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Impulsivity moderates promotive environmental influences on adolescent delinquency: A comparison across family, school, and neighborhood contexts

Pan Chen, Ph.D.^{a,b} and Kristen C. Jacobson, Ph.D.^a

^aDepartment of Psychiatry and Behavioral Neuroscience, University of Chicago, CNPRU, Chicago, IL

Abstract

The present study examined moderating effects of impulsivity on the relationships between promotive factors from family (family warmth, parental knowledge), school (school connectedness), and neighborhood (neighborhood cohesion) contexts with delinquency using data collected from $N = 2,978$ sixth to eighth graders from 16 schools surrounding a major city in the Midwestern United States. More than half of the respondents were non-Caucasian ($M_{age} = 12.48$; 41.0% male). Multilevel modeling analyses were conducted to take into account the clustering of the participants within schools. Impulsivity was positively associated with adolescent delinquency. Additionally, family warmth, parental knowledge, and school connectedness, but not neighborhood cohesion, were independently and inversely related to adolescent delinquency. Finally, impulsivity moderated relationships between family warmth and parental knowledge with delinquency but not relationships between school attachment and neighborhood cohesion with delinquency. Specifically, the negative relationship between family warmth and delinquency was significant for adolescents with high levels of, but not for those with below-average levels of, impulsivity. In addition, parental knowledge had a stronger association with decreased levels of delinquency for adolescents reporting higher levels of impulsivity. The moderating effects of impulsivity did not differ for males and females or for minority and non-minority participants. Findings indicate that impulsivity may have greater impact on adolescents' susceptibility to positive family influences than on their susceptibility to promotive factors from school or neighborhood contexts. Implications for future research and practice are discussed.

Keywords

impulsivity; family warmth; parental knowledge; school connectedness; neighborhood cohesion; delinquency; moderating effects

Adolescence is a developmental period marked by increases in problem behaviors. Impulsivity, defined as a tendency to act on the spur of the moment or to respond quickly to a given stimulus without deliberation or evaluation of consequences (Buss & Plomin, 1975; White et al., 1994), is one of the key dimensions of low self-control, a construct thought to be the main cause of criminal and other externalizing behaviors (Gottfredson & Hirschi, 1990). Empirically, impulsivity has been consistently identified as a risk factor leading to maladjustment in adolescence. Adolescents reporting higher levels of impulsivity exhibit increased problem behaviors, including aggressive/violent behaviors (e.g., Beyers, Loeber,

^bCorresponding author: Department of Psychiatry and Behavioral Neuroscience, L-607, University of Chicago, CNPRU, 5841 S Maryland Ave., MC3077, Chicago, IL, 60637 USA; pchen2@yoda.bsd.uchicago.edu, phone: (773)834-7715, fax: (773)-834-4635.

Wikström, & Stouthamer-Loeber, 2001; Fite, Goodnight, Bates, Dodge, & Pettit, 2008), antisocial behaviors (e.g., Cauffman, Steinberg, & Piquero, 2005; Neumann, Barker, Koot, & Maughan, 2010), school misconduct (e.g., Chen & Vazsonyi, 2010; Vogel & Barton, 2011), and delinquency (e.g., Meier, Slutske, Arndt, & Cadoret, 2008; Vazsonyi, Cleveland, & Wiebe, 2006).

Impulsive and non-impulsive youth may not only differ in their levels of problem behaviors, but may also differ in the degree to which they are affected by environmental influences. Bronfenbrenner's ecological system model (Bronfenbrenner, 1979; Bronfenbrenner & Ceci, 1994) specifically posits that similar experiences in a given context may have differential influences on development depending on the characteristics of the person. In line with this proposition, the differential susceptibility hypothesis (Belsky, 1997; Belsky & Pluess, 2009) proposes that children and adolescents with certain temperamental traits, such as high levels of negative emotionality or impulsivity, are not only more likely to be impacted by adverse environmental experiences but may also be more responsive to positive environmental influences.

In support of the differential susceptibility hypothesis, a handful of studies have found that impulsive youth are more susceptible to risk environmental factors. For instance, Lengua Wolchik, Sandler, and West (2000) found a stronger positive relationship between inconsistent parental discipline practices and adolescent conduct problems for youth with higher levels of impulsivity. Findings from a similar study indicated that harsh discipline predicted increases in girl's externalizing behaviors only when impulsivity was high, although the study did not find such an interaction effect for boys (Leve, Kim, & Pears, 2005). There is also evidence that adverse neighborhood environment has a more salient influence on problem behaviors for impulsive youth. Both census-based rates of neighborhood poverty and self-reports of poor neighborhood quality (i.e., ratings of criminal and non-criminal activities in the neighborhood) have been found to be significantly and positively related to violent offenses among impulsive, but not non-impulsive, youth (Lynam et al., 2000). A more recent study reported similar patterns of interaction effects between impulsivity and youth reports of low neighborhood collective efficacy on delinquency (Meier et al., 2008).

