ethnically diverse, low-income boys and girls followed prospectively from toddlerhood through middle childhood. Study hypotheses were four-fold: (1) We hypothesized that neighborhood deprivation in the toddler period would positively predict parent-, teacher-, and youth-report of CPs in middle childhood. (2) We expected that neighborhood deprivation in toddlerhood would be positively associated with ARG at age 9.5. (3) We predicted that ARG would be positively associated with youth CPs, and (4) We hypothesized that ARG would mediate the relationship between neighborhood deprivation and youth CPs. As this study included a multi-site experimental intervention to prevent child CPs, we included intervention group status and geographic location as covariates (Campbell et al. 2000). Additionally, extensive research indicating that boys outnumber girls in frequency and seriousness of CPs motivated the decision to also include child sex as a covariate in our analyses (American Psychiatric Association, 2013; Kessler et al. 1994).

Methods

Participants

Participants for this study included 731 children and their primary caregivers who were recruited between 2002 and 2003 as part of the Early Steps Multisite (ESM) study, a randomized controlled trial investigating the prevention of children's behavioral problems. Over 96 % of the primary caregivers at the initial assessment were biological mothers, and in all other cases, were non-maternal custodial caregivers, such as biological fathers. Participants were recruited from Women, Infants, and Children (WIC) Nutritional Supplement Centers in the metropolitan areas of Pittsburgh, Pennsylvania and Eugene, Oregon and within and outside of the town of Charlottesville, Virginia. Families were eligible to participate if they had a child between 24 and 35 months of age ($M = 29.9$ months, $SD = 3.2$) and if they met risk criteria in at least two of three risk domains for future behavioral problems: a) child risk (e.g., early CPs, high-conflict relationships with adults), b) familial risk (e.g., teen parent status when first child was born, maternal depression indicated by a score greater than 9 on the Center for Epidemiological Studies Depression Scale (CES-D; Radloff 1977), and c) socio-demographic risk (e.g., low levels of parental educational attainment indicated by less than or equal to a mean of 2 years of post-high school education between caregivers, low family income). In cases where clinical cut-points were not established for risk indices, scores at or one standard deviation above the normative mean were deemed to meet risk criteria for that particular domain. In cases where two of the risk criteria were met on the basis of socio-demographic and family risk, then children were required to be above the standardized mean for CPs or parent-child conflict to increase the probability that families would be motivated in modifying child behavior. Specifically, to be eligible, children were required to score above the clinical cut scores of the Eyberg Child Behavior Inventory (i.e., either 126 on the Intensity subscale or 13 on the ECBI Problem scale; ECBI, Robinson et al. 1980), or one standard deviation above the normative mean on the Conflict factor of the Adult-Child Relationship Scale (ACRS; Pianta et al. 1995).

Of the 1,666 families approached at WIC sites, 879 met eligibility requirements, and 731 provided consent and assent, with 272 (37 %) being recruited in Pittsburgh, 271 (37 %) in Eugene, and 188 (26 %) in Charlottesville. T-tests comparing participants who qualified but did not enroll to those who did enroll revealed no mean level differences in family income, maternal depression on the CES-D, parent-child conflict on the ACRS, or child CPs on the ECBI.

At age 2, 367 (51 %) of the initial sample were randomly assigned to the Family Check-Up, a brief, family-based preventive intervention for children at risk for problem behaviors. At the time of recruitment, 49.5 % of the children across project sites were female and 50.1 % were White, 27.9 % African American, 13.0 % biracial, and 8.9 % were of other races (e.g., American Indian, Native Hawaiian). More than two thirds of enrolled families had an annual income less than \$20,000 and the average number of family members per household was 4.5 ($SD = 1.63$). Thus, the sample was ethnically diverse and primarily of lower socioeconomic status (SES).

Retention rates have been moderately high across data collection. Of the original 731 families, some data are available for 587 families (80.30 %) at the age 9.5 assessment and 572 families (78.25 %) at the age 10.5 assessment.

Procedure

Two- to three-hour assessments were conducted almost annually in families' homes and/or laboratory settings with primary caregivers and their participating child from ages 2 to 10.5 years. The assessments providing data for the present study occurred at ages 2, 9.5, and 10.5, and during these visits, parents and when sufficiently old, target children, completed questionnaires regarding socio-demographic characteristics, parenting, neighborhood conditions, and child behavior. For the present study, teacher reports of child problem behavior completed at child age 10.5 were also utilized. All participants provided consent and were compensated for their time after each assessment.

