Skin Conductance Reactivity as a Moderator of Associations Between Youth Perceptions of Neighborhood Stress and Depressive Symptoms

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Abstract
Young adolescents (N = 68) completed questionnaires concerning perceptions of neighborhood stress (i.e., high negative influences, low cohesion, and connectedness). Youth self-reported their own depressive symptoms and participated in a public speaking task designed to be moderately stressful. Increases in skin conductance in response to this laboratory-based challenge task were measured (i.e., skin conductance level reactivity; SCLR). Higher levels of depressive symptoms were associated with greater perceptions of neighborhood stress, with the effects of neighborhood stress particularly strong among boys. For boys only, the association between perceived neighborhood stress and depressive symptoms was moderated by SCLR. For boys with average or above average levels of SCLR, greater perceptions of neighborhood stress were associated with more depressive symptoms.

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Evidence suggests that adolescence is a developmental period during which physiological stress reactivity is heightened and exposure to stressors may be particularly detrimental (Holder & Blaustein, 2014). As adolescents begin spending more unsupervised time outside of their homes and in the community, exposure to the neighborhood context becomes more developmentally salient (Delany-Brumsey, Mays, & Cochran, 2014). A large body of literature is devoted to the effects of neighborhood stressors on adolescent well-being. However, few studies have investigated the ways in which neighborhood stressors and individual-level characteristics may work together to impact adjustment. Greater consideration of person characteristics has the potential to provide a more comprehensive and holistic understanding of ways in which stressors impact adolescents. Specifically, individual physiological stress reactivity may interact with perceived neighborhood stressors to predict depressive symptoms.

The purpose of the current study is to consider whether skin conductance reactivity moderates the association between neighborhood problems and youth depressive symptoms. A dual-risk model of vulnerability is used to generate hypotheses, to interpret findings, and to help elucidate why some adolescents develop depressive symptoms in the context of neighborhood problems and others do not.

Youth Depressive Symptoms

Early adolescence represents a particularly vulnerable time for the development of internalizing problems. During this developmental period, young people show increased physiological reactivity to stressors, which may correspond to increased symptoms of anxiety and depression (Holder & Blaustein, 2014). Analyzing data from a nationally representative sample of adolescents in Grades 6, 8, and 10, Saluja and colleagues (2004) reported that 18% of participants endorsed five or more items on an 8-item measure of depression based on the Diagnostic and Statistical Manual of Mental Disorders–Revised Third Edition (3rd ed., rev.; DSM-III-R; American Psychiatric Association, 1987). Percentages varied by gender, with 25% of girls but only 10% of boys in this nationally representative sample reporting five or more symptoms (Saluja et al., 2004). Research that has considered subclinical levels of depression has indicated even higher levels of
prevalence. Using a large, international sample of 14-year-old adolescents, Balázs et al. (2013) reported subthreshold depression rates of 38.24% in boys, with girls even more likely to experience clinical and subthreshold depression. Levels of depressive symptoms increase during adolescence (Bertha & Balázs, 2013), and these increases are particularly evident among girls (Bongers, Koot, van der Ende, & Verhulst, 2003).

Depressive symptomatology during adolescence is of concern, because youth who experience internalizing problems are also at higher risk for a variety of accompanying mental health problems, academic problems, and externalizing problems such as delinquency (Bhatia & Bhatia, 2007; Byrd, Loeber, & Pardini, 2012; Hallfors et al., 2004). Based on a systematic review of the literature on depressive symptomatology, Bertha and Balázs (2013) concluded that depressive symptoms constituted a significant health problem during adolescence, in part because they constitute a risk factor for major depressive episodes later in life. Such statistics suggest that research focused on understanding factors, both personal and contextual, that confer risk or resilience with respect to depressive symptoms meet a critical public health need.

**Neighborhood Stress in Relation to Youth Depressive Symptoms**

Links between characteristics of neighborhoods and depressive symptomatology have been well documented among adults (Gariepy et al., 2015; Kim, 2010; Kohen, Leventhal, Dahinten, & McIntosh, 2008; Mair, Diez Roux, & Galea, 2008; Ross & Mirowsky, 2009), and a considerable amount of evidence indicates that such associations are present among adolescents as well. Evidence from longitudinal and cross-sectional research indicates that the impact of neighborhood effects becomes more pronounced as children reach adolescence (Browning, Burrington, Leventhal, & Brooks-Gunn, 2008; Delany-Brumsey et al., 2014). This change may correspond to neighborhood exposure; adolescents spend increasing amounts of time unsupervised in neighborhoods and outside the home, as compared to children. Thus, residing in neighborhoods that are perceived as dangerous or lacking in connection among residents constitutes a contextual stressor that has the potential to place youth at risk for distress, including heightened depressive symptomatology.