Relatively fewer studies have examined if impulsive youth are also more susceptible to positive environmental influences that promote health and well-being and reduce negative outcomes. Research on promotive factors is important because it can shed light on environmental processes that may effectively reduce the negative sequelae associated with impulsivity. For instance, because impulsive youth have lower levels of internal self-control, they may benefit more than non-impulsive youth from external constraint mechanisms, such as promotive environmental factors associated with heightened social control. Decades of theoretical and empirical research has highlighted the role of informal social controls as promotive factors that reduce adolescent problem behaviors. Social control theory (Hirschi, 1969) posits that attachment to and involvement with family and school prevent adolescents from engaging in deviant behaviors because youth who are more affectively tied to prosocial agents (e.g., parental figures and school personnel) are more motivated to conform to conventional norms and regulations. Likewise, social disorganization theory (Sampson, Raudenbush, & Earls, 1997) identifies high levels of neighborhood cohesion as a type of informal social control that prevents youth from engaging in problem behaviors. Finally, the coercive family process model (Patterson, 1982) emphasizes direct parental control as an important promotive factor from the family context that prevents problem behaviors. An important aspect of parental control is monitoring, generally defined as parental knowledge of adolescent activity (Stattin & Kerr, 2000). In support of these theoretical propositions, prior research has consistently found inverse associations between family warmth (e.g.,

Fletcher, Steinberg, & Williams-Wheeler, 2004; Hipwell et al., 2008), parental knowledge (e.g., Jacobson & Crockett, 2000; Pettit, Laird, Dodge, Bates, & Criss, 2001), school connectedness (e.g., Bond et al., 2007; Dornbusch, Erickson, Laird, & Wong, 2001), and neighborhood cohesion (e.g., Browning, Burrington, Leventhal, & Brooks-Gunn, 2008; Simons, Simons, Burt, Brody, & Cutrona, 2005) with adolescent problem behaviors. Although the importance of promotive factors from family, school, and neighborhood contexts in reducing adolescent problem behaviors has been documented, research has not adequately examined moderating effects of impulsivity on youth's susceptibility to these positive environmental influences.

A limited number of studies provided evidence that positive family processes, such as parental support and parental knowledge, have greater promotive effects in reducing antisocial behaviors for youth with higher levels of impulsivity (Barker, Trentacosta, & Salekin, 2011; Jones, Cauffman, & Piquero, 2007). However, researchers have not tested influences of impulsivity on youth's susceptibility to promotive factors from the neighborhood context, such as high levels of neighborhood cohesion. Furthermore, only one prior study has examined moderating effects of impulsivity on relationships between promotive factors from the school context and adolescent problem behaviors. Findings from this study indicated that aggregated levels of school connectedness (as an indicator of school climate) were more strongly associated with decreased likelihood of carrying weapons to school among youth reporting higher levels of impulsivity (Vogel & Barton, 2011).

Limitations of Prior Research

Although there is growing evidence that impulsive youth are more susceptible to environmental influences than non-impulsive youth, few studies have been based on socioeconomically, racially, and ethnically diverse samples of adolescents (c.f., Vogel & Barton, 2011), limiting generalization of results. Additionally, there is a clear need for more research examining moderating effects of impulsivity on youth's susceptibility to promotive environmental factors, especially those from school and neighborhood contexts. Finally, previous research has rarely examined environmental influences across multiple ecological contexts simultaneously, and therefore it remains unclear if impulsivity impacts youth's susceptibility to family, school, and neighborhood contextual influences to the same extent. Only one prior study has examined moderating effects of impulsivity across different contexts, although only family and neighborhood influences (but not school influences) were included (Barker et al., 2011). This study found that effects of census-based measures of neighborhood disadvantage (e.g., percentage of population unemployed) on antisocial behaviors did not differ for impulsive and non-impulsive youth, whereas impulsivity significantly moderated the effect of parental knowledge on antisocial behaviors, although only among girls. These findings suggest that impulsivity may have a greater impact on adolescents' susceptibility to family influences than on their susceptibility to environmental influences from the neighborhood context. However, this hypothesis needs to be further examined with other measures and in other samples before any firm conclusions can be made. Furthermore, no study has examined whether impulsivity differentially affects adolescents' susceptibility to family versus school contextual influences.