Measures

Neighborhood Deprivation—Neighborhood deprivation was ascertained by geocoding residential addresses using 2000 U.S. Census data when children were 2 years old. Two hundred and seventy census tracts with 414 block groups were identified across geographic sites. Block-level data, the smallest unit for which all census data are available, were used to approximate families' immediate neighborhood. Based on methods devised by Wikström and Loeber (2000) and adapted by others including Vanderbilt-Adriance and Shaw (2008), neighborhood deprivation index scores were created for each block group by averaging Z-scores of eight census block group level variables: 1) percent of unemployed adults, 2) percent of households on public assistance (e.g., Temporary Assistance to Needy Families and General Assistance), 3) percent of single-mother households, 4) percent of households earning less than \$30,000 a year, 5) percent of households below the poverty level, 6) percent of families in crowded housing (i.e., more than one person per room), 7) percent of men in management and professional occupations (reverse coded), and 8) percent of adults earning less than a high school education. Findings from Choe et al. (2016) indicate moderate stability in neighborhood deprivation from ages 2 to 5 in the current sample. Specifically, neighborhood deprivation index scores at ages 2, 3, 4, and 5 are all highly correlated with each other, with coefficients ranging from 0.58 to 0.84 (mean $r(716) = 0.76$, $p < 0.001$).

Aggressive Response Generation (ARG)—When participants were 9.5 years old, a vignette procedure was used to assess ARG (Dodge and Somberg 1987). This procedure has been widely used to assess ARG and has been shown to be highly valid (e.g., Dodge et al. 1990; Dodge et al. 1995). Participants were orally presented with four social vignettes and accompanying pictures and asked to imagine that they were the target child in the story. In each vignette, the behavior of a peer leads to a negative outcome for the target child (e.g., being bumped, excluded from an activity). The other child's motives are intentionally left ambiguous, and after viewing each vignette, participants were asked to indicate how they would respond in the situation (e.g., tell a teacher, yell at the child). Consistent with prior literature, hypothetical responses involving acts or threats of physical or verbal retaliation received a score of two, while responses ambiguous in their adaptive value (e.g., doing

nothing, making commands, telling the teacher) were coded as one (Schultz and Shaw 2003). Verbally engaging and assertive responses (e.g., asking why the behavior occurred, asking for permission again) most clearly represented socially competent responses and were assigned a score of zero. Responses were summed to create a scale of ARG, with higher scores reflecting retaliatory response tendencies and lower scores reflecting more adaptive strategies. The four ARG items cohered moderately well ($\alpha = 0.60$) but less strongly than in previous reports (e.g., $\alpha = 0.71$; Dodge et al. 1995). Immediately after administering the vignettes, the experimenter coded participants' responses for aggressive response generation. All coders were required to reach adequate reliability levels (i.e., $\kappa > 0.70$) prior to being eligible to conduct these assessments.

Disruptive Behavior Disorders Rating Scale (DBD; Pelham et al. 1992)—During the age 10.5 home assessments, primary caregivers completed the DBD, a 45-item measure keyed to DSM-IV child symptoms of ADHD, ODD, and CD. All items were rated on a 4-point scale (0 = *not at all*, 3 = *very much*), and items rated as *very much* were scored as a symptom. The total number of CD symptoms endorsed, derived from 15 items, was used in the present study. Sample items include “often bullies, threatens, or intimidates others” and “has stolen items of nontrivial value without confronting a victim (e.g., shoplifting, but without breaking and entering).” This measure has excellent psychometric properties (e.g., Lahey et al. 2004), and internal consistency for CD was 0.77 in the present study.

Teacher Report Form (TRF; Achenbach and Rescorla 2001)—The TRF is a 112-item rating scale completed by teachers at child age 10.5 years to yield measures of child psychopathology. Teachers rated each item on a 3-point scale (0 = *not true*, 1 = *somewhat or sometimes true*, 2 = *very true or often true*), and the total raw score from the 13-item CPs DSM-IV oriented scale was used for analyses ($\alpha = 0.89$). Sample items from this scale include “destroys property belonging to others” and “threatens people.” The TRF was normed on a large sample of children ages 6–18 and possesses excellent test-retest and interrater reliability, as well as adequate to excellent internal consistency (Achenbach and Rescorla 2001).