Ford and Rechel (2012) analyzed parent data ($N = 32,499$) from the 2007 National Survey of Children’s Health to assess contemporaneous associations between parent-perceived characteristics of neighborhoods and depressive symptoms and diagnoses among youth aged 12 to 17. More
depressive symptoms were linked with higher levels of neighborhood disorder, social isolation, and lack of safety. Neighborhood disorder was also associated with a greater likelihood of a depression diagnosis among adolescents, despite the fact that such diagnoses are considerably less prevalent during adolescence than are depressive symptoms (Ford & Rechel, 2012). Similarly, Latkin and Curry (2003) reported that the extent to which adolescents perceived their neighborhoods as having problems with crime, litter, and vacant housing at Time 1 predicted increases in depressive symptoms over a 9-month period.

A variety of mechanisms have been identified to explain associations between perceived neighborhood stress and depressive symptoms during early adolescence. Gilster (2014) tested a model based on neighborhood stress process theory, and findings indicated links between neighborhood stressors (e.g., neighborhood disorder, perceived neighborhood violence, neighborhood hazards, and limited neighborhood services) and youth depressive symptoms, with these associations explained in part by limited individual feelings of mastery. Others have implicated fear of crime as a mechanism linking residence in unsafe neighborhoods and depressive symptoms among adolescents (Pearson, Breetzke, & Ivory, 2015; Stevenson, 1998).

In addition to direct associations between neighborhood stressors and depressive symptoms, some researchers have documented that it is the combination of neighborhood stressors and vulnerability characteristics of adolescents that predict internalizing symptoms. For example, Rabinowitz, Drabick, and Reynolds (2016) reported that neighborhood stressors were associated with higher levels of internalizing symptoms only when adolescents were high in temperamental withdrawal. These findings elucidated one reason why neighborhood stressors represent a risk factor for some adolescents with internalizing problems, but not for others. Physiological characteristics of adolescents might also constitute a source of risk for internalizing symptoms if the youth are also exposed to neighborhood stressors. However, such a possibility has rarely been addressed within the literature connecting youth perceptions of neighborhood stress to their depressive symptoms.

**Skin Conductance Reactivity**

Dual-risk stress models posit that contextual stressors pose the greatest risk for youth who have physiological markers suggesting debilitating stress responses. Such models are consistent with the diathesis-stress model (Alloy, Hartlage, & Abramson, 1988), which suggests that the
likelihood of adjustment difficulties is due to both experiences of stressful events and preexisting vulnerability. However, a dual-risk model focuses on ways in which physiological functioning may explain individual differences in vulnerability to environmental stressors. For example, El-Sheikh and Erath (2011) articulated a conceptual model considering ways in which family conflict and autonomic nervous system functioning work together to determine which children are the most likely to experience psychological problems. Similarly, Steinberg and Avenevoli (2000) proposed a modified version of the diathesis-stress perspective suggesting that individual differences in physiological reactivity to stress and exposure to contextual stressors work together to predict adjustment difficulties among children and adolescents.

A dual-risk perspective was used to generate hypotheses and interpret findings for the current study. Skin conductance reactivity is a physiological marker that is hypothesized, in this study, to interact with adolescent perceptions of neighborhood stressors. We expect that the combination of greater reactivity and greater perceptions of neighborhood stress place adolescents at greater risk for higher levels of depressive symptoms. The sympathetic nervous system (SNS) is a branch of the autonomic nervous system (ANS) that is responsible for the “fight or flight” response in the presence of a perceived threat. Its role is to rapidly produce high levels of energy needed by the body during periods of challenge (Boucsein, 1992). When the SNS is activated, sweat gland activity increases, allowing the skin to better conduct electricity. The ability of the skin to conduct electricity is measured through electrodermal activity (EDA), typically assessed by placing electrodes on two adjacent fingers of an individual and passing a small electric charge between electrodes, then measuring current flow. Skin conductance level (SCL) is linearly related to the rate at which sweat is produced.

Baseline SCL (SCLB) is measured during a time of relaxation—baseline—when an individual is not experiencing challenge. In contrast, SCL reactivity (SCLR) is measured during a period of challenge (typically a laboratory stressor), and is defined in terms of the change in SCL from baseline to challenge. SCLB and SCLR are both considered to represent stable differences among individuals (El-Sheikh, 2007). Higher levels of SCLR have been linked with higher levels of internalizing problems among children (El-Sheikh, 2005). It has been suggested that links between SCLR and depressive symptoms may be explained by brain mechanisms related to approach and avoidance (Gray, 1987), a premise that is supported by research linking higher levels of SCLR with behavioral inhibition and shyness (Kagan, Reznick, & Snidman, 1987), as well as internalizing symptoms (El-Sheikh, 2005).
Interaction Between Neighborhood Stress and Skin Conductance Reactivity

The development of internalizing problems, and depressive symptoms, in particular, is the result of both biological and contextual factors (Thapar, Collishaw, Pine, & Thapar, 2012).