The Present Study

The purpose of the present study is to systematically compare interaction effects of impulsivity with promotive factors from family (family warmth, parental knowledge), school (school connectedness), and neighborhood (neighborhood cohesion) contexts on individual differences in delinquency, using a large socioeconomically, racially, and ethnically diverse sample of adolescents. By examining how impulsivity moderates youth's

susceptibility to influences of promotive factors across various ecological levels, the current study can provide important insights into the design of more targeted intervention programs aiming at reducing problem behaviors in impulsive youth. Consistent with the differential susceptibility hypothesis, we expect to find stronger associations between the promotive environmental factors examined and delinquency among youth reporting higher levels of impulsivity, as compared to youth reporting lower levels of impulsivity. However, based on findings from the study by Barker et al. (2011), we further expect that impulsivity will have stronger effects on adolescents' susceptibility to positive family experiences than on their susceptibility to promotive neighborhood contexts. As no previous studies have examined interaction effects between impulsivity with family and school contexts simultaneously, we did not develop specific hypotheses regarding the comparison in influences of impulsivity on adolescents' susceptibility to promotive family and school environment.

Method

Sample

Study participants are from the "Neighborhoods to Neurons and Beyond" (NNB) cohort, a sample of $N = 3,350$ sixth to eighth graders ($M_{age} = 12.47$, $SD = 0.99$) from 16 urban and suburban middle schools located within 25 miles of a major university in the Midwestern United States. Individual schools were specifically selected to maximize racial/ethnic and socioeconomic variation in the NNB cohort. Based on publicly available data from the schools, the percentage of minority students in the total student population ranged from 23.3% to 100% across schools ($M = 64.9\%$, $SD = 25.6\%$). The proportion of students eligible for free lunch (an indicator of student poverty) ranged from 7–80% ($M = 42.4\%$, $SD = 20.8\%$). All youth in the NNB cohort participated in a 30 minute in-school, self-report survey, which obtained data on environmental and psychosocial factors related to youth problem behaviors. The National Opinion Research Center (NORC) administered the in-school surveys. Permission was obtained from school administrators/school boards and the study was approved by both local university and NORC Institutional Review Boards (IRB). Schools received an average compensation of \$2,500 for allowing the survey to take place in the school. Youth were not individually compensated for their participation.

All sixth to eighth grade students in each school were targeted for recruitment; however, university IRB regulations necessitated active parental consent and prohibited investigators from directly contacting parents/guardians. Thus, consent forms were distributed to students in school to take home. The consent return rate across schools was 44.8% (range = 16.9%–87.7%) and > 80% of those who returned consent forms agreed to participate. Youth also provided written assent for participation. Response rates across schools were not significantly correlated with either school poverty rates ($r = .18$, $p > .50$) or percentage of minority students in each school ($r = -.28$, $p > .25$). Missing data from 11.0% of youth resulted in a final study sample of $N = 2,978$ adolescents (41.0% male) ranging in age from 10–15 years old (with 98.9% between 11 and 14 years old; $M_{age} = 12.48$, $SD = 0.98$). Based on self-reports of race and ethnicity, over half of the study sample (56.9%) were non-Caucasian (22.5% Hispanic, 19.7% African American, 4.1% Asian, 3.5% other, and 7.1% mixed race/ethnicity). For analytical purpose, four racial/ethnic groups were developed (i.e., non-Hispanic Caucasian, Hispanic, African American, and other race/ethnicity), and dummy-coded variables were created for Hispanic, African American, and other race/ethnicity, using non-Hispanic Caucasian as the comparison group.

Measures

All of the measures used in the present study are based on or developed from well-established scales with demonstrated good psychometric properties (Eysenck, Easting, &

Pearson, 1984; Fletcher et al., 2004; Glynn, 1981, 1986; Neumann et al., 2010; Sieving et al., 2001; Soenens, Vansteenkiste, Luyckx, & Goossens, 2006; Stattin & Kerr, 2000). Measures of delinquency, family warmth, and school connectedness were selected from established self-report scales used in the National Longitudinal Study of Adolescent Health (Add Health; Sieving et al., 2001). Neighborhood cohesion was assessed with seven items adapted from the Psychological Sense of Community scale (Glynn, 1981) and four items about neighborhood cohesion from the Add Health study (Sieving et al., 2001). The Impulsivity scale was largely based on a subset of items from the Junior Impulsiveness Questionnaire (Eysenck et al., 1984), a widely used measure that assesses impulsivity as a personality trait (Neumann et al., 2010; White et al., 1994; Wingrove & Bond, 1997). Finally, measures of parental knowledge were adapted from items used by Stattin and Kerr (2000). Details on these scales are provided below.

Delinquency—Youth delinquency was measured with 16 items assessing frequency of a broad range of illegal (e.g., stealing something worth more than \$50), norm-violating (e.g., skipping school without permission), and aggressive (e.g., getting into a serious physical fight) behaviors within the past 12 months. Responses were given on a 3-point scale, ranging from 0 = *never* to 3 = *5 or more times*. A composite score of delinquency was computed by averaging responses to the 16 items ($\alpha = .83$; $M = 1.17$, $SD = .26$). The delinquency score was positively skewed (skewness = 3.04) and was transformed for analysis using an inverse transformation (adjusted skewness = 1.34).