Self-Report of Delinquency Questionnaire (SRD; Elliott et al. 1985)—At age 10.5, children rated the frequency of their CPs using a modified 27-item version of the SRD. Using a 3-point scale (1 = *never*, 2 = *once/twice*, 3 = *more often*), children rated the extent to which they engaged in aggressive and deviant behaviors (e.g. stealing, skipping school without an excuse) in the past year, with sample items including “In the past year, have you on purpose broken or damaged or destroyed something belonging to your parent or other people in your family?” and “In the past year, have you hit other students or got into a physical fight with them?” Due to the age of children, items regarding sexual risk taking were removed. Additionally, substance use was assessed in a separate measure, and as such, related items were removed from the SRD for parsimony. Items were summed to create an index of participants' self-reported CPs ($\alpha = 0.67$).

Covariates—Single dummy codes were used to indicate child sex (0 = *female*, 1 = *male*) and as the ESM study involved a randomized controlled trial testing the efficacy of the

Family Check-Up, intervention status (0 = *control*, 1 = *intervention*) also was accounted for in multivariate models. As study site varied in terms of urbanicity (i.e., Pittsburgh primarily urban, Eugene primarily suburban, and Charlottesville primarily rural), study site was also accounted for in multivariate analyses using multiple dummy codes (Pittsburgh: 0 = *Eugene*, 1 = *Pittsburgh*; Charlottesville: 0 = *Eugene*, 1 = *Charlottesville*). Finally, family household income at age 2 (0 = *annual household income equal to or greater than \$20,000 per year*, 1 = *annual household income less than \$20,000 per year*) was included as a covariate to ensure that the effect of neighborhood deprivation not be confounded with family SES. The cutoff of \$20,000 was selected based on 2006 Census Bureau *poverty thresholds* for a family size of 4.5 members (i.e., the average family size of participants in the study). Finally, harsh parenting and child inhibitory control at age 2 were entered as covariates to control for the potentially confounding influence of early parenting and child temperament. Harsh parenting was assessed using a composite index ($\alpha = 0.75$; see Moilanen et al. 2010) formed from five items from the Coder Impressions Inventory (COIMP) and three duration proportions from the Relationship Process Code (RPC; Jabson et al. 2004). Child inhibitory control was measured with the 13-item inhibitory control subscale of the Child Behavior Questionnaire (CBQ; Rothbart et al. 2001), a parent-reported questionnaire used to assess children's behavioral self-regulation ($\alpha = 0.66$).

Data Analysis

Analyses proceeded from univariate correlations to hierarchical multiple regression analyses to initially test hypothesized pathways from age 2 neighborhood deprivation to age 10.5 child CPs, from neighborhood deprivation to ARG, from ARG to child problem behaviors, and finally to test the hypothesis that ARG would mediate the relationship between early neighborhood deprivation and child CPs. First, to examine the hypothesis that exposure to deprived neighborhoods would predict more maladaptive youth outcomes in middle childhood, linear regression was used to examine prospective associations between early neighborhood deprivation and multiple reports of children's CPs at school-age. To combat potential shared method variance, analyses were conducted separately for parent-, teacher-, and youth-report of CPs. Second, linear regression was used to examine the prospective association between early neighborhood deprivation at age 2 and ARG at age 9.5. Lastly, to test the hypothesis that ARG would mediate the association between neighborhood deprivation and child CPs, the SPSS PROCESS macro (Hayes 2012) with bootstrapping ($k = 5000$) was used to assess the indirect effect, with child sex, intervention status, study site, family income, harsh parenting, and child inhibitory control initially entered as covariates. Bootstrapping is a non-parametric resampling procedure (MacKinnon et al. 2000) that calculates confidence intervals (CI) and estimates indirect effects by repeatedly sampling from a data set with replacement. Among its many advantages, bootstrapping is statistically more powerful than traditional approaches, including the Sobel test, which assume normality of the sampling distribution (Preacher and Hayes 2008; Zhao et al. 2010). Ninety-five percent bias corrected and accelerated (BCa) CI were calculated for parameter estimates, and if the CI does not include zero, the indirect effect is considered to be statistically significant. Contrary to traditional mediation, recent developments illustrate that direct effects of the predictor on the outcome are not required to establish significant mediation (Preacher and Hayes 2008; Zhao et al. 2010).