There is considerable evidence that (a) youth perceptions of neighborhood stress constitute a risk factor for depressive symptoms, and (b) physiological characteristics of youth represent a promising direction for understanding why children differ in terms of their vulnerability to perceived neighborhood stressors. Yet, to our knowledge, there has been no work considering the ways in which levels of SCLR during a simulated laboratory stressor may differentiate children who do versus do not experience depressive symptoms within the context of higher levels of perceived neighborhood stress. A number of investigations have documented, however, that SCLR functions in this manner with respect to other types of contextual stressors.

Cummings, El-Sheikh, Kouros, and Keller (2007) assessed parents’ levels of depressive symptoms and children’s adjustment over a 2-year period. Of interest was whether children’s SCLR when exposed to adult arguments and engaged in problem-solving tasks would moderate associations between parents’ depressive symptoms and children’s experiences of internalizing behaviors, externalizing behaviors, and social adjustment problems. Results supported a dual-risk perspective in that children with higher levels of SCLR were more vulnerable to parents’ depressive symptoms in terms of all three markers of child adjustment difficulties. El-Sheikh (2005) examined SCLR in response to a simulated argument as a potential moderator of associations between levels of parental reports of marital conflict and children’s externalizing, internalizing, and cognitive problems. For girls only, higher levels of SCLR increased vulnerability in terms of all three maladjustment outcomes. Once again, these findings were consistent with a dual-risk perspective.

The laboratory stressor in the above-referenced studies was child exposure to a simulated adult argument. It is unclear whether the same pattern of effects would emerge if youth were exposed to other types of stressors. In both the Cummings et al. (2007) and the El-Sheikh (2005) study, the simulated argument stressor was closely aligned with the contextual stressor under consideration in that both the laboratory stressor and the contextual stressor exposed youth to dysregulated adult behavior (conflict, depressive symptoms). It is possible that it was not physiological stress reactivity in general that placed children in these studies at particular risk when also exposed to contextual stressors, but rather physiological reactivity to adult dysregulated behavior. Research involving laboratory stressors unrelated to the types of
contextual stressors being considered would clarify this issue. A laboratory-based public speaking task, or a task that focused on experiences of youth stress unrelated to adult behavior would permit exploration of whether physiological stress reactivity more broadly defined moderated associations between a range of contextual stressors and youth depressive symptoms. Public speaking is considered to be a stressful experience for individuals of all ages (Stein, Walker, & Forde, 1996).

**Gender Differences**

Several studies have indicated gender differences in the expression of internalizing behaviors in response to neighborhood effects. Browning, Soller, Gardner, and Brooks-Gunn (2013) reported that social disorder within neighborhoods was associated with higher levels of internalizing symptoms among girls but not among boys. Similarly, Milam et al. (2012) found that greater perceptions of alcohol and drug use within neighborhoods was associated with higher levels of internalizing problems among girls, but not among boys. Conversely, neighborhood theories posit that adolescent boys will be impacted by neighborhood context to a greater extent than will girls, because boys are often subjected to less parental monitoring and have freedom to spend more time outside of the home (Fagan & Wright, 2012). However, problem behavior expression in response to neighborhood stressors may differ for boys versus girls. Milam et al. (2012) suggested that boys may be more likely to express externalizing symptoms in response to neighborhood disorder, whereas girls respond to neighborhood disorder with internalizing symptoms, such as feelings of hopelessness and depression.

Research is inconsistent in terms of finding gender differences in the manner in which SCLR moderates associations between contextual stressors and child adjustment. Gender differences in associations have been found to depend on the type of SCL measured (SCLB, SCLR). El-Sheikh (2005) reported that associations between marital conflict and child maladjustment (internalizing, externalizing, cognitive problems) were significant only at higher levels of SCLR, and only for girls. Cummings et al. (2007) reported positive associations between parental depression and child maladjustment (internalizing, externalizing, social problems) only in the context of high SCLR—but these effects were present for both boys and girls. Erath and colleagues (Erath, El-Sheikh, & Cummings, 2009) concluded that the role of SCLR as a moderator of associations between a contextual stressor (in their study, harsh parenting) and indicators of child adjustment (in their case, externalizing behavior) is more consistently present among boys than among girls. Thus, although there are conflicting perspectives regarding the ways in
which youth gender might shape associations among neighborhood stressors, youth physiological reactivity, and depressive symptoms, theory and research suggest that youth gender needs to be considered in analyses.

