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Permissive Parenting, Deviant Peer Affiliations, and Delinquent Behavior in Adolescence: The Moderating Role of Sympathetic Nervous System Reactivity

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Abstract

The present study examined two measures of sympathetic nervous system (SNS) activity as moderators of the indirect path from permissive parenting to deviant peer affiliations to delinquency among a community sample of adolescents. Participants included 252 adolescents ($M = 15.79$ years; 53% boys; 66% European American, 34% African American). A multi-method design was employed to address the research questions. Two indicators of SNS reactivity, skin conductance level reactivity (SCLR) and cardiac pre-ejection period reactivity (PEPR) were examined. SNS activity was measured during a baseline period and a problem-solving task (star-tracing); reactivity was computed as the difference between the task and baseline periods. Adolescents reported on permissive parenting, deviant peer affiliations, externalizing behaviors, and substance use (alcohol, marijuana). Analyses revealed indirect effects between permissive parenting and delinquency via affiliation with deviant peers. Additionally, links between permissive parenting to affiliation with deviant peers and affiliation with deviant peers to delinquency was moderated by SNS reactivity. Less SNS reactivity (less PEPR and/or less SCLR) were risk factors for externalizing problems and alcohol use. Findings highlight the moderating role of SNS reactivity in parenting and peer pathways that may contribute to adolescent delinquency and point to possibilities of targeted interventions for vulnerable youth.

Keywords

permissive parenting; deviant peer affiliation; delinquency; sympathetic nervous system reactivity

Delinquent behaviors in adolescence stem, in part, from parental permissiveness and affiliation with deviant peers (Barnes, Hoffman, Welte, Farrell, & Dintcheff, 2006; Trudeau, Mason, Randall, Spoth, & Ralston, 2012). Although parenting, peer affiliation, and delinquent behaviors are likely interconnected in multiple ways (e.g., adolescent behaviors influence parenting), one relatively well-documented pathway is that permissive or uninvolved parenting predicts deviant peer affiliation which, in turn, predicts adolescents' delinquent behaviors (Chung & Steinberg, 2006; Dishion, Patterson, Stoolmiller, & Skinner, 1991; Kiesner, Poulin, & Dishion, 2010; Scaramella, Conger, Spoth, & Simons, 2002).

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Although this pathway has theoretical and empirical support, the effects of environmental risk factors vary, such that some youth may be highly vulnerable whereas other youth may be relatively resilient in the face of family and peer risks. Indeed, accumulating research demonstrates that psychophysiological responses to stress moderate the effects of various social-environmental experiences (El-Sheikh & Erath, 2011). In the present study, we examined measures of sympathetic nervous system (SNS) reactivity (skin conductance level reactivity or SCLR and cardiac pre-ejection period reactivity or PEPR) as moderators of the indirect path from permissive parenting to deviant peer affiliation to delinquent behaviors (externalizing behaviors and substance use) among typically developing adolescents.

One candidate psychophysiological moderator is SNS underarousal, including diminished reactivity in the behavioral inhibition (BI) and behavioral activation (BA) subsystems. These subsystems reflect threat- and reward-sensitive dimensions of the SNS, respectively. SNS underarousal is reliably associated with delinquent behaviors, and this association has been explained in terms of fearlessness and sensation-seeking theories (Raine, 2002). According to the fearlessness conceptualization, less SNS arousal is a marker of low anxiety as well as insensitivity to threat or punishment (Raine, 2002). SCLR is a well-validated measure of the BI or threat-sensitive dimension of the SNS (Beauchaine, 2001; Gray, 1987), and less SCLR (blunted or less of an increase from resting levels in response to a task) is generally linked with disinhibited, impulsive, and delinquent behaviors during childhood and adolescence (Beauchaine, Gatzke-Kopp, & Mead, 2007; Murray-Close, 2013; Raine, 2002).

According to the sensation-seeking conceptualization, less SNS arousal is an uncomfortable physiological state, and individuals with less SNS arousal therefore seek excitement, sometimes in the form of delinquent behaviors, that increases arousal to more normal and comfortable levels (Raine, 2002). PEP, which refers to the time between when the heart fills with blood and when blood is ejected from the heart, is a well-validated marker of the BA or reward-sensitive dimension of the SNS (Beauchaine, 2001). Adolescents with less PEPR (longer PEP and less SNS arousal) may seek reward or stimulation consistent with sensation-seeking theory; indeed, less PEPR has been linked with increased likelihood of alcohol use (Brenner & Beauchaine, 2011) as well as behavior disorders and other approach-oriented delinquent behaviors (Beauchaine et al., 2007).

The association between permissive parenting and deviant peer affiliation may be stronger among adolescents with relatively less SNS reactivity indexed by less SCLR or PEPR given the fearless and sensation-seeking tendencies associated with these physiological responses. Several studies have shown that SNS activity moderates the effects of parenting on social and externalizing behavior outcomes (Erath, El-Sheikh, Hinnant, & Cummings, 2011; Kochanska, Brock, Chen, Aksan, & Anderson, 2015). One particularly relevant study found that SCLR moderates the association between one form of parental control and affiliation with prosocial peers (Tu, Erath, Pettit, & El-Sheikh, 2014). Parental encouragement of prosocial friendships and discouragement of deviant friendships (i.e., parental directing) predicted increased friendship quality and positive peer affiliations across the transition to middle school among young adolescents with less SCLR in response to peer evaluation but not among young adolescents with greater SCLR. Adolescents with less SCLR and parents who provided less discouragement of deviant peer affiliations (perhaps similar to permissive

parenting) reported relatively low-quality friendships and affiliations with peers who engaged in less positive activities and behaviors; adolescents with greater SCLR (greater increases from baseline to task) were not susceptible to the absence of parental directing (Tu et al., 2014).