Results

Descriptive statistics, including means, standard deviations, and range of scores are presented in Table 1. Participants lived in neighborhoods that on average, had 7.93 % of unemployed adults, 20.22 % of adults with less than a high school education, 18.52 % of families living under the poverty line, as well as 11.06 % of families headed by single mothers. Consistent with a WIC sample, in some of the most deprived neighborhoods, as many as 41.41 % of adults were unemployed, 54.02 % of adults had less than a high school education, 79.53 % of families lived under the poverty line, and 64.89 % of households were headed by single mothers.

Of those child outcome measures with established norms, it is notable that according to teacher reports at age 10.5, youth had a mean t-score of 56.83 on the Conduct Problems DSM-IV oriented scale, versus a mean t-score of 53.8 for boys and 53.2 for girls in the normative sample. With respect to ARG, 39.40 % of all responses were verbally engaging, 56.37 % were ambiguous in their adaptive value, and 4.23 % were verbally or physically aggressive. These findings are consistent with those of Schultz and Shaw (2003), who identified a similar percentage of different responses (40.2 % verbally engaging, 55.2 % ambiguous, 4.6 % aggressive) in an ethnically diverse sample of low-income, 10-year old boys.

Table 2 presents bivariate correlations among study variables. Child sex was unrelated to all study variables, with the exception of ARG and TRF Conduct Problems. Specifically, boys were more likely to produce retaliatory responses and were rated by their teachers as having more CPs than girls. Intervention status was unrelated to reports of child CPs across informants.¹ Neighborhood deprivation measured at age 2 was positively related to ARG at age 9.5, as well as teacher and youth reports of CPs at age 10.5. Additionally, aggressive response generation at age 9.5 was significantly correlated with parent and teacher reports of CPs at age 10.5, but not youth-report.

Neighborhood Deprivation and Youth Conduct Problems

We fit a linear regression model to examine prospective associations between neighborhood deprivation at age 2 and parent-, teacher-, and youth-reported CPs, controlling for child sex, intervention status, study site, family income, harsh parenting at age 2, and child inhibitory control at age 2. Neighborhood deprivation did not significantly predict parent-report of CPs on the DBD, $B = 0.018$, $SE = 0.009$, $t(479) = 0.359$, $p = 0.720$, 95 % CI $[-0.020, 0.014]$, or youth-report of CPs on the SRD, $B = 0.018$, $SE = 0.119$, $t(446) = 0.359$, $p = 0.720$, 95 % CI $[-0.191, 0.276]$. Neighborhood deprivation uniquely predicted teacher-report of CPs, $B = 0.155$, $SE = 0.235$, $t(311) = 2.560$, $p < 0.05$, 95 % CI $[0.139, 1.063]$ and explained a small proportion of the variance, $R^2 = 0.020$.

¹Although no intention-to-treat intervention effects were found for teacher reports of CP at age 10.5, a recent report (Shaw et al. 2016) finds moderated intervention effects of the Family Check-Up on teacher reports of CP at age 9.5 for those not living in the most deprived neighborhoods (i.e., 2/3 of the sample).

Neighborhood Deprivation and Maladaptive Response Generation

Next, we fit a linear regression to examine the association between neighborhood deprivation at age 2 and ARG at age 9.5. Neighborhood deprivation positively predicted ARG, $B = 0.098$, $SE = 0.070$, $t(479) = 2.069$, $p < 0.05$, 95 % CI [0.007, 0.284], explaining a small percentage of variance in responses, $R^2 = 0.009$.

Neighborhood Deprivation and Youth Conduct Problems: Mediation by Aggressive Response Generation

Next, having established univariate associations between neighborhood deprivation and ARG and ARG and subsequent youth CPs, we tested whether ARG at age 9.5 mediated the association between neighborhood deprivation at age 2 and reports of children's CPs at age 10.5 across informants. Using hierarchical multiple regression analyses and after initially entering child sex, study site, intervention status, family income, harsh parenting, and child inhibitory control as covariates, a significant indirect effect of ARG was evident from neighborhood deprivation to ARG to parent reports of child CPs, 95 % CI [0.0002, 0.0071] (see Fig. 1). A similar indirect effect was found for teacher reports of child CPs, with the indirect effect estimated to lie between 0.0027 and 0.1848. Because zero was not within the 95 % CI, the indirect effect from neighborhood deprivation to ARG to teacher reports of CPs was interpreted as differing significantly from zero (also see Fig. 1). However, ARG did not significantly mediate the association between neighborhood deprivation and youth reports of CPs, 95 % CI [-0.0542, 0.0226].