A study focused on understanding the interplay among youth perceptions of neighborhood stress, internalizing problems, and SCLR must consider the possibility that the nature of associations among these variables may differ for boys and girls.

**The Current Study**

Within the current study, we consider SCLR in response to a laboratory stressor as a potential moderator of associations between youth perceptions of neighborhood stress and their levels of depressive symptoms. Drawing upon a dual-risk perspective, we hypothesize that greater perceived neighborhood stress predicts more depressive symptoms only for youth who are high in SCLR. Given the extensive literature indicating gender differences in depressive symptomatology, as well as the impact of biological stress reactivity, we consider gender as a potential moderator of effects. However, given the inconsistent findings regarding role of gender in moderating such effects, we make no specific hypotheses regarding the nature of possible gender differences.

**Method**

**Participants**

A total of 68 mother-youth dyads participated in this study. Youth were recruited during fifth grade from two elementary schools in the southeastern United States. Participation began the following school year when the children were in sixth grade. The youth sample was 56% female \( (n = 38) \) and 44% male \( (n = 30) \). Children identified themselves as European American \( (n = 37; 54\%) \) and African American \( (n = 28; 41\%) \), with one child each self-identifying as Hispanic, Native American, and Asian (not Hmong). In total, 43 participating mothers (63%) indicated that they were married, and 25 mothers (37%) indicated that they were single. The Economic Pressure Scale (which yields scores ranging from 1 to 5; Conger & Elder, 1994) was used as an indicator of economic well-being with scores in our sample ranging from 1.38 to 5 with a mean of 3.49 \( (SD = .85) \).

**Procedures**

Data collection occurred in a university research laboratory from 2011-2012. Upon their arrival, electrodes measuring SCL were attached to the
adolescents’ hands using small straps wrapped around two of their fingers. During a 10-minute acclimation period, youth wore the SCL finger bands while they completed questionnaires. Baseline SCL data were then collected during a 2-minute period during which the youth sat quietly at the computer wearing earphones and watching a relaxation video. Next, the youth participated in the Trier Social Stress Test for Children (TSST-C; Kirschbaum, Pirke, & Hellhammer, 1993), which involved a public speaking task and a math activity. Youth were asked to construct a speech about a time in their lives that they felt left out, rejected, or excluded by a peer group—or when they had made another feel that way. Youth spent 3 minutes preparing the speech and 5 minutes performing the speech in front of an audience. The audience consisted of a video camera, the adolescents’ mother, and two expressionless research assistants. Mothers were instructed to maintain a neutral expression during the performance. Finally, youth participated in a mental arithmetic task in which they were asked to count backwards from 758 by sevens for 4 minutes in front of the same audience. At the conclusion of the math task, SCL cuffs were removed from adolescents’ hands while adolescents completed additional questionnaires. All study procedures were approved by the university’s Institutional Review Board. Mothers provided written consent for their own and youth participation, and youth provided written assent to participate.

Measures

Potential control variables. Youth sex (0 = female; 1 = male) and ethnicity (0 = European American; 1 = ethnic minority) were self-reported by youth. Socioeconomic status was assessed through mother completion of the 8-item Economic Pressure Scale (Conger, Ge, Elder, Lorenz, & Simons, 1994). The Economic Pressure Scale is designed to measure the perceived extent of families’ financial pressure. Mothers were asked to rate their agreement with statements about whether their family could afford expenses such as “clothing we should have,” and “leisure and recreational activities we want to participate in” on a scale of 1 (strongly disagree) to 5 (strongly agree). Items were averaged to create a summary score in which higher scores indicated lower perceived economic pressures (α = .89).

Adolescents reported on their physical development using the Pubertal Development Scale (PDS; Petersen, Crockett, Richards, & Boxer, 1988). Using the 5-item scale (some items were different based on sex), adolescents were asked to rate their development on a scale of 1 (has not started to develop) to 4 (development seems completed). The item scores were averaged to yield a summary score for which higher scores indicated higher levels of
physical pubertal development. Adolescents were asked, “Did you have any caffeine today?” (0 = no; 1 = yes). They were also asked to rate their overall physical health on a scale of 1 (very poor) to 5 (excellent).