Impulsivity—Participants rated nine statements describing their impulsive tendencies (e.g., “how often do you do and say things without stopping to think”; “how often do you lose your temper”) using a 5-point scale ranging from 1 = *never* to 5 = *always*. A scale score of impulsivity was computed by averaging responses to the 9 items ($\alpha = .88$; $M = 2.76$, $SD = .64$).

Family warmth—Participants responded to five items assessing family warmth (e.g., “how much do you feel that people in your family understand you”) with a 5-point scale ranging from 1 = *not at all* to 5 = *very much*. A family warmth score was created using the mean of the responses to the 5 items ($\alpha = .80$; $M = 4.20$, $SD = .75$). The family warmth score was negatively skewed (skewness = -1.23) and was transformed for analysis using a square transformation (adjusted skewness = $-.74$).

Parental knowledge—Participants responded to six items asking how often their primary caregiver, defined as the adult they live with who takes the most care of them¹, knows where they are after school, on school-nights, and on weekends, how often the caregiver knows if they have done their homework, and how often the caregiver knows their friends and their friends’ parents. Responses ranged from 1 = *never* to 5 = *always* and were averaged to create a scale score of parental knowledge ($\alpha = .76$; $M = 4.39$, $SD = .55$). The parental knowledge score was negatively skewed (skewness = -1.40) and was transformed for analysis using a square transformation (adjusted skewness = $-.92$).

School connectedness—School connectedness was assessed with six items. Participants responded to five items asking how much they agreed with statements

¹Although the items concerning parental knowledge did not ask adolescents to specify their primary caregiver, we do have data on the primary female and male caregivers in the household. The majority of participants (97.2%) identified a biological mother, step-mother, or adoptive mother as their primary female caregiver (92.1% of the sample) and/or identified a biological father, step-father, or adoptive father as their primary male caregiver (80.2% of the sample). Thus the items comprising parental knowledge do reflect knowledge of behavior from at least one residential parent for most youth. Most of the remaining 2.8% of the sample reported that other relatives (e.g., grandmother/grandfather, aunt/uncle, older brother/sister) served as their primary female/male caregivers.

describing their connectedness to school (e.g., “I feel like I am part of this school”). Responses ranged from 1 = *strongly disagree* to 5 = *strongly agree*. A sixth item assessed how much participants felt that their teachers care about them (1 = *not at all* to 5 = *very much*). A score of school connectedness was computed by averaging the responses to all 6 items ($\alpha = .84$; $M = 3.94$, $SD = .74$).

Neighborhood cohesion—Neighborhood cohesion was measured with 11 items (e.g., “people in my neighborhood look out for each other”). Responses ranged from 1 = *strongly disagree* to 4 = *strongly agree* and were averaged to create an overall score of neighborhood cohesion ($\alpha = .88$; $M = 3.05$, $SD = .57$).

Analytic Plan

Multilevel modeling using SPSS was implemented to account for non-independence between participants in the same school. Hierarchical models were specified to examine the main effects of impulsivity and contextual factors on delinquency. Model 1 was an unconditional means model estimating the proportion of variability in delinquency that exists between individuals and between schools. Model 2 added demographic covariates for age, gender (coded as male = 1, female = 0), racial/ethnic background (with non-Hispanic Caucasian used as the comparison group) and percentage of school poverty as a proxy for youth socioeconomic status. Model 3 added main effects of impulsivity and contextual factors. Additional models were then fitted to test the interaction effects between impulsivity and contextual factors. For comparison with prior studies, interaction effects were first examined individually in four separate models along with all main effects (Models 4 to 7), and were then considered simultaneously in a final model (Model 8). Standardized scores of all continuous variables were used in analyses so that standardized coefficients could be reported. Comparisons across models were based on differences in -2LL between models (Δ -2LL), which is distributed as a chi-square statistic with degrees of freedom equal to the differences in degrees of freedom between the models compared. Significant interactions were probed using published methods for interpreting interactions with continuous variables using clustered data (Preacher, Curran, & Bauer, 2006). Specifically, regression coefficients for the effects of contextual factors on delinquency were calculated at low and high levels of impulsivity. Post hoc significant region tests then identified the levels of impulsivity at which associations between contextual factors and delinquency were statistically significant.

Results

Missing Data Analyses

Multiple logistic regression analyses were conducted to compare the demographic characteristics of youth included in the final sample with youth who were excluded due to missing data in main study constructs. Findings indicated that excluded youth were more likely to be younger ($b = -.24$, $p < .001$) and male ($b = .53$, $p < .001$). In addition, African American adolescents were more likely to be excluded from the current analyses than Caucasian adolescents ($b = .38$, $p < .05$). Other racial comparisons were not statistically significant. No significant differences were found between included and excluded youth in levels of school poverty.