Discussion

Summary of Findings

The current study tested hypotheses relating neighborhood deprivation in early childhood to CPs in middle childhood via ARG, a salient component of maladaptive social information processing. Consistent with our first hypothesis and previous research (Ingoldsby and Shaw 2002; Ingoldsby et al. 2006; Leventhal and Brooks-Gunn 2000), exposure to deprived neighborhoods in early childhood was positively related to teacher reports of CPs, although it did not predict parent-or youth-report. The second hypothesis, which predicted that neighborhood deprivation would positively predict ARG, was also supported, as was our third hypothesis predicting that ARG would be positively associated with CPs. Moreover, individual differences in ARG significantly mediated associations between neighborhood deprivation and both parent and teacher (but not youth) reports of CPs.

Direct Effects of Neighborhood Deprivation on Youth Outcomes

The present study corroborates previous findings demonstrating direct, albeit modest, associations between neighborhood risk and youth CPs (Beyers et al. 2003; Ingoldsby and Shaw 2002; Leventhal and Brooks-Gunn 2000). Indeed, in a sample of low-income boys followed from ages 5 to 11, Ingoldsby et al. (2006) demonstrated that neighborhood context was significantly related to trajectories of antisocial behavior, with youth in the early-starting and high/decreasing groups being exposed to more disadvantaged neighborhoods than those in the low antisocial groups. Support for current findings also come from a

genetically-informed study indicating that 2-year-old twins living in deprived neighborhoods were at increased risk for concurrent emotional problems, inattention problems, and CPs, above and beyond shared genetic liability (e.g., Caspi et al. 2000).

Direct Effect of Aggressive Response Generation on Youth Outcomes

Results indicating a positive association between ARG at age 9.5 and subsequent CPs a year later were expected and consistent with extant research (Dodge and Pettit 2003; Dodge et al. 1995). Youth who were more likely to generate aggressive responses to ambiguous social conflict were rated by their parents and teachers as exhibiting higher levels of CPs. Choe et al. (2015) demonstrated similar findings in an independent sample of urban, male, low-income youth, linking ARG in middle childhood to a greater number of criminal arrests in young adulthood. These findings also are consistent with the extensive body of literature indicating that SIP problems in childhood, particularly ARG, have long-standing consequences for adolescents' CPs (e.g., Hyde et al. 2010).

Indirect Effect of Neighborhood Deprivation on Youth Outcomes through Aggressive Response Generation

Considering maladaptive social information processing more broadly, the current study identifies ARG as a potential mechanism by which neighborhood deprivation confers risk for CPs among youth. These findings add to a limited body of work implicating ARG as an intrapsychic mechanism by which family and community risk shape the emergence of youth CPs (Schultz and Shaw 2003; Schwartz and Proctor 2000). Several investigators have linked early neighborhood risk to the emergence of child and adolescent CPs; however, we believe this study is the first time ARG has been implicated as a mediator of pathways from neighborhood deprivation to child CPs. Notably, findings held while controlling for numerous family- and child-level factors, such as family income, harsh parenting at age 2, child sex, and child inhibitory control at age 2. While neighborhood deprivation accounted for a small percentage of the variance in ARG, results highlight the unique effect of neighborhood deprivation on ARG and CPs above and beyond the effects of more proximal factors.

Although beyond the scope of the present study, there are a few plausible mechanisms by which neighborhood deprivation may exert its effects on ARG. First, deprived neighborhoods characterized by high levels of community violence, vandalism, gangs, and drugs provide models of aggressive problem-solving techniques (Bandura 1986; Ingoldsby and Shaw 2002). Repeated exposure to expressions of hostility, anger, and distress in the neighborhood may facilitate the development of negatively-oriented knowledge structures, which likely become consolidated as internal mental representations of distrust and suspicion of others' intentions (Dodge and Pettit 2003; Stromquist and Strauman 1992). These knowledge structures guide the processing of subsequent information, and for children living in highly deprived neighborhoods, likely include facile access to aggressive responses and hypervigilance to perceived social threat. Study findings suggest that these abnormalities in processing patterns in turn heighten sensitivity to demonstrate CPs in middle childhood.