**Neighborhood stressors.** To develop a measure of neighborhood stressors, we created a weighted composite of three measures of adolescent perceptions of neighborhood quality. The extent to which youth perceived negative neighborhood influences was evaluated using a 5-item subscale from the Neighborhood Quality Index (Cook, Herman, Phillips, & Settersten, 2002). A sample item is “You want to get away from this neighborhood as soon as possible.” Adolescents were asked to rate their agreement with statements on a scale from 1 (strongly disagree) to 5 (strongly agree). Items were averaged, and higher scores on this measure indicated more negative perceptions of neighborhood. One of the items was dropped after performing a preliminary factor analysis, leaving a total of 4 items for the scale as used in this study (α = .77). Adolescents’ perceptions of neighborhood social cohesion were assessed using a subscale from the Neighborhood Quality Index (Cook et al., 2002). This 4-item scale asked participants to rate their agreement with statements such as, “There are a lot of adults around here that I can look up to,” on a scale of 1 (strongly agree) to 5 (strongly disagree). Items were averaged to yield a summary score on which higher scores indicated less social cohesion (α = .79). Youth reported on their perceptions of neighborhood connectedness using a 6-item subscale of the Neighborhood Cohesion Scale (Aber & Seidman, 1993; Adolescent Pathways Project, 1992). Adolescents were asked to rate their agreement with items such as “My neighborhood is a better place to live than other neighborhoods” on a scale of 1 (very true) to 4 (not at all true). The items were averaged to create a summary score for which higher scores indicated lower neighborhood connectedness (α = .79).

We transformed summary scores for all three measures of neighborhood stress to z scores. We then used structural equation modeling (SEM) in SPSS Amos 20.0 to test a confirmatory measurement model loading the three neighborhood stress z-scores scores onto a single latent factor. We then used factor loadings from this analysis to create a composite neighborhood stress variable that was used in subsequent analyses. The factor loadings were .93 for negative influences, .75 for lower cohesion, and .87 for lower connectedness.

**Skin conductance reactivity.** SCL was measured using skin surface electrodes filled with a gel medium to capture the amount of sweat produced on the surface of the skin. SCL (units = microSiemens; μSiemens) was measured using UFI’s 3991x-GPP General Purpose Psychophysiological BioLog,
model 1081FG, with a sampling rate of 10 Hz. Before applying the electrodes, two sites on the youths’ fingers were wiped with alcohol pads in order to remove sweat or skin oils from the area. The laboratory environment was held at a standard room temperature to avoid impacting the amount of sweat produced. Next, the skin surface electrodes were attached to two of the adolescents’ finger pads at the distal phalange on the non-dominant hand, as recommended by Scerbo, Freedman, Raine, Dawson, and Venables (1992). A constant, low voltage current of 0.5 volts was passed between electrodes throughout the procedure as a bias (i.e., reference) point. An input connector ran from the electrodes to the BioLog. The experimenter had a key fob linked with the BioLog that was used to record event marks; specifically, the experimenter pressed a button that communicated to the BioLog when an “event” started and ended. These events represented the different sections of the TSST-C (preparation, speech, math). SCL data were downloaded from the BioLog to a computer using BioLog GPP DPS software. Event markers were used to parse the data stream into task episodes. The mean SCL for each episode was then calculated. Reactivity was calculated by subtracting average SCL during baseline from average SCL during each task episode (Erath et al., 2009; Erath, El-Sheikh, Hinnant, & Cummings, 2011). Thus, the SCLR score represents the change in skin conductance level from baseline to stress-inducing episode. Higher SCLR scores signify increases in SCL values from the baseline to the stress task. Evidence that the TSST-C was effective in producing a physiological response in the current study was demonstrated by the percentage of adolescents who experienced an increase in SCL from baseline to stress-inducing episodes, which was 91%, 94%, and 92% for the instructions, speech, and math episodes, respectively.

Participants also completed a subjective measure of negative affect before and after completion of the TSST-C, which indicated that 82% of participants self-reported more negative affect after completion of the TSST-C than they did before. Finally, our measure of SCLR was significantly different from 0 for the full sample, \( t(65) = 8.78, p < .01 \) for SCLR, for girls, \( t(36) = 7.03, p < .01 \), and for boys, \( t(28) = 4.70, p < .01 \).

Bivariate correlations among SCLR for the three task segments ranged from .50 to .81. To generate a single measure of SCLR across episodes, we used SEM in SPSS Amos to test a confirmatory measurement model loading the three SCLR scores (preparation, speech, math) onto a single latent factor. As such, one score was derived from comparing baseline SCL with SCL during the preparation period. The second score was derived from comparing baseline SCL with SCL during the speech challenge. The third score was derived from comparing baseline SCL with SCL during the math challenge. We then used factor loadings from this analysis to create a composite SCLR
variable that was used in subsequent analyses. The standardized factor loadings were .75 for the preparation episode, 1.00 for the speaking episode, and .69 for the math episode.