Correlations

Table 1 shows bivariate correlations among main study constructs. Family warmth, parental knowledge, school connectedness, and neighborhood cohesion were all positively correlated with each other and negatively correlated with delinquency and impulsivity, and impulsivity was positively associated with delinquency.²

Main Effects of Impulsivity and Contextual Factors

Results for the main effects of impulsivity and contextual factors on delinquency are shown in Table 2. Findings from Model 1 revealed statistically significant variability in delinquency between individuals ($\sigma^2 = .94, p < .001$) and between schools ($\tau_{00} = .06, p < .05$), supporting the use of multilevel modeling to correct for sample non-independence. Model 2 testing the effects of demographic control variables fitted significantly better than Model 1. Age and school poverty were significantly and positively related to levels of delinquency, and males reported higher levels of delinquency than females. In addition, African American and Hispanic adolescents, as well as youth from other racial/ethnic groups, were more likely to show higher levels of delinquency than Caucasian adolescents.

Model 3, which examined the main effects of impulsivity and contextual factors net the effects of demographic control variables, had a significantly better model fit than Model 2. Impulsivity was significantly and positively associated with delinquency, controlling for everything else in the model. Furthermore, family warmth, parental knowledge, and school connectedness had significantly and independently negative associations with delinquency, with the association being considerably stronger for parental knowledge than for family warmth and school connectedness. Neighborhood cohesion was not associated with delinquency after controlling for all other factors.

Interaction Effects between Impulsivity and Contextual Factors

Findings regarding the interaction effects between impulsivity and contextual factors on delinquency are presented in Table 3. Model 4 to Model 7 tested the interaction effects individually in separate analyses (Model 4: impulsivity X family warmth; Model 5: impulsivity X parental knowledge; Model 6: impulsivity X school connectedness; Model 7: impulsivity X neighborhood cohesion). These models all had significantly better fit than Model 3. Significant interaction effects were found between all four contextual factors and impulsivity, suggesting variations in associations between these factors and problem behavior for adolescents with different levels of impulsivity. Follow-up analyses tested simple slopes of each contextual factor (i.e., regression coefficients of the factor at conditional values of impulsivity) at low (-1 SD) and high ($+1$ SD) levels of impulsivity. Family warmth, school connectedness, and neighborhood cohesion were significantly and negatively associated with delinquency at high levels of impulsivity (family warmth: $b = -.12, p < .001$; school connectedness: $b = -.09, p < .001$; neighborhood cohesion: $b = -.05, p < .05$), but not at low levels of impulsivity (family warmth: $b = .03, p = .32$; school connectedness: $b = -.01, p = .82$; neighborhood cohesion: $b = .04, p = .15$). Similarly, the negative relationship between parental knowledge and delinquency was stronger at high ($b = -.33, p < .001$) vs. low ($b = -.18, p < .001$) levels of impulsivity.

The final model (Model 8), which examined all the interaction effects simultaneously, also had a significantly better model fit than Model 3. Findings from this model indicated that when all interactions were considered simultaneously, only the interaction effects between family warmth and parental knowledge with impulsivity remained significant. Consistent with findings from Models 4 and 5, follow-up analyses indicated a significant association between family warmth and delinquency at high ($b = -.09, p < .001$) but not low ($b = -.02, p = .61$) levels of impulsivity, and a stronger relationship between parental knowledge and delinquency at high ($b = -.32, p < .001$) vs. low ($b = -.22, p < .001$) levels of impulsivity. Significant region tests specified that the association between higher levels of family

²The moderate correlations between environmental factors suggest low potential for multicollinearity. Additional analyses testing correlations between the interaction terms examined and other indicators of multicollinearity (i.e., tolerance and variance inflation factor statistics) also detect no issues of multicollinearity.

warmth and lower levels of delinquency was statistically significant only among youth with standardized impulsivity scores $> -.28$. In other words, the relationship between family warmth and delinquency was not significant for adolescents whose impulsivity scores were more than one-quarter of a standard deviation below average. In contrast, the negative relationship between parental knowledge and delinquency was statistically significant across the entire range of impulsivity, although the magnitude of the association increased with higher levels of impulsivity.