Less SCLR or PEPR may also increase vulnerability to delinquent behaviors in the context of deviant peer affiliation. Several studies have shown that SNS activity moderates the effects of peer experiences on externalizing behaviors (e.g., Gregson, Tu, & Erath, 2014; Rudolph, Troop-Gordon, & Granger, 2010). Most relevant to the present investigation, autonomic nervous system (ANS) underarousal was found to interact with affiliation with bullies to predict delinquent behaviors (Sijtsema et al., 2013; Sijtsema et al., 2010). These authors reported that low resting heart rate (RHR) predicted concurrent affiliation with adolescents who bully others and directly and indirectly (via sensation-seeking) predicted increased delinquent behaviors over time. Furthermore, low RHR predicted later delinquent behaviors among boys with greater affiliations with bullies, but not among boys with fewer affiliations with bullies (Sijtsema et al., 2013). A related study that used self-report measures of personality documented the highest levels of delinquent behaviors among adolescents with permissive parents, deviant peers, and high sensation-seeking tendencies, compared to their counterparts with lower levels of these personality and social-environmental risk factors (Mann, Kretsch, Tackett, Harden, & Tucker-Drob, 2015).

The available literature suggests that permissive parenting predicts deviant peer affiliation which, in turn, predicts delinquent behaviors. Other studies also suggest that these associations may be stronger among adolescents with low ANS reactivity. However, to our knowledge, no published studies have tested this complete model. Furthermore, one limitation of existing studies is the use of single measures of ANS activity that capture aggregate functioning of the SNS and PNS branches of the ANS (e.g., heart rate) or that capture either the BI or BA subsystem of the SNS (but not both dimensions of the SNS). Including measures of BI and BA reactivity may clarify which dimension of the SNS accounts for the vulnerability function of SNS underarousal or yield more powerful prediction if both dimensions of the SNS contribute to the vulnerability function.

We hypothesize that permissive parenting is linked to delinquent behaviors via the indirect path of affiliation with deviant peers. We also hypothesize that the association between permissive parenting and deviant peers, and the association between deviant peers and delinquent behaviors, would be moderated by SNS reactivity, such that the relations would be stronger among adolescents with less SCLR or PEPR compared to adolescents with greater SCLR or PEPR. The present study is the first to examine SCLR and PEPR as moderators of the indirect paths from permissive parenting to deviant peer affiliation to delinquent behaviors in adolescence and, consistent with the notion that indices of both BI and BA may play an interactive role in predicting delinquency, we tested both two-way and three-way interactions.

Method

Participants

Families participated in four waves of a longitudinal study from childhood to adolescence that examined relations between family functioning and youth development. Data for the current study comes from the fourth wave (data collected in 2012–2013). Participants were recruited from elementary schools in the Southeastern United States at the first wave of data collection in 2005). Eligibility criteria required parents to have been living together for at least two years, and exclusion criteria included a diagnosis of attention deficit hyperactivity disorder, developmental delays or a chronic illness.

At Time 1 (T1), 251 school-aged children participated, and approximately 79% of these children participated at T4. At the current wave (T4), participants included 199 adolescents who participated in prior waves (93 boys, 106 girls; 64% European American and 36% African American; M age = 15.78 years, SD = .82). Additionally, due to a 5 year lag between the third and fourth waves of data collection and loss of participants (e.g., unable to contact families, families relocating), an additional 53 families were recruited from the same school systems as the original sample to participate in the fourth wave. These participants (25 boys, 28 girls; 74% European American, 26% African American; M age = 15.83 years, SD = .78) were matched to the original sample's demographics and the same inclusion/exclusion criteria were applied. No differences on demographics or primary study variables were found between participants who were recruited at T1 compared to T4. Thus, the final analytic sample was composed of 252 adolescents (118 boys, 134 girls; 66% European American, 34% African American; M age = 15.79 years, SD = .81).

Families in the current wave were from a wide range of socioeconomic backgrounds, according to their income-to-needs ratio (annual family income divided by federal poverty threshold for a given family size; U.S. Department of Commerce, 2013). Approximately 14% of families were living in poverty (ratio < 1); 28% near the poverty line (ratio >1 and < 2); 22% lower middle class (ratio > 2 and < 3); and 36% middle class (ratio > 3). A majority (82%) of adolescents lived in two parent households (e.g., both biological parents or one biological parent and step-parent/partner), 14% lived in a single-parent household (some parents separated or divorced), and 4% lived with a legal guardian(s).

Procedure

Data for the current study comes from a larger, longitudinal investigation and only pertinent procedures are presented. This study was approved by the university's institutional review board. Consent and assent for participation were obtained from parents and adolescents, respectively. Parents and adolescents visited the university laboratory where adolescents' physiological responses (i.e., SCL and PEP) were measured during a three minute resting condition (baseline assessment), during which adolescents were asked to sit quietly. This was followed by a three minute stress task: star-tracing task in which participants were asked to trace the outline of a star using only the reflection of the star through a mirror as a guide (LaFayette Instrument Company, Lafayette, IN). During the laboratory visit, adolescents and parents also completed questionnaires in separate rooms for confidentiality.

Measures

Permissive parenting—Adolescents completed the reliable and valid Parent Behavior Inventory (Schaefer, 1965; Schwarz, Barton-Henry, & Pruzinsky, 1985) for mothers and fathers. Two scales that are reliably and commonly conceptualized as dimensions of permissive parenting or lax control (e.g., Schludermann & Schludermann, 1970; Weiss & Schwarz, 1996) were examined: lax discipline (e.g., “Let’s me off easy when I do something wrong”, “Can’t say no to anything I want”; four items) and nonenforcement (e.g., “Doesn’t pay much attention to my misbehavior”, “Doesn’t check up to see whether I have done what s/he told me”; 4 items) during the past year (α s ranged from .63 to .76 across parents and subscales). Items were rated on a 3-point scale (1 = *not like* to 3 = *like*, referring to similarity of behavior described to parents’ behavior). Correlations between adolescents’ reports for mothers and fathers across lax discipline and nonenforcement were high (r s = .42 and .52, p s < .001; respectively) and were averaged for each subscale. For adolescents who only reported on one parent (2.5% of participants), only responses for the one parent were used. Further, the two subscales were correlated (r = .53, p < .001) and averaged to create a single score of permissive parenting (α = .84).

Affiliation with deviant peers—Adolescents reported on the extent to which they associated with deviant peers during the past three months using the Child Peer Social Skills measure (Dishion, & Kavanagh, 2003), which has demonstrated reliability among adolescents (ages 12 to 17 years; Bullock & Dishion, 2002; Piehler, n.d.). Six items regarding friends’ behavior in the past three months (e.g., What percentage of your friends... “misbehaved or broke rules?”, “experimented with smoking or other substances,” “dressed or acted like a gang member,” “were older,” and “did not attend school”) were rated on a 5-point scale (1 = *less than 25%* to = *more than 75%*; α = .77).