Youth depressive symptoms. Youth depressive symptoms were assessed using the 10-item (short form) Children’s Depression Inventory (Kovacs, 1992) designed to measure cognitive, affective, and behavioral indicators of depression in children and adolescents. For each item, youth were asked to choose the response that most described how they had felt during the past 2 weeks. For example, one item contained the responses (1) sad once in a while, (2) sad many times, (3) sad all the time. Items were averaged to create a total depressive symptoms score for which higher scores indicated more depressive symptoms (α = .82).

Analytic Strategy

To determine whether SCLR moderated associations between neighborhood stress and youth depressive symptoms, we adopted a multi-step approach that included all of the following. First, we used multiple regression entering neighborhood stress, SCLR, and all potential control variables as predictors of depressive symptoms. All control variables that were not significantly associated with depressive symptoms were eliminated from further analyses. Second, we performed regression analyses using SPSS Amos 20 to test a path model predicting depressive symptoms from baseline SCL, additional control variables identified in initial regression analyses, neighborhood stress, the composite SCLR variable, and the interaction between neighborhood stress and SCLR. Amos was used to conduct multiple-group analyses to determine whether this model differed from one in which paths were constrained to be the same for boys versus girls. If a chi-squared difference test indicated gender differences, critical ratios were used to identify structural paths that were significantly different for boys and girls. Finally, for cases in which significant interaction terms indicated a moderating effect of SCLR, these effects were probed using tests of simple slopes and regions of significance estimations (using the Johnson-Neyman technique). For main effects, we used a probability level of .05 as a cutoff for determining statistical significance. Whisman and McClelland (2005) have documented the increased level of power needed to detect interaction effects in non-experimental research and have recommend that research involving such interaction effects use higher probability levels so that potentially important patterns are not missed. Given our relatively small sample size, such an approach was particularly
appropriate. Accordingly, we used a probability value of .10 as a cutoff for determining the statistical significance of interaction effects and when probing the interactions.

**Results**

**Preliminary Analyses**

We performed a regression analysis to identify controls needed in the focal analyses. We predicted youth depressive symptoms from the composite neighborhood stress variable and the composite SCLR variable, controlling for ethnicity, economic pressure, pubertal development, caffeine consumption, self-rated physical health, and baseline RSA. None of these potential control variables was significantly associated with depressive symptoms. However, we decided to include baseline SCL as a control in subsequent analyses due to conventions within the field (Hinnant, Erath, Tu, & El-Sheikh, 2016). No other control variables were included in subsequent analyses.

**Intercorrelations Among Model Variables and Gender Differences**

Descriptive statistics and bivariate correlation coefficients for all model variables are presented in Table 1 separately by gender. Among girls, higher SCL at baseline was associated with higher scores on the composite SCLR variable, \( r(38) = .48, p < .01 \). Among boys, there were no significant bivariate correlations. We also examined bivariate correlation coefficients for associations between levels of depressive symptoms and SCLR scores for each component of the stress task and found that none were statistically significant.

Tests were conducted to test for gender differences in mean levels of all variables. Only one such difference emerged. Girls had higher levels of depressive symptoms than did boys, \( t(64.60) = 2.50, p = .01 \).

**Associations Among Neighborhood Stress, Skin Conductance Level Reactivity, and Youth Depressive Symptoms**

We used SPSS Amos 20 to conduct regression analyses testing whether youth perceptions of neighborhood stress (centered), SCLR (centered), and the interaction between the two, predicted youth depressive symptoms, controlling for baseline SCL. Higher levels of perceived neighborhood stress predicted higher levels of depressive symptoms, \( b = .04, \beta = .22, p = .04, 95\% \) confidence interval (CI) = \([-1.940, 2.020]\). Contrary to the hypothesis, there
was not a significant interaction between perceived neighborhood stress and SCLR, $b = .005, \beta = .09, p = .39, 95\% \text{ CI} = [–.004, .014]$.

We conducted a multi-group analysis comparing this model with a model in which the regression paths were constrained to equality across boys versus girls. The chi-square difference test comparing these models was significant, $\chi^2(4) = 9.71, p = .04$, indicating that there were gender differences in the strength of regression coefficients within the model. We then used critical ratios to identify structural paths that were significantly different for boys versus girls. There were no gender differences for the association between baseline SCL and depressive symptoms (significant for the full sample) or for the association between SCLR and depressive symptoms for the full sample (not significant for the full sample). However, for the association between neighborhood stress and depressive symptoms, and for the association between the interaction term and depressive symptoms, gender differences were such that paths were only significant for boys. For boys, higher neighborhood stress was associated with more depressive symptoms, $b = .08, \beta = .60, p < .01, 95\% \text{ CI} = [.046, .125]$ (girls’ $b = .01, \beta = .03, p = .55, 95\% \text{ CI} = [–.037, .071]$). For boys, the interaction of neighborhood stress and SCLR was significant, $b = .02, \beta = .68, p < .01, 95\% \text{ CI} = [–1.962, 1.988]$ (girls’