Gender and Racial Differences in Interaction Effects between Impulsivity and Contextual Factors

Because we had a large sample of male and female minority and non-minority youth, we explored gender and racial differences in the interaction effects reported in Model 8 by testing three-way interactions among gender/race, impulsivity, and contextual factors. To enhance statistical power to detect significant interaction effects with race/ethnicity, non-Caucasian youth (i.e., African American, Hispanic, and other race/ethnicity) were combined into a single minority group (i.e., race/ethnicity was coded as 1 = minority and 0 = non-minority) in these analyses. Results (available from authors) indicated that none of the three-way interactions were significant, suggesting patterns of interactions found in Model 8 did not differ for males and females or for minority and non-minority participants.³

Discussion

The present study tested specifically whether the differential susceptibility hypothesis (i.e., impulsive youth would be more susceptible to environmental influences on delinquency than non-impulsive youth) is generalizable across promotive factors measured at multiple ecological levels. Although prior studies have provided evidence for influences of impulsivity on relationships between risk environmental factors and adolescent problem behaviors, moderating effects of impulsivity on positive environmental influences, especially on effects of promotive factors from school and neighborhood contexts, have not been adequately examined. In addition, no study has compared the moderating effects of impulsivity across family, school, and neighborhood contexts simultaneously. We also further extended prior findings by examining the interactions between impulsivity and environmental influences using a socioeconomically, racially, and ethnically diverse sample of youth.

Findings from the present study demonstrate a significant and positive relationship between impulsivity and adolescent delinquency, while controlling for demographic and contextual factors, providing additional support for the role of impulsivity as an important risk factor in the etiology of adolescent problem behaviors. Furthermore, in line with social control theory and coercion theory, family warmth, parental knowledge, and school connectedness were all significantly and independently associated with decreased levels of adolescent delinquency, suggesting that these contextual factors may function as informal social controls to prevent adolescents from engaging in problem behaviors. In contrast, we found limited support for social disorganization theory. Specifically, while neighborhood cohesion was significantly associated with adolescent delinquent behaviors in the correlation analysis, it did not predict these behaviors when controlling for demographic factors and the effects of impulsivity and other contextual influences. These findings suggest that effects of neighborhood cohesion on adolescent behaviors are likely mediated by family and school processes, a proposition that has received prior empirical support (Chung & Steinberg, 2006; Ennett, Flewelling,

³Additional analyses based on the original categories of race/ethnicity found that none of the interaction effects reported in Model 8 differed between African American, Hispanic, and other minority youth.

Lindrooth, & Norton, 1997; Rankin & Quane, 2002; Simons, Johnson, Beaman, Conger, & Whitbeck, 1996). Our results highlight the importance of controlling for family and school contextual influences in studies examining the role of the neighborhood context in adolescent adjustment. Nevertheless, as the present study relied exclusively on youth self-reports of neighborhood environment, future research needs to more thoroughly examine the effect of the neighborhood context and its interaction effect with impulsivity independent of family and school processes using both structural and subjective measures of neighborhood environment.

The most interesting results are from analyses testing impulsivity as a potential moderator of relationships between promotive environmental factors and delinquency. Overall, the moderating effects of impulsivity observed in the present study provide support for the differential susceptibility hypothesis (Belsky, 1997). The inverse relationship between family warmth and delinquency was significant for adolescents with high levels of, but not for those with below-average levels of impulsivity, and parental knowledge was more strongly associated with lower levels of delinquency for adolescents reporting higher levels of impulsivity. The moderating effects of impulsivity on the relationships between family warmth and parental knowledge with delinquency did not differ for males and females or for minority and non-minority youth. These findings indicate that impulsive youth derive more benefits from positive environmental experiences than non-impulsive youth. At the same time, there were differences observed in the patterns of interactions of impulsivity with family warmth and parental knowledge. Although the effect was stronger among more vulnerable youth, our study showed that parental knowledge of youth activity was associated with decreased levels of delinquency for both impulsive and non-impulsive youth. Parental knowledge also had a stronger main effect on delinquency compared to other contextual factors. These results are consistent with a recent meta-analysis showing that parental monitoring is one of the strongest predictors of child and adolescent delinquency (Hoeve et al., 2009). In contrast, our pattern of interactions indicated that family warmth was associated with lower levels of delinquency only among impulsive youth. Although both parental warmth and monitoring are important dimensions of parenting, they function differentially to prevent adolescent delinquency. High levels of parental monitoring lessen adolescents' involvement with deviant peers, which in turn reduces their likelihood of engaging in delinquency (Patterson, Reid, & Dishion, 1992). On the other hand, high levels of parental warmth establish strong affective ties between youth and parents, which restrain youth's motivation for engaging in delinquent behaviors (Hirschi, 1969; Wiatrowski, Griswold, & Roberts, 1981). Therefore, findings of the present study suggest that while restricting adolescents' opportunities to engage in delinquent behaviors may be effective in reducing delinquency for both impulsive and non-impulsive youth, promoting youth's motivations of self-restraint by strengthening affectional ties between parents and children may be of particular importance for intervention or prevention of delinquent behaviors among youth with high levels of impulsivity.