Resting SCL and SCLR—Data acquisition for skin conductance level (SCL) followed standard procedures (MindWare Technologies, Inc., Gahanna, Ohio). SCL was measured using two disposable silver/silver-chloride (Ag-AgCl) electrodes (1” x 1” foam, 0% chloride gel) placed on the palms of the non-dominant hand. SCL data were sampled at 1000 Hz and quantified with MindWare EDA analysis software, where data were analyzed in 1-minute intervals using a gain of 10 mV and a low pass filter of 10-Hz (units = microsiemens or μ S). SCL was averaged across the three minute baseline assessment, as well as the star-tracing task. SCLR was computed as a difference score (SCL star-tracing minus baseline SCL), such that positive scores reflect an increase in SCL (or increased SNS) and negative scores reflect a decrease in SCL or SNS activity to the star-tracing task.

Resting PEP and PEPR—Data acquisition for cardiac pre-ejection period (PEP) was derived from cardiac data using a modified lead-II configuration (Berntson et al., 1997) and thoracic impedance data using a four-spot impedance configuration (Berntson & Cacioppo, 2004). These data were collected using Ag-AgCl electrodes (1” foam, 7% chloride gel; MindWare Technologies, Inc., Gahanna, OH). To measure cardiac data, electrodes were placed on the right clavicle and left and right ribs. Thoracic impedance was measured using electrodes placed at the apex and base of the thorax and dual electrodes were placed on the back, approximately 1 1/2 inches above and below the thorax electrodes. PEP data were

sampled at 1000 Hz and amplified with a gain of 5000. Data were quantified using MindWare IMP analysis software. PEPR was computed as a difference score (PEP start-tracing minute baseline PEP), such that positive scores denote longer PEP or decrease in SNS activity and negative scores denote shortened PEP or an increase in SNS activity in response to challenge.

Externalizing symptoms—Adolescents reported on their externalizing behaviors during the past six months using the Youth Self-Report form (Achenbach & Rescorla, 2001). The Externalizing scale (32 items) is comprised of two subscales: aggressive behavior (e.g., “I get in many fights,” “I argue a lot”) and rule-breaking (e.g., “I cut classes or skip school”). Items are rated on a 3-point scale (1 = *not true* to 3 = *very often or often true*); $\alpha = .92$. T-scores were used in the present study; 9% of participants scored within the clinical range on externalizing symptoms ($T > 65$).

Substance use—Adolescents completed the Centers for Disease Control’s Youth Risk Behaviors Survey (Centers for Disease Control and Prevention, 2011; Mrug, Gaines, Su, & Windle, 2010). The variables of interest were lifetime frequency of alcohol and marijuana use: adolescents reported on how many days in their lifetime they had at least one drink of alcohol or smoked marijuana. Adolescents rated these items on a 7-point scale (1 = *0 days*; 2 = *1 or 2 days*; 3 = *3 to 9 days*; 4 = *10 to 19 days*; 5 = *20 to 39 days*; 6 = *40 to 99 days*; 7 = *100 or more days*). Approximately 44% of adolescents reported having consumed alcohol and 18% reported having smoked marijuana at least once. Both variables were positively skewed, marijuana more so. Based on best practices for transformation of skewed data, frequency of alcohol use was square-root transformed and marijuana use was log transformed to normalize their distributions for statistical analyses (Tabachnick & Fidell, 2007).

Results

Analysis Overview

The full model testing moderated indirect effects was evaluated separately for each adolescent outcome: externalizing behavior, frequency of alcohol use, and frequency of marijuana use (Figure 1). Following recommended practices in evaluating indirect and moderated indirect effects (Preacher, Rucker, & Hayes, 2007), in each model all parameters were estimated simultaneously in AMOS, a path and structural equation modeling program. AMOS uses full information maximum likelihood (FIML) estimation to handle missing data, which is the recommended best practice (Enders & Bandalos, 2001). Model fit was evaluated with the root mean squared error of approximation (RMSEA) with values of .08 or less indicating adequate fit; model fit indices are presented in Table 2.

In evaluating conditional indirect effects (i.e., moderated indirect effects) we used a moderator centering approach wherein significant moderation effects on paths a and b were probed post-hoc (Preacher et al., 2007). Potential indirect effects were then evaluated at conditional values of the moderator(s) (± 1 *SD*) using a Monte Carlo sampling procedure to derive 95% confidence intervals for indirect effects at these conditional values (Preacher & Selig, 2012; Selig & Preacher, 2008). All models controlled for effects of ethnicity, sex, and

resting levels of PEP and SCL on both the intervening variable, affiliation with deviant peers, and the outcomes of externalizing behavior, frequency of alcohol use, and frequency of marijuana use.

Preliminary Analyses

Descriptive statistics and correlations for all study variables are presented in Table 1. Of greatest relevance to our hypotheses, permissive parenting was positively correlated with more deviant peer affiliation and higher frequency of alcohol use.

Affiliation with Deviant Peers

Parameter estimates for all models are presented in Table 2. Male adolescents and African American adolescents reported greater affiliation with deviant peers ($R^2 = .03$ and $.02$, respectively). Permissive parenting was positively related to affiliation with deviant peers ($R^2 = .02$, path a). There was a significant three-way interaction between permissive parenting, PEPR, and SCLR on deviant peer affiliation ($R^2 = .09$; Figure 2), indicating that path a was moderated by both measures of SNS activity.

Plotting simple slopes at ± 1 *SD* of PEPR and SCLR, we found that permissive parenting was unrelated to affiliation with deviant peers for adolescents who had asynchronous SNS reactivity, with either less PEPR (lower SNS reactivity) and greater SCLR (higher SNS reactivity) ($B = -.62$, $SE = .52$, $\beta = -.19$, $p = .27$). Permissive parenting was strongly related to deviant peer affiliations for adolescents with synchronous SNS activity, whether low SNS reactivity indexed by less PEPR and less SCLR ($B = 1.39$, $SE = .40$, $\beta = .49$, $p < .001$) or high reactivity indexed by greater PEPR and greater SCLR ($B = 1.54$, $SE = .34$, $\beta = .54$, $p < .001$). The total model accounted for 21.7% of the variance in deviant peer affiliation.