A second mechanism by which neighborhood deprivation may exert its effects on ARG includes exposure to environmental toxins. Research suggests that in addition to being exposed to violence, youth living in deprived neighborhoods may be disproportionately exposed to air pollution, lead, and other chemicals, which may alter normal cognitive and behavioral development (Mielke 2002; Ponce et al. 2005). Indeed, numerous studies have linked lead exposure, even at relatively low levels, not only with lower IQ and poor executive functioning, but also with the subsequent development of aggression and juvenile delinquency (Needleman and Bellinger 2001; Needleman et al. 2002). Considering these findings collectively, it is possible that exposure to lead in the neighborhood may contribute to CPs by disrupting cognitive control mechanisms that have theoretically and empirically been linked to the maladaptive processing of social information (Choe et al. 2013; Runions and Keating 2007).

The present findings should also be considered in conjunction with evidence using neuroimaging indicating that regions of the limbic system (e.g., amygdala) and the prefrontal cortex (e.g., ventral prefrontal cortex) are activated as individuals process information in response to interpersonal conflict (Choe et al. 2015; Meyer-Lindenberg et al. 2006). For example, in an independent sample of 310 racially diverse and low-income men, Choe et al. (2015) found that maladaptive SIP patterns at ages 10 and 11 predicted increased left amygdala reactivity to facial expressions of fear at age 20, suggesting hypervigilance to indications of social threat. Thus, transgressions from normative information processing may have an underlying biological basis that involves an altered neural threat circuit. The current findings, considered in parallel with findings from the preceding neuroimaging study, suggest that exposure to early-life stress has an enduring effect on the threat detection system and alters brain processes that include neural and cognitive functioning.

Limitations

Although the present study is strengthened by its prospective longitudinal design, use of multiple assessment methods and informants, and relatively large and ethnically diverse sample, we note several important limitations that warrant further consideration. First, the current sample was originally recruited from WIC nutrition supplement centers and further screened and deemed eligible based on the presence of family (maternal depression, substance use) and/or child risk (i.e., high levels of CPs); thus, findings are limited in generalizability to high-risk children and families from low-SES backgrounds. Although the present study was strengthened by its investigation of neighborhood deprivation across urban, suburban, and rural settings, future studies using more socioeconomically diverse samples are needed. Second, the measurement of ARG was based entirely on participants' responses to hypothetical vignettes. Although vignettes are the gold standard for assessing ARG, it is unclear the extent to which such an approach reflects emotional and cognitive processes in real-life situations. The study would have been strengthened by use of in vivo, experimental manipulations of ambiguous peer scenarios. This approach may better capture children's implicit mental representations as they occur during interpersonal exchanges in real time. Third, according to SIP theory, the information processing system consists of a sequence of mental operations that are deployed to generate a behavioral response during a social interaction. These steps include encoding of social cues, interpretation of social

information (e.g., attribution of intent), clarification of social goals, generation of responses, evaluation of response effectiveness, selection of a response, and behavioral enactment. Thus, while the generation of responses is a critical component of the information processing system, it represents only one step in a sequence of cognitive processes involved in the production of social behavior (Crick and Dodge 1994). Fourth, although the present study modeled ARG as a predictor of CPs, transactional perspectives suggest that behavior and social cognitive processes likely interact in a bidirectional and reciprocal manner across development (Fontaine et al. 2009). While SIP patterns such as ARG demonstrate relatively high stability during the school-aged years (Dodge and Price 1994), new social experiences inevitably alter the processing of subsequent social information. For example, the use of aggression to yield desired outcomes likely further reinforces the social-cognitive patterns that contributed to the initial act of aggression. These processing patterns may in turn shape the selection of future social encounters, favoring those that support aggressive behavior while avoiding situations that could provide opportunities for prosocial processing of information (Fontaine and Dodge 2009). Future research would benefit from the inclusion of concurrent and longitudinal assessment of ARG and CPs, which would allow for a dynamic investigation of transactional relationships between these constructs. Finally, ARG represents only one of several potential factors that might mediate the association between early neighborhood deprivation and later child CP (e.g., child emotion regulation, over-controlling parenting).