In addition, as expected, our findings suggest that the applicability of the differential susceptibility hypothesis varies across different ecological contexts. Consistent with prior studies (e.g., Lynam et al., 2000; Meier et al., 2008; Vogel & Barton, 2011), our initial analyses examining interactions of impulsivity with each of the promotive environmental factors independently showed that the relationships between school connectedness and neighborhood cohesion with delinquency were stronger at higher levels of impulsivity. However, these differences between impulsive and non-impulsive youth disappeared when moderating effects of impulsivity on the relationships between family warmth and parental knowledge with delinquency were controlled. We note that our findings are congruent with patterns reported in the only prior published study examining moderating effects of impulsivity on both family and neighborhood processes (Barker et al., 2011). Our findings

suggest that positive family experiences play a more important role than promotive factors from more distal contexts, such as school and neighborhood, in promoting resilience among vulnerable youth. This result is consistent with evidence from some previous studies suggesting greater influences of the family context than school and neighborhood environment on adolescent adjustment (Coley, Morris, & Hernandez, 2004; Dufur, Parcel, & McKune, 2013; Parcel, Dufur, & Cornell Zito, 2010; Rankin & Quane, 2002); it is also in line with the ecological systems model (Bronfenbrenner & Ceci, 1994), which proposes that proximal processes (i.e., interactions between the person and his/her immediate environment) are the primary engines of human development. Finally, as family, school, and neighborhood processes are inter-correlated, our results emphasize the need for future research to more rigorously examine the applicability of the differential susceptibility hypothesis to school and neighborhood environmental influences while considering individual differences in family processes.

Study Limitations

A number of study limitations should be noted. First, our study used a cross-sectional design, and therefore the causality of relationships between study constructs cannot be determined. Several of the relationships assessed in this study could be bidirectional. For instance, youth delinquent behaviors might result in lower family warmth and vice versa, and parents of youth who are involved in delinquent behavior may have more difficulty effectively monitoring their children. However, it is worth noting that directions of our predictions were not arbitrary; instead, they were derived from propositions of major theoretical perspectives on adolescent delinquency that have been supported in prior longitudinal studies. Second, the present study examined a limited set of promotive factors from the family, school, and neighborhood contexts. Although our choice of measures was derived from prior theoretical and empirical work on promotive factors that are inversely associated with adolescent delinquency, it is possible that different patterns would emerge with other measures (e.g., parental support, school discipline practices). Relatedly, the environmental factors examined in the present study were assessed using adolescents' own perceptions of family, school, and neighborhood environment instead of structural characteristics of these contexts, such as census-based measures of neighborhood contexts. Subjective measures of social environment have been proven to be valid and reliable and have been found to mediate the effects of objective contextual measures on adolescent adjustment (Bass & Lambert, 2004). Moreover, prior research has found interactions of impulsivity with both structural and subjective measures of neighborhood environment (Lynam et al., 2000), suggesting that our results are not likely to be biased by the self-report measures of environment used in the present study. Third, the present study could only provide partial support for the differential susceptibility hypothesis, as it focused exclusively on promotive environmental factors and did not examine how impulsivity moderates relationships between risk environmental factors and adolescent delinquency. Studies testing this hypothesis using both risk and promotive factors are needed. We also note that our findings may not generalize to other youth behaviors, such as internalizing behaviors or prosocial behaviors. Finally, consistent with expectations for studies examining interaction effects (Frazier, Tix, & Barron, 2004; McClelland & Judd, 1993), we note that the significant interactions between impulsivity with family warmth and parental knowledge accounted for only a small (<1%) increase in variance explained. However, the impact of these interactions on our understanding of the etiology of problem behaviors may be understated. For instance, our findings suggest fundamental differences in effects of family warmth on delinquency for youth with low vs. high levels of impulsivity. In addition, our results indicate important distinctions among promotive environmental factors measured in different ecological contexts.

Clinical Implications

Results of the current study provide several implications for intervention and prevention practices. Our finding that impulsivity, family warmth, parental knowledge, and school connectedness were all independently associated with adolescent delinquency suggests that intervention and prevention programs need to be multi-faceted. Specifically, programs aiming at reducing adolescent delinquency may benefit not only from practices promoting individual self-control, but also from approaches targeting at enhancing family warmth and youth connectedness to school. Additionally, the stronger association between parental knowledge and delinquency observed among youth reporting higher levels of impulsivity implies that intervention/prevention efforts directed at improving parental knowledge of youth activity might be highly effective in reducing problem behaviors, especially for impulsive youth. Previous research has suggested that as adolescents become more autonomous and generally spend less time at home, parents' knowledge about their children's activities and whereabouts are largely determined by youth disclosure rather than parents' active monitoring behaviors (Hoeve et al., 2009; Stattin & Kerr, 2000). Therefore, training programs for effective parenting need to help parents develop skills that enhance youth disclosure (Hoeve et al., 2009). An example of such programs is Parent Effectiveness Training (PET). By focusing on providing parents with training in active listening, appropriate assertiveness, and conflict resolution and problem solving skills, the PET program has been found to effectively improve parent-child communication and parental knowledge (Davidson & Wood, 2004; Gordon, 2000). Finally, although family warmth was not associated with delinquency among youth with below-average levels of impulsivity, our findings suggest that family warmth does have a promotive effect that is above and beyond the effect of parental knowledge on reducing problem behaviors for impulsive youth, implying that a combination of high levels of parental knowledge and family warmth may most effectively reduce problem behaviors among vulnerable youth.