Externalizing behavior

African American adolescents exhibited lower levels of externalizing behaviors ($R^2 = .03$), and higher resting SCL was associated with lower levels of externalizing behavior ($R^2 = .03$; see Table 2). Accounting for deviant peer affiliations and other covariates, permissive parenting did not predict externalizing behavior (path c'). Of primary interest, affiliation with deviant peers was positively related to externalizing behavior ($R^2 = .11$, path b), and the relation between deviant peer affiliations and externalizing behavior was moderated by PEPR ($R^2 = .08$; Figure 3).

[INSERT FIGURE 3 ABOUT HERE] Plotting the simple slope at $+1$ *SD* of PEPR showed that there was a strong positive relation between affiliation with deviant peers and externalizing behavior (path b) for adolescents with less PEPR (longer PEP indicative of lower SNS reactivity; $B = 1.48$, $SE = .26$, $\beta = .68$, $p < .001$). Plotting the slope at -1 *SD* showed that for adolescents with greater PEPR (shorter PEP), affiliation with deviant peers was also positively, though less strongly related to externalizing behavior ($B = .63$, $SE = .24$, $\beta = .29$, $p = .008$). The total model accounted for 31.5% of the variance in externalizing behavior.

Test of indirect effects—The indirect main effect (a x b) of permissive parenting on externalizing behavior through affiliation with deviant peers was $B = .48$, and Monte Carlo bootstrapped estimates indicated a significant indirect effect (95% $CI [.06, .95]$). Because PEPR was a moderator of paths a and b, we also tested if the significant indirect effect was moderated by PEPR. The indirect effect as moderated by PEPR showed that for adolescents with less PEPR (longer PEP or lower SNS reactivity), paths a ($B = .54$, $SE = .12$, $\delta = .19$, $p < .001$) and b ($B = 1.48$, $SE = .26$, $\delta = .68$, $p < .001$) were highly significant and that deviant peer affiliation was a significant intervening variable for these less reactive adolescents ($B = .81$, 95% $CI [.39, 1.32]$). For adolescents with greater PEPR (shorter PEP or higher SNS reactivity), we found that paths a ($B = .52$, $SE = .22$, $\delta = .19$, $p = .02$) and b ($B = .63$, $SE = .24$, $\delta = .29$, $p = .008$) were also significant and that affiliation with deviant peers was a significant intervening variable for these more reactive adolescents ($B = .33$, 95% $CI [.03, .78]$). Thus, indirect effects were found for adolescents with both less and greater PEPR, though the stronger effect was found for adolescents who showed less PEPR.

Alcohol Use

Parameter estimates predicting alcohol use are presented in Table 2 (total model $R^2 = .23$). Greater SCLR was related to less frequent alcohol use ($R^2 = .04$). Both permissive parenting (path c', $R^2 = .04$) and affiliation with deviant peers (path b, $R^2 = .03$) were related to more frequent adolescent alcohol use. Of primary interest, the two-way interaction between deviant peer affiliation and SCLR ($R^2 = .08$) and the three-way interaction between affiliation with deviant peers, PEPR, and SCLR ($R^2 = .07$) were significant predictors of alcohol use (path b). The significant three-way interaction is depicted in Figure 4.

Evaluation of simple slopes showed that SCLR was an important moderator between affiliation with deviant peers and alcohol use (Figure 4). Affiliation with deviant peers was negatively related to alcohol use for adolescents with less PEPR and greater SCLR ($B = -.07$, $SE = .03$, $\delta = -.61$, $p = .03$) and was unrelated to alcohol use for adolescents with greater PEPR and greater SCLR ($B = .02$, $SE = .02$, $\delta = .15$, $p = .40$). For adolescents with greater PEPR and less SCLR, affiliation with deviant peers was positively related to days of alcohol use ($B = .03$, $SE = .01$, $\delta = .28$, $p = .005$). There was also a positive but stronger relationship between affiliation with deviant peers and alcohol use for adolescents with less PEPR and less SCLR ($B = .10$, $SE = .03$, $\delta = .79$, $p < .001$). The total model accounted for 23.0% of the variance in frequency of alcohol use.

Test of indirect effects—The indirect main effect (a x b) of permissive parenting on frequency of alcohol use through affiliation with deviant peers was $B = .01$, and Monte Carlo bootstrapped estimates indicated no significant indirect effect (95% $CI [-.01, .02]$). Because PEPR and SCLR were moderators of paths a and b, we also tested if there was evidence for an indirect effect that was conditional on these moderators. For adolescents with less PEPR and greater SCLR, path a was not significant and there was no evidence for an indirect effect ($B = -.03$, 95% $CI [-.07, .01]$). Path b was not significant for adolescents with greater PEPR and greater SCLR, also with no evidence for an indirect effect ($B = .02$; 95% $CI [-.02, .06]$). For adolescents with greater PEPR and less SCLR, path a was not significant and the indirect effect was not significant ($B = -.02$, 95% $CI [-.05, .01]$). For

adolescents with less PEPR and less SCLR, paths a ($B = 1.39$, $SE = .40$, $\beta = .49$, $p < .001$) and b ($B = .10$, $SE = .03$, $\beta = .79$, $p < .001$) were highly significant and deviant peer affiliation was a significant intervening variable for alcohol use for these less reactive adolescents ($B = .13$, 95% $CI [.044, .25]$). Thus, the only significant conditional indirect path between permissive parenting and alcohol use via affiliation with deviant peers was for adolescents with less PEPR and less SCLR.

Marijuana Use

Greater SCLR was associated with lower frequency of marijuana use ($R^2 = .02$). Similar to aforementioned finding for externalizing behavior and alcohol use, affiliation with deviant peers was positively related to frequency of marijuana use ($B = .01$, $SE = .00$, $\beta = .29$, $p < .001$, $R^2 = .05$, path b). Accounting for affiliation with deviant peers and other covariates, permissive parenting did not predict marijuana use (path c'). Contrary to expectations, PEPR and SCLR did not moderate the association between deviant peer affiliation and frequency of marijuana use. The total model accounted for 12.2% of the variance in frequency of marijuana use.