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
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<tr>
<td>1. Skin Conductance—Preparation</td>
<td>—</td>
<td>.88**</td>
<td>.64**</td>
<td>.50*</td>
<td>.90**</td>
<td>–.15</td>
<td>–.20</td>
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<td>2. Skin Conductance—Speech</td>
<td>.76**</td>
<td>—</td>
<td>.83**</td>
<td>.40*</td>
<td>.95**</td>
<td>–.13</td>
<td>–.04</td>
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<td>3. Skin Conductance—Math</td>
<td>.44*</td>
<td>.75**</td>
<td>—</td>
<td>.43*</td>
<td>.86**</td>
<td>–.17</td>
<td>–.04</td>
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<td>4. Baseline Skin Conductance</td>
<td>.38*</td>
<td>.37*</td>
<td>.07</td>
<td>—</td>
<td>.49*</td>
<td>–.14</td>
<td>–.29</td>
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<tr>
<td>5. Skin Conductance Reactivity</td>
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<td>.96**</td>
<td>.84**</td>
<td>.27</td>
<td>—</td>
<td>–.16</td>
<td>–.13</td>
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<td>6. Neighborhood Stress</td>
<td>.03</td>
<td>–.17</td>
<td>–.15</td>
<td>.19</td>
<td>–.11</td>
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<td>.14</td>
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<td>7. Youth Depressive Symptoms</td>
<td>.18</td>
<td>.20</td>
<td>.20</td>
<td>–.07</td>
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Mean:

Girls: 1.75 2.28 2.52 5.20 6.97 5.99 1.34
Boys: 1.30 2.21 2.47 5.46 6.12 5.69 1.16

SD:

Girls: 1.32 1.42 1.45 3.31 4.33 1.95 .35
Boys: 1.48 1.82 2.55 4.56 5.16 1.66 .24

N:

Girls: 38 38 37 38 38 38 38
Boys: 28 28 29 29 29 29 30

Note. Correlations for girls are above the diagonal; correlations for boys are below the diagonal.

$p < .10. *p < .05. **p < .01.
We then probed the interaction between neighborhood stress and SCLR in the sample of boys. This interaction was probed using tests of simple slopes as recommended by Aiken, West, and Reno (1991). Figure 1 shows the simple slopes graphed one standard deviation above and below the mean of SCLR. For boys with low SCLR, levels of perceived neighborhood stress were unassociated with depressive symptoms, $b = -0.02, \beta = -0.18, t(25) = -0.86, p = .39, 95\% \text{ CI} = [-0.084, 0.032]$. For boys with higher SCLR, higher levels of perceived neighborhood stress were associated with more depressive symptoms, $b = 0.19, \beta = 1.38, t(25) = 3.89, p < .01, 95\% \text{ CI} = [0.294, 0.098]$. In other words, high SCLR placed boys at risk for the negative effects (in terms of depressive symptoms) of neighborhood stress.

To allow for a more detailed understanding of the way in which SCLR moderated associations between neighborhood stress and depressive symptoms, regions of significance were estimated using the Johnson-Neyman technique. Results of this analysis are depicted graphically in Figure 2, which displays the 95% confidence bands for the association between levels of SCLR and the strength of associations between neighborhood stress and depressive symptoms among boys. All variables were converted to $z$ scores in conducting this analysis for ease of interpretation. A significant association between neighborhood stress and depressive symptoms is present when the
value of 0 for this association falls outside of the confidence bands. This more careful examination of moderation effects indicated that greater perceptions of neighborhood stress were associated with more depressive symptoms for boys scoring above –.10 on SCLR (mean centered). The significant region represented the top 51.72% of boys in the sample.

**Discussion**

In an attempt to understand variability in the extent to which perceptions of stressful neighborhoods are associated with depressive symptoms in early adolescence, we considered SCLR as a potential moderator of such associations. Among all youth, higher levels of perceived neighborhood stress were associated with more depressive symptoms; however, such associations were particularly strong for boys. Among boys only, the association between
perceived neighborhood stress and depressive symptoms was moderated by levels of SCLR during a laboratory-based public speaking task. For boys with average or above average levels of SCLR, perceptions of greater neighborhood stress were associated with more depressive symptoms.