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Table 1

Correlation Statistics among Main Study Variables

	1	2	3	4	5	6
1. Delinquency						
2. Impulsivity	.52***					
3. Family Warmth	-.45***	-.54***				
4. Parental Knowledge	-.52***	-.45***	.56***			
5. School Connectedness	-.35***	-.42***	.48***	.38***		
6. Neighborhood Cohesion	-.37***	-.42***	.46***	.42***	.52***	

Note.

 $p < .001$.

Table 2
Main Effects of Impulsivity and Promotive Environmental Factors on Adolescent Delinquency

	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Fixed Effect						
Intercept	.057	.065	-.219***	.048	-.133***	.032
Age			.141***	.018	.030*	.015
Male			.152***	.036	.124***	.029
African American			.288***	.059	.178***	.046
Hispanic			.336***	.056	.150***	.045
Other			.272***	.054	.127**	.044
School Poverty			.113*	.041	.053*	.024
Impulsivity					.287***	.018
Family Warmth					-.070***	.020
Parental Knowledge					-.290***	.018
School Connectedness					-.063***	.018
Neighborhood Cohesion					-.018	.019
Variance Component						
Residual	.943***	.025	.905***	.024	.600***	.016
Intercept	.060*	.023	.017*	.009	.004	.003
Explained Variance						
Individual-level				4.0%		36.4%
Goodness-of-fit						
χ^2	8315.5		8175.7		6939.4	
Comparison model			1		2	
Δ -2LL (Δ df)			139.8(6)***		1236.3(5)***	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 3
Interaction Effects between Impulsivity and Promotive Environmental Factors on Adolescent Delinquency

	Model 4		Model 5		Model 6		Model 7		Model 8	
Fixed Effect	b	SE	b	SE	b	SE	b	SE	b	SE
Intercept	-.176***	.033	-.172***	.033	-.152***	.032	-.185***	.032	-.185***	.033
Age	.033*	.015	.033*	.015	.032*	.015	.033*	.015	.034*	.015
Male	.129***	.029	.131***	.029	.126***	.029	.127***	.029	.132***	.029
African American	.187***	.046	.187***	.046	.180***	.046	.191***	.046	.190***	.046
Hispanic	.149***	.045	.147***	.045	.149***	.045	.153***	.045	.147***	.045
Other	.128**	.044	.130**	.044	.126**	.044	.131**	.044	.129**	.044
School Poverty	.050*	.023	.052*	.023	.051*	.023	.055*	.023	.051*	.023
Impulsivity	.292***	.018	.297***	.018	.290***	.018	.286***	.018	.297***	.018
Family Warmth (FW)	-.046*	.020	-.066***	.019	-.068***	.020	-.069***	.019	-.054**	.020
Parental Knowledge (PK)	-.288***	.018	-.258***	.019	-.292***	.018	-.290***	.018	-.268***	.020
School Connectedness (SC)	-.063***	.018	-.068***	.018	-.050**	.019	-.062***	.018	-.064***	.019
Neighborhood Cohesion (NC)	-.018	.019	-.017	.019	-.017	.019	-.010	.019	-.018	.019
Impulsivity X FW	-.073***	.014							-.038*	.019
Impulsivity X PK			-.076***	.014					-.050**	.018
Impulsivity X SC					-.045***	.013			-.007	.016
Impulsivity X NC							-.045***	.013	-.002	.017
Variance Component										
Residual	.594***	.015	.594***	.015	.597***	.016	.597***	.016	.593***	.015
Intercept	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003
Explained Variance										
Individual-level	37.0%		37.1%		36.7%		36.7%		37.2%	
Goodness-of-fit										
χ^2	6912.7		6909.7		6927.3		6927.9		6903.5	
Comparison model	3		3		3		3		3	
Δ -2LL (Δ df)	26.7(1)***		29.7(1)***		12.1(1)***		11.5(1)***		35.9(4)***	

100
Note. * $p < .05$, ** $p < .01$, *** $p < .001$