Test of indirect effects—The indirect main effect (a x b) of permissive parenting on marijuana use through affiliation with deviant peers was $B = .01$, and Monte Carlo bootstrapped estimates indicated no significant indirect effect (95% $CI [-.01, .02]$). Neither PEPR nor SCLR were moderators of both paths a and b, indicating there was little evidence for conditional indirect effects on frequency of marijuana use.

Discussion

Permissive parenting may create contexts that put adolescents at risk for delinquent behaviors and substance use, either directly or indirectly through increased opportunities to associate with deviant peers (Chung & Steinberg, 2006; Dishion et al., 1991; Kiesner et al., 2010; Scaramella et al., 2002). In the current study, we investigated individual differences in autonomic regulation that may moderate pathways among permissive parenting, deviant peer affiliation, and delinquent behavior. A few studies have documented the role of low RHR and less SNS reactivity (SCLR or PEPR) in affiliation with deviant peers, sensation-seeking, and delinquency (Sijtsema et al., 2013; Sijtsema et al., 2010; also reviewed in Beauchaine et al., 2007; Matthys, Vanderschuren, & Schutter, 2013). Further, others have found less SNS reactivity indexed through SCLR to be a risk factor exacerbating relations between parenting or peer relations and delinquency (e.g., Erath et al., 2011; Gregson et al., 2014). Thus, accumulating evidence is showing that low SNS reactivity generally is associated with, or is a moderator of, relations among family and peer relationships and delinquency and substance use in adolescence. However, no published studies have simultaneously evaluated the conditional effects of autonomic indices of BI and BA on the indirect path from parenting behaviors to deviant peer affiliation to delinquency.

Our primary hypotheses were that deviant peer affiliations would provide an indirect link between permissive parenting and adolescent delinquent behavior and that less SCLR, less PEPR, or both would serve as risk factors in associations between: (1) permissive parenting and affiliation with deviant peers, and (2) affiliation with deviant peers and adolescent

delinquent behaviors. Delinquent behaviors were assessed with externalizing symptoms, frequency of alcohol use, and frequency of marijuana use. Building on this scant literature, we found evidence for indirect paths that were conditional upon SNS reactivity in two out of three measures of adolescent delinquency.

Permissive parenting was conditionally associated with deviant peer affiliation for adolescents who exhibited SNS reactivity to stress that was synchronous (i.e., either less SCLR and PEPR or greater SCLR and PEPR). This relationship for adolescents with less SNS reactivity was expected; less SCLR and PEPR may serve as physiological markers of fearlessness and sensation-seeking and, in contexts of permissive parenting, may lead adolescents to associate with peer groups that are more likely to engage in risky behaviors. The positive relationship for adolescents high in SNS reactivity is more surprising and potentially offers some support for biological sensitivity to context-based models in which suboptimal environments and heightened SNS reactivity interact to promote impulsive risk-taking (Del Giudice, Ellis, & Shirtcliff, 2011). We can only speculate on the differential person-environment transactions that may lead adolescents low or high in SNS reactivity to affiliate with deviant peers. For example, it is plausible that permissive parents create environments that promote or tolerate association with deviant peers, or that children with specific SNS profiles are more likely to seek out, or accept friendship bids from, deviant peers. By contrast, asynchronous SNS activity (e.g., less PEPR and greater SCL) seemed to protect against affiliation with deviant peers in contexts of permissive parenting, perhaps because these physiological indices of BA and BI counteract or balance each other out to some extent. Explicating the nature of these transactions and processes will help address these unanswered questions. However, it is notable that associations between deviant peer affiliation and adolescent delinquent behaviors were found only for adolescents with less SNS reactivity.

Building on the literature in important ways, our findings indicated that there was an overall significant indirect effect of permissive parenting on externalizing behavior that was carried through affiliation with deviant peers. This indirect path to externalizing symptoms was especially strong for adolescents with less PEPR (less SNS reactivity). Although there was not an overall indirect effect of permissive parenting on alcohol use, there was a conditional indirect effect: affiliation with deviant peers served as an intervening variable between permissive parenting and alcohol use only for adolescents with less SCLR and PEPR. We found no evidence for main or conditional indirect effects on adolescents' marijuana use.

Several conclusions can be drawn from these findings. First, the results support prior studies delineating pathways from parenting practices, to adolescents' affiliation with deviant peers, to externalizing and delinquency problems (e.g., Bowman, Prellow, & Weaver, 2007). Second, our findings highlight the important moderating role of individual differences in SNS reactivity in these processes. In particular, less SCLR and PEPR may be markers of risk in contexts of permissive parenting, increasing affiliation with deviant peers, and markers of vulnerability to involvement in delinquent behavior when adolescents affiliate with high risk or deviant peers. Third, the findings give some important insights into interactions between social and psychophysiological risk factors in pathways to adolescent delinquency and risky

behavior, which may help to explain the small to moderate main effects of SNS activity on indices of externalizing behaviors found in meta-analyses (e.g., Lorber, 2004).

The findings also tie in well to potential directions for the prevention of adolescent delinquency and health risk behaviors. At a broad level, it has been argued that including biomarkers of risk has the potential to increase the effectiveness of prevention and intervention programs (Beauchaine, Neuhaus, Brenner, & Gatzke-Kopp, 2008). In the context of these findings, programs aimed at preventing adolescents from associating with deviant peer groups or reducing delinquency and health risk behavior might utilize biomarkers of risk by highlighting those who may be most at risk: adolescents with low SNS reactivity who have parents with more permissive or lax parenting styles. Alternatively or additionally, prevention and intervention programs might use biomarkers of risk to help choose alternative or supplementary treatments for adolescents who do not show improvement in response to a program's normal curriculum (Beauchaine et al., 2013). While the science of biosocially-informed prevention and intervention programs is in its infancy and the incorporation of biomarkers of risk in prevention and intervention programs undoubtedly brings challenges, such work may lead to more efficient use of programs' resources.