In general, empirical research has indicated that adolescents who perceive their neighborhoods are more dangerous, or less cohesive, are at risk for higher levels of depressive symptoms (Ford & Rechel, 2012; Latkin & Curry, 2003). Our findings were consistent with this work, as we found that neighborhoods perceived as stressful by adolescents of both genders placed them at risk for depressive symptoms. However, boys appeared to be particularly at risk in this respect. It has been suggested (Fagan & Wright, 2012) that boys may be more likely to experience problematic adjustment (including depression) when they reside in unsafe neighborhoods, given that boys spend more time unsupervised in the neighborhood context than do girls. Other researchers (Milam et al., 2012) have suggested that contextual stressors of all sorts (including neighborhoods) are more likely to be linked with externalizing behaviors among boys but internalizing symptoms among girls. Given that levels of depression are lower among boys than among girls in adolescence (Saluja et al., 2004), the finding that perceived neighborhood stress was strongly linked with depressive symptoms among boys is noteworthy. Although girls are more susceptible to internalizing problems in general, it may be that the presence of this particular contextual stressor—neighborhood problems—is especially relevant in eliciting symptoms of depression among boys.

Of primary interest in the current study was whether associations between perceptions of neighborhood stress and levels of depressive symptoms among youth varied based on levels of physiological reactivity to stress (SCLR). SCLR moderated associations between perceptions of neighborhood stress and boys’ depressive symptoms. Among boys, a specific set of contextual circumstances, combined with biological predispositions, increased vulnerability in this area. Interestingly, “vulnerability” for our sample was defined in terms of average or above average levels of SCLR. Specifically, higher levels of neighborhood stress were associated with more depressive symptoms problems for boys in the top 51.72% of the range of SCLR scores. Our findings are consistent with previous work (El-Sheikh, 2005) indicating that higher levels of SCLR constitute a risk factor for internalizing problems. These findings extend the understanding of ways in which high SCLR places youth at risk when exposed to other types of contextual stressors (perceptions of neighborhood stress)—and highlight the importance of considering how the moderating role of SCLR may vary for boys versus girls across these different contexts.
The results of this study suggest that the way in which the SNS responds to a laboratory stressor involving a public speaking task that is unrelated to exposure to dysregulated adult behavior plays a role in determining which individuals are, or are not, negatively impacted (in terms of reports of internalizing symptoms) by exposure to dangerous and disconnected neighborhoods of residence. As intriguing as these findings may be, we note that the current study is not without limitations. These include a small sample size, a lack of ethnic diversity within the sample, and the artificial nature of our laboratory stressor.

Though a sample of 68 is limited in its power to detect effects, and moderator effects in particular, we were able to identify the moderating role that SCLR played with respect to associations between neighborhood stress and levels of internalizing problems among boys. These findings speak to the magnitude of this effect size and suggest that SCLR is important to consider when attempting to understand variability in boys’ responses to living in neighborhoods characterized by danger and lack of connectedness.

Our sample was also limited in that it was comprised predominantly of youth from two ethnic groups: African American and European American. In light of the increasing ethnic diversity in the United States, it is all the more important that researchers recruit samples that reflect this diversity. This was a challenge within the current study, given that the two most prevalent ethnic groups within the geographic region in which this study was conducted were African American and European American. Future research in this area might target geographic areas that are more ethnically diverse—or that contain larger percentages of specific ethnic groups not represented in the current study.

Another limitation of the current study is its reliance on a laboratory task to elicit stress responses from youth. Such tasks are clearly artificial. However, the Trier Stress Task (Buske-Kirschbaum et al., 1997) is widely accepted as an effective way to induce moderate levels of stress among young adolescents. Engaging in a public speaking task in a strange environment might actually be more stress-inducing than engaging in a similar task in a more comfortable and familiar setting. Importantly, our adaptation of the Trier Stress Task required that youth prepare and present a speech about a potentially stressful experience in their past that was unrelated to experiences of neighborhood stress. The fact that this task raised levels of skin conductance among our participants, and that the magnitude of that increase was observed to moderate associations between experiences of neighborhood stress and internalizing problems, gives us confidence that, although not perfect, this laboratory stress task was effective in inducing moderate levels of stress among participants.
Findings from the current study highlight the individual and interactive roles of environment and physiology in relation to levels of depressive symptomatology in early adolescence. More importantly, they shed light on why the experience of living in dangerous neighborhoods that lack cohesion and connectedness is not uniformly associated with depressive symptoms during this developmental period. Neighborhood risk matters, as does baseline levels of SNS activation and levels of SNS reactivity during times of stress. Even more intriguing, these findings represent an important step in understanding variability in the extent to which such associations are observed. Boys appear to be at particular risk when exposed to neighborhood risk; boys with high levels of SNS reactivity are even more susceptible to such effects. The potential ability to customize prevention programs based on context, gender, and physiological characteristics of young adolescents represents an intriguing glimpse into what prevention programs may look like in the future.

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