Clinical Implications and Future Directions

Existing theories proposed to account for the influence of neighborhood factors on youth adjustment have traditionally focused on situational and contextual mechanisms, such as social relationships among neighborhood youth (e.g., deviant peer affiliation), community-level social processes (e.g., low collective efficacy), and compromised parenting (Sampson 1997). However, with few exceptions, existing studies have largely overlooked potential child-level factors that may underlie the relationship between neighborhood context and youth psychological functioning (e.g., Perkins et al. 2012). Findings from the present study suggest that ARG may be a logical avenue of research for further understanding the child-related mechanisms through which neighborhood deprivation confers increased risk for youth CPs. Importantly, although automatic attributions of hostility, detection of threat, and use of aggression may be functional in threatening environments, such as dangerous neighborhoods, results underscore the fact that readily accessing aggressive solutions from memory in response to perceived or actual threat still confers increased risk for CPs in settings where such behavior is likely not adaptive (e.g., in the classroom). However, as study effect sizes were small and base rates of ARG were low in the present study, future work is needed to corroborate current findings before ARG can be labeled as a target for intervention and prevention programs for youth CPs. Future research should be dedicated to identifying additional cognitive mechanisms that may further elucidate the sensitivities that mediate contextual influences on youth adjustment. While effective interventions for CPs have been developed, targeting specific social-cognitive skills related to the processing of social information may constitute a logical approach to treating youth exposed to extra-familial contextual risk.

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Fig. 1.

Standardized path coefficients shown; $†p < 0.10$. $*p < 0.05$. $**p < 0.01$; CP: Conduct Problems; For both figures below, covariates were included in all pathways but their regression coefficients are not diagrammed due to space considerations. Bootstrap tests (5000) of mediation indicated a significant indirect effect of neighborhood deprivation in early childhood on parent-and teacher-report of youth conduct problems at age 10.5 through aggressive response generation at age 9.5

Table 1

Descriptive statistics

Study Variables	Mean (SD)	Minimum	Maximum
Neighborhood Characteristics ^a			
Neighborhood Deprivation	0.36 (1.01)	-0.82	5.24
Unemployed Adults (%)	7.93 (6.44)	0.0	41.41
Households Below Poverty Line (%)	18.52 (14.12)	0.0	79.53
Adults with Less than a High School Education (%)	20.22 (10.52)	1.04	54.02
Families Headed by Single Mothers (%)	11.06 (9.88)	0.0	64.89
Households on Public Assistance (%)	5.91 (6.05)	0.0	35.75
Households Earning Less than \$30,000 a year (%)	46.82 (16.81)	4.75	91.52
Families in Crowded Housing (%)	3.48 (3.52)	0.0	22.17
Males in Management and Professional Occupations (%)	24.22 (14.25)	0.0	86.96
Social Information Processing			
Total Aggressive Response Generation	2.59 (1.50)	0.0	8
Youth Outcomes			
DBD Conduct Problems (Parent-Report)	0.13 (0.18)	0.0	1.13
TRF Conduct Problems (Teacher-Report; t-score) ^b	56.83 (7.94)	50	86
SRD Conduct Problems (Youth-Report)	1.76 (2.41)	0.0	25

DBD Disruptive Behavior Disorders Rating Scale, *TRF* Teacher Report Form, *SRD* Self-Report of Delinquency Questionnaire

^aThese descriptives characterize the neighborhoods that the participants live in, rather than the families themselves

^bAlthough TRF raw scores were used for primary analyses to maximize variability, t-scores are presented in Table 1 for comparison

Table 2

Correlation matrix

	1	2	3	4	5	6	7	8
Child Sex (1 = Male)	1							
Intervention Status (0 = Control, 1 = intervention)	-0.023	1						
Family Income	-0.003	0.016	1					
4. Neighborhood Deprivation	-0.003	0.018	0.187**	1				
5. Aggressive Response Generation	0.163**	-0.013	0.087*	0.165**	1			
6. DBD Conduct Problems (Parent-Report)	0.030	0.057	0.103*	0.062	0.166**	1		
7. TRF Conduct Problems (Teacher-Report; raw score)	0.211**	-0.020	0.096 [†]	0.190**	0.183**	0.356**	1	
8. SRD Conduct Problems (Youth-Report)	0.064	0.037	0.091*	0.100**	0.041	0.223**	0.202**	1

DBD Disruptive Behavior Disorders Rating Scale, TRF Teacher Report Form, SRD Self-Report of Delinquency Questionnaire;

[†] $p < 0.10$.* $p < 0.05$.** $p < 0.001$