Limitations and Future Directions

It is notable that we found evidence for conditional indirect effects of permissive parenting on outcomes through affiliation with deviant peers for externalizing behavior and alcohol use but not marijuana use. Despite the ethnic and socioeconomic variability in the study, there were low rates of marijuana use overall in this community sample, and the limited variability may have curtailed our ability to detect the hypothesized effects. Additionally, families enrolled in this study were limited to those with couples that had been living together for at least two years, which suggests that caution be used in generalizing findings to adolescents with different family structures and marital histories. These limitations highlight the need for studies that sample across the full spectrum of family backgrounds and outcomes and include more high risk individuals.

A second limitation is the lack of longitudinal data on all of the variables in these models. Determining the direction of effects was not possible, and other research points to the possibility that affiliation with deviant peers predicts parenting practices (Dishion, Nelson, & Bullock, 2004), rather than the other way around. Last, and related to the point above, there are statistical limitations to our findings that are linked to the cross-sectional nature of the data. We have avoided the term mediation because by definition mediational processes unfold over time as part of a (conceptually) causal chain. Methodologists urge caution in placing too much faith in cross-sectional assessments of mediation and indirect effects, as indirect effects estimates derived from cross-sectional data often do not replicate with longitudinal data (Maxwell, Cole, & Mitchell, 2011). In the current study this limitation was unavoidable (due to study funding timelines we did not have data from early adolescence). Thus, we also urge caution in interpreting correlational results as causal effects and suggest follow up longitudinal analyses to replicate and extend upon these findings.

The task used in this study, the star-tracer, is well known for inducing frustration while also requiring some inhibitory control (i.e., each movement is reversed because of the mirror). We believe that physiological reactivity to such a task is highly relevant to our outcomes of interest, though it is also important to acknowledge that reactivity to other tasks eliciting feelings of social evaluation or peer pressure might also be important in understanding relations between peer affiliations and problem behavior. Thus, we urge researchers to consider carefully the conceptual match between the research questions of interest and the tasks that are used to answer those research questions. In particular, we support the move to greater standardization of tasks used to assess reactivity in various domains which will improve reliability in findings across studies, which in turn will support meta-analytic efforts in the field.

Finally, we used adolescent self-reports for all of the variables used to test indirect effects, which introduces the potential for inflated estimates due to shared methods (i.e., adolescent as reporter). This would be a more problematic issue if we were interested only in indirect effects. However, our primary questions of interest involved testing if these links between parenting, peers, and problem behaviors were moderated by SNS reactivity, which was assessed through electrophysiological measures. Given the focus of our research questions, we believe that assessing the moderators with a different methodology significantly attenuates the issue of shared method variance.

Conclusions

Despite these limitations, findings from the present study elucidate for whom and under which conditions adolescents may be more susceptible to deviant peer affiliations and delinquent behaviors. Deviant peer affiliations were found to be influential in linking permissive parenting indirectly to externalizing behavior. Conditional indirect effects on externalizing behavior and alcohol use also emerged wherein the strongest indirect paths were found for adolescents with less SNS reactivity. Findings highlight the importance of considering physiological processes in links between permissive parenting and peer affiliations, as well as peer affiliations and delinquency, in adolescence.

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References

- Achenbach, TM.; Rescorla, L. ASEBA school-age forms & profiles. Burlington, VT: Aseba; 2001.
- Barnes GM, Hoffman JH, Welte JW, Farrell MP, Dintcheff BA. Effects of parental monitoring and peer deviance on substance use and delinquency. *Journal of Marriage and Family*. 2006; 68:1084–1104.
- Beauchaine TP. Vagal tone, development, and Gray's motivational theory: Toward an integrated model of autonomic nervous system functioning in psychopathology. *Developmental Psychopathology*. 2001; 13:183–214.

- Beauchaine TP, Gatzke-Kopp L, Mead HK. Polyvagal Theory and developmental psychopathology: Emotion dysregulation and conduct problems from preschool to adolescence. *Biological Psychology*. 2007; 74:174–184. [PubMed: 17045726]
- Beauchaine TP, Gatzke-Kopp L, Neuhaus E, Chipman J, Reid MJ, Webster-Stratton C. Sympathetic- and parasympathetic-linked cardiac function and prediction of externalizing behavior, emotion regulation, and prosocial behavior among preschoolers treated for ADHD. *Journal of Consulting and Clinical Psychology*. 2013; 81:481–493. [PubMed: 23544677]
- Beauchaine TP, Neuhaus E, Brenner SL, Gatzke-Kopp L. Ten good reasons to consider biological processes in prevention and intervention research. *Development and Psychopathology*. 2008; 20(03):745–774. [PubMed: 18606030]
- Berntson GG, Bigger JT Jr, Eckberg DL, Grossman P, Kaufmann PG, Malik M, van der Molen MW. Heart rate variability: Origins, methods, and interpretive caveats. *Psychophysiology*. 1997; 34:623–648. [PubMed: 9401419]
- Berntson, GG.; Cacioppo, JT. Heart rate variability: Stress and psychiatric conditions. In: Malik, M.; Camm, A.J., editors. *Dynamic Electrocardiography*. New York, NY: Blackwell/Futura; 2004. p. 57-64.
- Bowman MA, Prelow HM, Weaver SR. Parenting behaviors, association with deviant peers, and delinquency in African American adolescents: A mediated-moderation model. *Journal of Youth and Adolescence*. 2007; 36:517–527.
- Brenner SL, Beauchaine TP. Pre-ejection period reactivity and psychiatric comorbidity prospectively predict substance use initiation among middle-schoolers: A pilot study. *Psychophysiology*. 2011; 48:1587–1595.
- Bullock BM, Dishion TJ. Sibling collusion and problem behavior in early adolescence: Toward a process model for family mutuality. *Journal of Abnormal Child Psychology*. 2002; 30:143–153. [PubMed: 12002395]
- Centers for Disease Control and Prevention. Youth Risk Behavior Surveillance System (YRBSS). 2011. from <http://www.cdc.gov/HealthyYouth/yrbs/index.htm>
- Chung HL, Steinberg L. Relations between neighborhood factors, parenting behaviors, peer deviance, and delinquency among serious juvenile offenders. *Developmental Psychology*. 2006; 42:319–331. [PubMed: 16569170]
- Del Giudice M, Ellis BJ, Shirtcliff EA. The Adaptive Calibration Model of stress responsivity. *Neuroscience and Biobehavioral Reviews*. 2011; 35:1562–1592. [PubMed: 21145350]
- Dishion, TJ.; Kavanagh, KE. CRPSK: Child Peer Social Skills. In: Dishion, TJ.; Kavanagh, K., editors. *Intervening in adolescent problem behavior: A family centered approach*. New York: Guilford; 2003.
- Dishion TJ, Nelson SE, Bullock BM. Premature adolescent autonomy: Parent disengagement and deviant peer process in the amplification of problem behaviour. *Journal of Adolescence*. 2004; 27:515–530. [PubMed: 15475044]
- Dishion TJ, Patterson GR, Stoolmiller M, Skinner ML. Family, school, and behavioral antecedents to early adolescent involvement with antisocial peers. *Developmental Psychology*. 1991; 27:172–180.
- El-Sheikh M, Erath SA. Family conflict, autonomic nervous system functioning, and child adaptation: State of the science and future directions. *Development and Psychopathology*. 2011; 23:703–721. [PubMed: 23786705]
- Enders CK, Bandalos DL. The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling*. 2001; 8:430–457.
- Erath SA, El-Sheikh M, Hinnant JB, Cummings EM. Skin conductance level reactivity moderates the association between harsh parenting and growth in child externalizing behavior. *Developmental Psychology*. 2011; 47:693–706. [PubMed: 21142369]
- Gray, JA. *The Psychology of Fear and Stress*. New York: Cambridge University Press; 1987.
- Gregson KD, Tu KM, Erath SA. Sweating under pressure: Skin conductance level reactivity moderates the association between peer victimization and externalizing behavior. *Journal of Child Psychology and Psychiatry*. 2014; 55:22–30. [PubMed: 23734821]

- Kiesner J, Poulin F, Dishion TJ. Adolescent substance use with friends: Moderating and mediating effects of parental monitoring and peer activity contexts. *Merrill-Palmer Quarterly*. 2010; 56:529. [PubMed: 21165170]
- Kochanska G, Brock RL, Chen K-H, Aksan N, Anderson SW. Paths from mother-child and father-child relationships to externalizing behavior problems in children differing in children differing in electrodermal reactivity: A longitudinal study from infancy to age 10. *Journal of Abnormal Child Psychology*. 2015; 43:721–734. [PubMed: 25218772]
- Lorber MF. Psychophysiology of aggression, psychopathy, and conduct problems: A meta-analysis. *Psychological Bulletin*. 2004; 130:531–552. [PubMed: 15250812]
- Mann FD, Kretsch N, Tackett JL, Harden KP, Tucker-Drob EM. Person $\times$ environment interactions on adolescent delinquency: Sensation seeking, peer deviance and parental monitoring. *Personality and Individual Differences*. 2015; 76:129–134. [PubMed: 25908885]
- Matthys W, Vanderschuren LJ, Schutter DJ. The neurobiology of oppositional defiant disorder and conduct disorder: Altered functioning in three mental domains. *Development and Psychopathology*. 2013; 25:193–207. [PubMed: 22800761]
- Maxwell SE, Cole DA, Mitchell MA. Bias in cross-sectional analyses of longitudinal mediation: Partial and complete mediation under an autoregressive model. *Multivariate Behavioral Research*. 2011; 46:816–841. [PubMed: 26736047]
- Mrug S, Gaines J, Su W, Windle M. School-level substance use: Effects on early adolescents' alcohol, tobacco, and marijuana use. *Journal of Studies on Alcohol and Drugs*. 2010; 71(4):488–495. [PubMed: 20557827]
- Murray-Close D. Psychophysiology of adolescent peer relations I: Theory and research findings. *Journal of Research on Adolescence*. 2013; 23:236–259.
- Piehlert, T.; (n.d.). [August 27, 2015] Psychometric properties for CPRSK: Child peer social skills. Retrieved <http://measures.earlyadolescence.org/psychometrics/view/7/#>
- Preacher KJ, Rucker DD, Hayes AF. Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research*. 2007; 42:185–227. [PubMed: 26821081]
- Preacher KJ, Selig JP. Advantages of Monte Carlo confidence intervals for indirect effects. *Communication Methods and Measures*. 2012; 6:77–98.
- Raine A. Annotation: The role of prefrontal deficits, low autonomic arousal, and early health factors in the development of antisocial and aggressive behavior in children. *Journal of Child Psychology and Psychiatry*. 2002; 43:417–434. [PubMed: 12030589]
- Rudolph KD, Troop-Gordon W, Granger DA. Peer victimization and aggression: Moderation by individual differences in salivary cortisol and alpha-amylase. *Journal of Abnormal Child Psychology*. 2010; 38:843–856. [PubMed: 20405198]
- Scaramella LV, Conger RD, Spoth R, Simons RL. Evaluation of a social contextual model of delinquency: A cross-study replication. *Child Development*. 1995; 73:175–195. [PubMed: 14717251]
- Schaefer ES. Children's reports of parental behavior: An inventory. *Child Development*. 1965; 36:413–434. [PubMed: 14300862]
- Schludermann E, Schludermann S. Replicability of factors in children's report of parent behavior (CRPBI). *The Journal of Psychology*. 1970; 76:239–249.
- Schwarz JC, Barton-Henry ML, Pruzinsky T. Assessing child-rearing behaviors: A comparison of rating made by mother, father, child, and sibling on the CRPBI. *Child Development*. 1985; 56:462–479. [PubMed: 3987419]
- Selig, JP.; Preacher, KJ. Monte Carlo method for assessing mediation: An interactive tool for creating confidence intervals for indirect effects [Computer software]. 2008. Available from <http://quantpsy.org/>
- Sijtsema JJ, Nederhof E, Veenstra R, Ormel J, Oldehinkel AJ, Ellis BJ. Effects of family cohesion and heart rate reactivity on aggressive/rule-breaking behavior and prosocial behavior in adolescence: The Tracking Adolescents' Individual Lives Survey study. *Development and Psychopathology*. 2013; 25:699–712. [PubMed: 23880386]
- Sijtsema JJ, Veenstra R, Lindenberg S, van Roon AM, Verhulst FC, Ormel J, Riese H. Mediation of sensation seeking and behavioral inhibition on the relationship between heart rate and antisocial

behavior: The TRAILS study. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2010; 49:493–502. [PubMed: 20431469]

Tabachnick, BG.; Fidell, LS. *Using Multivariate Statistics*. 5. Boston, MA: Allyn & Bacon; 2007.

Trudeau L, Mason WA, Randall GK, Spoth R, Ralston E. Effects of parenting and deviant peers on early to mid-adolescent conduct problems. *Journal of Abnormal Child Psychology*. 2012; 40:1249–1264. [PubMed: 22648200]

Tu KM, Erath SA, Pettit GS, El-Sheikh M. Physiological reactivity moderates the association between parental directing and young adolescent friendship adjustment. *Developmental Psychology*. 2014; 50:2644–2653. [PubMed: 25365119]

U.S. Department of Commerce. How the Census Bureau measures poverty from. 2013. <http://www.census.gov/hhes/www/poverty/about/overview/measure.html>

Weiss LH, Schwarz JC. The relationship between parenting types and older adolescents' personality, academic achievement, adjustment, and substance use. *Child Development*. 1996; 67:2101–2114. [PubMed: 9022232]

Figure 1. Conceptual indirect effects model of permissive parenting, deviant peer affiliation, externalizing behavior and substance use, as moderated by sympathetic nervous system reactivity.

Figure 2.

Three-way interaction between permissive parenting, skin conductance level reactivity, and pre-ejection period reactivity predicts deviant peer affiliation.

Figure 3.

Two-way interaction between affiliation with deviant peers and pre-ejection period reactivity predicts externalizing behavior.

Figure 4.

Three-way interaction between affiliation with deviant peers, skin conductance level reactivity, and pre-ejection period reactivity predicts frequency of alcohol use. Numerical scaling: 1 = 0 days; 2 = 1 or 2 days; 3 = 3 to 9 days.

Table 1

Descriptive Statistics and Correlations among Study Variables

	1	2	3	4	5	6	7	8	9	10	11
1. Sex (1 = boys)	-										
2. Ethnicity (1 = AA)	-.07	-									
3. Permissive parenting	-.09	.01	-								
4. Deviant peers	.10	.14*	.20**	-							
5. SCL-B	-.04	-.38***	.02	-.01	-						
6. PEP-B	.19**	.03	-.02	.10	.01	-					
7. SCLR	-.07	.06	.07	-.06	-.28**	-.08	-				
8. PEPR	-.08	.01	.05	-.06	.00	-.24**	-.18	-			
9. Externalizing	-.03	-.04	.07	.39***	-.11	.00	-.02	.06	-		
10. Alcohol use	.05	-.04	.20**	.26***	-.07	.02	-.11	.04	.33***	-	
11. Marijuana use	.11	.02	.09	.24***	-.02	.04	-.09	-.03	.30***	.45***	-
Mean (SD)%	47%	34%	6.39 (1.50)	4.31 (4.00)	9.16 (4.98)	119.79 (10.53)	1.84 (2.36)	-4.02 (7.28)	50.85 (11.02)	1.34 (.48)	.08 (.20)

Note. Due to non-normal distributions, alcohol use ($M = 2.04$, $SD = 1.61$) was square-root transformed and marijuana use ($M = 1.41$, $SD = 1.13$) was log transformed; correlations and mean (SD) were computed using the transformed variables. Correlations using the non-transformed variables yielded nearly identical associations. AA = African American; SCL-B = skin conductance level at baseline; PEP-B = pre-ejection period at baseline; SCLR = skin conductance level reactivity; PEPR = pre-ejection period reactivity.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 2

Model parameter estimates predicting deviant peer affiliation, externalizing behavior, frequency of alcohol use, and frequency of marijuana use

	Deviant Peer Affiliation	Externalizing Behavior	Alcohol Use	Marijuana Use
Intercept	3.306 *** (.388)	53.336 *** (1.070)	1.337 *** (.049)	.073 *** (.021)
Coefficients	<i>B</i> (<i>SE</i>)	<i>B</i> (<i>SE</i>)	<i>B</i> (<i>SE</i>)	<i>B</i> (<i>SE</i>)
Sex (1 = boys)	1.028 * (.465)	−1.898 (1.326)	.041 (.060)	.032 (.026)
Ethnicity (1 = AA)	1.231 * (.540)	−4.032 ** (1.548)	−.099 (.071)	−.013 (.030)
Permissive parenting	.452 * (.195)	−.288 (.447)	.055 ** (.020)	.004 (.009)
Deviant peers	---	1.366 *** (.208)	.021 * (.010)	.013 ** (.004)
SCL-B	.001 (.060)	−.362 * (.172)	−.012 (.008)	−.002 (.003)
PEP-B	.035 (.025)	−.022 (.070)	.001 (.003)	−.001 (.001)
SCLR	−.109 (.153)	−.242 (.401)	−.049 ** (.018)	−.106 * (.008)
PEPR	.018 (.039)	.128 (.108)	.002 (.005)	−.001 (.002)
SCLR x PEPR	−.022 (.021)	.051 (.062)	−.005 (.003)	−.001 (.001)
Perm par x SCLR	.047 (.074)	---	---	---
Perm par x PEPR	−.020 (.022)	---	---	---
Perm par x SCLR x PEPR	−.051 *** (.015)	---	---	---
Dev peer x SCLR	---	−.010 (.132)	−.022 *** (.006)	−.003 (.003)
Dev peer x PEPR	---	.090 *** (.029)	.001 (.001)	.001 (.001)
Dev peer x SCLR x PEPR	---	−.014 (.017)	−.002 *** (.001)	−.001 (.001)
Model Fit				
$\chi^2 / (DoF) =$	---	147.253 / (72) = 2.045	142.692 / (72) = 1.982	140.888 / (72) = 1.957
RMSEA	---	.058	.056	.055

Note. AA = African American; SCL-B = skin conductance level at baseline; PEP-B = pre-ejection period at baseline; SCLR = skin conductance level reactivity; PEPR = pre-ejection period reactivity. Estimates are presented for unstandardized regression coefficients (*B*) and standard errors (*SE*). Model fit estimates are presented for chi square / degrees of freedom ($\chi^2 / (DoF)$) and Root Mean Squared Error of Approximation (RMSEA).

*
 $p < .05$.

**
 $p < .01$.

 $p < .001$.